Prüfbericht-Nr.: *Test report no.*:	CN217OBX 001	**Auftrags-Nr.:** *Order no.*:	168294619	Seite 1 von 176 *Page 1 of* 176
Kunden-Referenz-Nr.: *Client reference no.:*		**Auftragsdatum:** *Order date:*	2020.12.07	
Auftraggeber: *Client:*	Huawei Technologies Co., Ltd. Administration Building, Headquarter of Huawei Technologies Co., Ltd., Bantian, Longgang District, Shenzhen, 51829, P.R. China			
Prüfgegenstand: *Test item:*	Power Distribution Unit			
Bezeichnung / Typ-Nr.: *Identification / Type no.:*	Backup Box-B0, Backup Box-B1			
Auftrags-Inhalt: *Order content*:	Report of CE_LVD			
Prüfgrundlage: *Test specification:*	EN 61439-2:2011 EN 61439-3:2012			

Wareneingangsdatum: *Date of sample receipt:*	2020.12.07
Prüfmuster-Nr.: *Test sample no:*	A002963565
Prüfzeitraum: *Testing period:*	2020.12.10 - 2020.12.27
Ort der Prüfung: *Place of testing:*	See page 4
Prüflaboratorium: *Testing laboratory:*	TÜV Rheinland (Shenzhen) Co., Ltd.
Prüfergebnis*: *Test result*:*	Pass

erstellt von: *created by:*		**genehmigt von:** authorized by:	
Datum: 2021.01.012 *Date:*	Elin Dong	**Datum:** 2021.01.12 *Date:*	William Xian
Stellung / *Position:*	Project Engineer	**Stellung** / *Position:*	Technical Certifier

Sonstiges / *Other:*

This report consist of:
1. this cover page
2. Part I: EN 61439-2 (page 2- 91)
3. Part II: EN 61439-3 (page 92- 173)
4. Photo Documentation (page 173-176)

Zustand des Prüfgegenstandes bei Anlieferung: Prüfmuster vollständig und unbeschädigt
Condition of the test item at delivery: *Test item complete and undamaged*

* Legende:	P(ass) = entspricht o.g. Prüfgrundlage(n)	F(ail) = entspricht nicht o.g. Prüfgrundlage(n)	N/A = nicht anwendbar	N/T = nicht getestet
* *Legend:*	*P(ass) = passed a.m. test specification(s)*	*F(ail) = failed a.m. test specification(s)*	*N/A = not applicable*	*N/T = not tested*

TEST REPORT
IEC 61439-2
Low-voltage switchgear and controlgear assemblies - Part 2: Power switchgear and controlgear assemblies

Report Number..... :	CN217OBX001
Date of issue..... :	See cover page
Total number of pages..... :	See cover page
Name of Testing Laboratory preparing the Report..... :	TÜV Rheinland (Shenzhen) Co., Ltd. 1601 R&D Room, 1602-1604, 17-18F, Building 7 Site C, Vanke Cloud City Phase I, Xingke First Street, Xili Street, Xili Community, Nanshan District, Shenzhen 518052, P.R. China
Applicant's name..... :	Huawei Technologies Co., Ltd.
Address..... :	Administration Building, Headquarter of Huawei Technologies Co., Ltd., Bantian, Longgang District, Shenzhen, 51829, P.R. China
Test specification:	
Standard..... :	EN 61439-2:2011
Test procedure..... :	Report for CE_LVD
Non-standard test method..... :	N/A
Test Report Form No..... :	IEC61439_2C
Test Report Form(s) Originator... :	DEKRA Certification B.V.
Master TRF..... :	Dated 2019-09-23

If this Test Report Form is used by non-IECEE members, the IECEE/IEC logo and the reference to the CB Scheme procedure shall be removed.

This report is not valid as a CB Test Report unless signed by an approved CB Testing Laboratory and appended to a CB Test Certificate issued by an NCB in accordance with IECEE 02.

General disclaimer:

The test results presented in this report relate only to the object tested.
This report shall not be reproduced, except in full, without the written approval of the Issuing CB Testing Laboratory. The authenticity of this Test Report and its contents can be verified by contacting the NCB, responsible for this Test Report.

Test item description.....:	Backup Box
Trade Mark.....:	HUAWEI
Manufacturer.....:	Same as client
Branding Manufacturer(s) .....:	
Model/Type reference .....:	Backup Box-B0, Backup Box-B1
Ratings.....:	Backup Box-B0: AC 220/ 230V, 22.7A Backup Box-B1: AC 380/400V, 15.7A Ui=500V, 50/60Hz; Icw=10kA (see page 6 for more details)

Responsible Testing Laboratory (as applicable), testing procedure and testing location(s): N/A			
☐	**CB Testing Laboratory:**		
Testing location/ address.....:			
Tested by (name, function, signature) .....:			
Approved by (name, function, signature)..:			
☐	**Testing procedure: CTF Stage 1:**		
Testing location/ address.....:			
Tested by (name, function, signature) .....:			
Approved by (name, function, signature)..:			
☐	**Testing procedure: CTF Stage 2:**		
Testing location/ address.....:			
Tested by (name + signature).....:			
Witnessed by (name, function, signature).:			
Approved by (name, function, signature)..:			
☐	**Testing procedure: CTF Stage 3:**		
☐	**Testing procedure: CTF Stage 4:**		
Testing location/ address.....:			
Tested by (name, function, signature) .....:			
Witnessed by (name, function, signature).:			
Approved by (name, function, signature)..:			
Supervised by (name, function, signature):			

List of Attachments (including a total number of pages in each attachment):
AU/ NZ National Differences (Page 74 - 91)

Summary of testing:

Tests performed (name of test and test clause):	**Testing location:**
All applicable tests performed.	**Hunan Electrical Equipment Testing & Inspection Institute Co., Ltd.** No.4, Xinzhong Road, Tianxin District, Changsha, Hunan, China

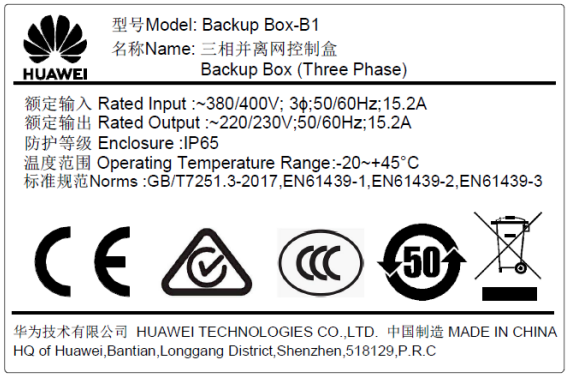
Summary of compliance with National Differences (List of countries addressed):

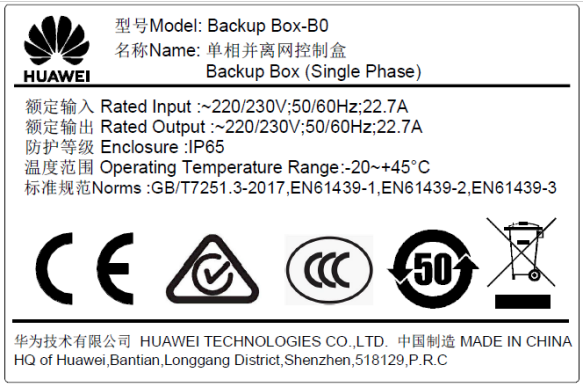
No EU Group difference, AU/NZ

☒ **The product fulfils the requirements of EN 61439-2:2011 and AS/NZS 61439.2:2016**

Copy of marking plate:

The artwork below may be only a draft. The use of certification marks on a product must be authorized by the respective NCBs that own these marks.





Statement concerning the uncertainty of the measurement systems used for the tests
(may be required by the product standard or client)

☐ **Internal procedure used for type testing through which traceability of the measuring uncertainty has been established:**

Procedure number, issue date and title:

Calculations leading to the reported values are on file with the NCB and testing laboratory that conducted the testing.

☒ **Statement not required by the standard used for type testing**

(Note: When IEC or ISO standard requires a statement concerning the uncertainty of the measurement systems used for tests, this should be reported above. The informative text in parenthesis should be delete in both cases after selecting the applicable option)

Test item particulars.....:	Power distribution unit
Classification of installation and use.....:	Fixed Installation
Supply Connection.....:	Screw-type terminal
.....:	
Possible test case verdicts:	
- test case does not apply to the test object.....:	N/A
- test object does meet the requirement .....:	P (Pass)
- test object does not meet the requirement.....:	F (Fail)
Testing .....:	
Date of receipt of test item.....:	See cover page
Date (s) of performance of tests .....:	See cover page

General remarks:

"(See Enclosure #)" refers to additional information appended to the report.
"(See appended table)" refers to a table appended to the report.

Throughout this report a ☐ comma / ☒ point is used as the decimal separator.

Manufacturer's Declaration per sub-clause 4.2.5 of IECEE 02:

The application for obtaining a CB Test Certificate includes more than one factory location and a declaration from the Manufacturer stating that the sample(s) submitted for evaluation is (are) representative of the products from each factory has been provided..... :	☐ **Yes** ☒ **Not applicable**

When differences exist; they shall be identified in the General product information section.

Name and address of factory (ies) .....: --

General product information and other remarks:

This product is for outdoor installation, which can only be accessed and maintained by authorized person.

Specifications:

Type designation	Rated Voltage	Rated Current
Backup Box-B0	AC 220/ 230V (single phase)	22.7A
Backup Box-B1	AC 380/ 400V (3 phase)	15.7A

Rated insulation voltage (Ui): 500V
Rated impulse voltage (Uimp): 4kV
Overvoltage Category: OV III

Rated short-time withstand current (Icw): 10kA

Rated peak withstand current (Ipk): 17kA

IP degree: IP65

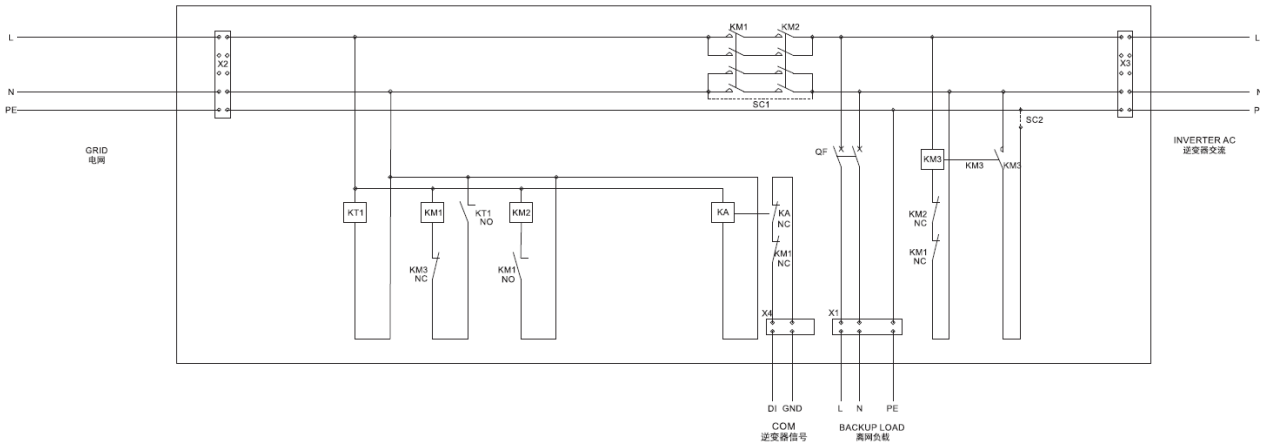
Overall dimensions: mm (Height x Width x Depth)

130x400x350

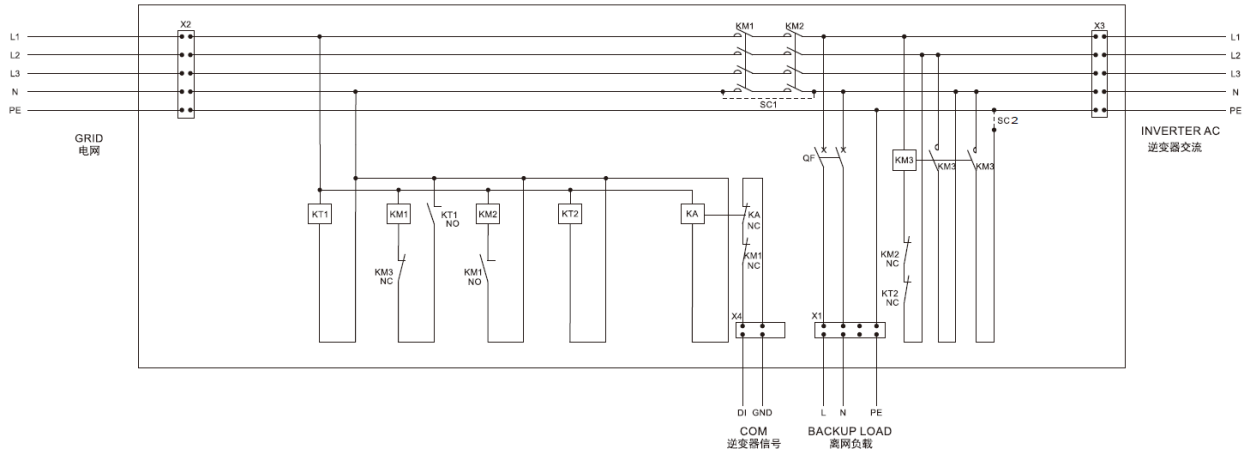
Maximum weight of assembly: 11 kg

Type of construction - FFF
Internal separation form: Form 1

Diagram:
Backup Box-B0



Backup Box-B1



IEC 61439-2			
Clause	Requirement + Test	Result - Remark	Verdict
5	**INTERFACE CHARACTERISTICS**		P
5.2	**Voltage ratings**		P
	Rated voltage (Un) (of the ASSEMBLY) ..... :	see page 6	-
	Rated operational voltage (Ue) ..... : (of a circuit of an ASSEMBLY)	see page 6	-
	Rated insulation voltage (Ui) ..... : (of a circuit of an ASSEMBLY)	see page 6	P
	Rated impulse withstand voltage (Uimp) ..... : (of the ASSEMBLY)	see page 6	P
5.3	**Current ratings**		P
	Rated current of the ASSEMBLY (InA) ..... :	see page 6	-
	Rated current of a circuit (Inc) ..... :	See page 6	-
	Rated peak withstand current (Ipk) ..... :	See page 6	P
	Rated short-time withstand current (Icw) ..... : (of a circuit of an ASSEMBLY)	See page 6	P
	Rated conditional short-circuit current of an ASSEMBLY (Icc) ..... :		N/A
5.4	**Rated diversity factor (RDF)**		N/A
5.5	**Rated frequency (fn)**	50/60Hz	P
5.6	**Other characteristics**		P
	additional requirements depending on the specific service conditions of a functional unit (e.g. type of coordination, overload characteristics);		-
	pollution degree..... :	3	-
	types of system earthing for which the ASSEMBLY is designed..... :	TN-S	P
	indoor and/or outdoor installation..... :	Outdoor	P
	stationary or movable..... :	Stationary	P
	degree of protection..... :	IP65	P
	intended for use by skilled or ordinary persons .... :	Skilled person	P
	electromagnetic compatibility (EMC) classification :		N/A
	special service conditions, if applicable ..... :		N/A
	external design..... :	box-type ASSEMBLY	P
	mechanical impact protection, if applicable..... :		N/A
	the type of construction - fixed, removable or withdrawable parts ..... :	FFF	P
	the nature of short-circuit protective device(s)..... :		N/A

IEC 61439-2			
Clause	Requirement + Test	Result - Remark	Verdict
	measures for protection against electric shock..... :		N/A
	overall dimensions (including projections e.g handles, covers, doors)..... :	see page 6	P
	the weight..... :	11kg	P
6	**INFORMATION**		P
6.1	**ASSEMBLY designation marking**		P
	The following information regarding the ASSEMBLY is provided on the designation label(s):		-
	a) ASSEMBLY manufacturer's name or trade mark (see 3.10.2);	See page 4	-
	b) type designation or identification number or any other means of identification, making it possible to obtain relevant information from the ASSEMBLY manufacturer;	See page 4	P
	c) means of identifying date of manufacture;	YYYY.MM	P
	d) IEC 61439-2.		P
6.2	**Documentation**		P
6.2.1	**Information relating to the PCS-ASSEMBLY**		-
	All interface characteristics according to Clause 5, where applicable, is provided in the technical documentation.		-
6.2.2	**Instructions for handling, installation, operation and maintenance**		P
	The ASSEMBLY manufacturer provides in documents or catalogues:		-
	the conditions, if any, for the handling, installation, operation and maintenance of the ASSEMBLY and the equipment contained therein.		P
	the proper and correct transport, handling, installation and operation of the ASSEMBLY.		P
	The provision of weight details in connection with the transport and handling of ASSEMBLIES.		P
	The correct location and installation of lifting means and the thread size of lifting attachments, if applicable, is given in the ASSEMBLY manufacturer's documentation or the instructions on how the ASSEMBLY has to be handled.		N/A
	The measures to be taken, if any, with regard to EMC associated with the installation, operation and maintenance of the ASSEMBLY is specified (see Annex J).		N/A
	If an ASSEMBLY specifically intended for environment A is to be used in environment B a warning is included in the operating instructions		N/A

IEC 61439-2			
Clause	Requirement + Test	Result - Remark	Verdict
	If the circuitry is not obvious from the physical arrangement of the apparatus installed, suitable information is supplied, for example wiring diagrams or tables.		P
6.3	**Device and/or component identification**		P
	Inside the ASSEMBLY, it is possible to identify individual circuits and their protective devices.		P
	Identification tags are legible, permanent and appropriate for the physical environment.		P
	Any designations used is in compliance with IEC 61346-1 and IEC 61346-2 and identical with those used in the wiring diagrams, which is in accordance with IEC 61082-1.		N/A
7	**SERVICE CONDITIONS**		-
7.1	**Normal service conditions**		-
7.1.1.1	**Ambient air temperature for indoor installations**		N/A
	The ambient air temperature does not exceed +40 °C and its average over a period of 24 h does not exceed +35 °C. The lower limit of the ambient air temperature is –5 °C.		N/A
7.1.1.2	**Ambient air temperature for outdoor installations**		P
	The ambient air temperature does not exceed +40 °C and its average over a period of 24 h does not exceed +35 °C. The lower limit of the ambient air temperature is –25 °C.		P
7.1.2.1	**Atmospheric conditions for indoor installations**		N/A
	The air is clean and its relative humidity does not exceed 50 % at a maximum temperature of +40 °C. Higher relative humidity may be permitted at lower temperatures, for example 90 % at +20 °C. Moderate condensation is taken care of, which may occasionally occur due to variations in temperature.		N/A
7.1.2.2	**Atmospheric conditions for outdoor installations**		P
	The relative humidity may temporarily be as high as 100 % at a maximum temperature of +25 °C.		P
7.1.3	**Pollution degree**		P
	The pollution degree refers to the environmental conditions for which the ASSEMBLY is intended.	PD 3	P
7.1.4	**Altitude**		P
	The altitude of the site of installation does not exceed 2 000 m.		P
7.2	**Special service conditions**		-

IEC 61439-2			
Clause	Requirement + Test	Result - Remark	Verdict
	Where any special service conditions exist, the applicable particular requirements are met or special agreements are made between the ASSEMBLY manufacturer and the user.		N/A
	a) values of temperature, relative humidity and/or altitude differing from those specified in 7.1;		N/A
	b) applications where variations in temperature and/or air pressure take place at such a speed that exceptional condensation is liable to occur inside the ASSEMBLY;		N/A
	c) heavy pollution of the air by dust, smoke, corrosive or radioactive particles, vapours or salt;		N/A
	d) exposure to strong electric or magnetic fields;		N/A
	e) exposure to extreme climatic conditions;		N/A
	f) attack by fungus or small creatures;		N/A
	g) installation in locations where fire or explosion hazards exist;		N/A
	h) exposure to heavy vibration, shocks, seismic occurrences;		N/A
	i) installation in such a manner that the current-carrying capacity or breaking capacity is affected, for example equipment built into machines or recessed into walls;		N/A
	j) exposure to conducted and radiated disturbances other than electromagnetic, and electromagnetic disturbances in environments other than those described in 9.4;		N/A
	k) exceptional overvoltage conditions.		N/A
7.3	**Conditions during transport, storage and installation**		-
	A special agreement is made between the ASSEMBLY manufacturer and the user if the conditions during transport, storage and installation, for example temperature and humidity conditions, differ from those defined in 7.1.		N/A
8	**CONSTRUCTIONAL REQUIREMENTS**		-
8.1	**Strength of materials and parts**		-
	ASSEMBLIES are constructed of materials capable of withstanding the mechanical, electrical, thermal and environmental stresses that are likely to be encountered in specified service conditions.		P
8.1.2	**Protection against corrosion**		P

IEC 61439-2			
Clause	Requirement + Test	Result - Remark	Verdict
	Protection against corrosion is ensured by the use of suitable materials or by protective coatings to the exposed surface, taking account of the intended normal service conditions of use and maintenance.	By protective coating	P
8.1.3.	**Properties of insulating materials**		P
8.1.3.1	**Thermal stability**		P
	For enclosures or parts of enclosures made of insulating materials, thermal stability is verified according to 10.2.3.1.	Enclosure made of metallic materials	N/A
8.1.3.2	**Resistance of insulating materials to heat and fire**		N/A
8.1.3.2.2	**Resistance of insulating materials to heat**		N/A
	The original manufacturer demonstrates compliance either by reference to the insulation temperature index (determined for example by the methods of IEC 60216) or by compliance with IEC 60085.		N/A
8.1.3.2.3	**Resistance of insulating materials to abnormal heat and fire due to internal electric effects**		P
	Insulating materials used for parts necessary to retain current carrying parts in position and parts which might be exposed to thermal stresses due to internal electrical effects, and the deterioration of which might impair the safety of the ASSEMBLY, are not adversely affected by abnormal heat and fire and are verified by the glow- ire test in 10.2.3.3. For the purpose of this test, a protective conductor (PE) is not considered as a current-carrying part.		P
	For small parts (having surface dimensions not exceeding 14 mm x 14 mm), an alternative test may be used (e.g. needle flame test, according to IEC 60695-11-5). The same procedure may be applicable for other practical reasons where the metal material of a part is large compared to the insulating material.		P
8.1.4	Resistance to ultra-violet radiation		P
	For enclosures and external parts made of insulating materials which are intended to be used outdoor, resistance to ultra-violet radiation is verified according to 10.2.4.		P
8.1.5	**Mechanical strength**		P
	All enclosures or partitions including locking means and hinges for doors are of a mechanical strength sufficient to withstand the stresses to which they may be subjected in normal service, and during short-circuit conditions (see also 10.13).		P

IEC 61439-2			
Clause	Requirement + Test	Result - Remark	Verdict
	The mechanical operation of removable parts, including any insertion interlock, is verified by test according to 10.13.		P
8.1.7	**Lifting provision**		N/A
	Where required, ASSEMBLIES are provided with the appropriate provision for lifting. Compliance is checked according to the test of 10.2.5.		N/A
8.2	**Degree of protection provided by an ASSEMBLY enclosure**		P
	Protection against mechanical impact		P
	The degree of protection provided by an ASSEMBLY enclosure against mechanical impact, if necessary, are defined by the relevant ASSEMBLY standards and verified in accordance with IEC 62262. (see 10.2.6).		P
8.2.2	**Protection against contact with live parts, ingress of solid foreign bodies and liquids**		**P**
	The degree of protection provided by any ASSEMBLY against contact with live parts, ingress of solid foreign bodies and liquid is indicated by the IP code according to IEC 60529 and verified according to 10.3	IP65	P
	The degree of protection of an enclosed ASSEMBLY is at least IP 2X, after installation in accordance with the ASSEMBLY manufacturer's instructions. The degree of protection provided from the front of a dead front ASSEMBLY is at least IP XXB.		P
	For ASSEMBLIES for outdoor use having no supplementary protection, the second characteristic numeral is at least 3.		P
	Unless otherwise specified, the degree of protection indicated by the ASSEMBLY manufacturer applies to the complete ASSEMBLY when installed in accordance with the ASSEMBLY manufacturer's instructions, for example sealing of the open mounting surface of an ASSEMBLY, etc.		P
	Where the ASSEMBLY does not have the same IP rating		N/A
	Enclosed ASSEMBLIES, for outdoor and indoor installation, intended for use in locations with high humidity and temperatures varying within wide limits, are provided with suitable arrangements (ventilation and/or internal heating, drain holes, etc.) to prevent harmful condensation within the ASSEMBLY. However, the specified degree of protection is the same time maintained.		N/A

IEC 61439-2			
Clause	Requirement + Test	Result - Remark	Verdict
8.2.3	**Degree of protection of removable parts**		N/A
	The degree of protection indicated for ASSEMBLIES normally applies to the connected position (see 3.2.3) of removable parts.	Fixed connection	N/A
	If, after the removal of a removable part, the original degree of protection is not maintained, an agreement is made between the ASSEMBLY manufacturer and the user as to what measures are taken to ensure adequate protection. Information provided by the ASSEMBLY manufacturer may take the place of such an agreement.		N/A
8.2.101	**Degree of protection of withdrawable parts**		N/A
	The degree of protection indicated for PSC-ASSEMBLIES normally applies to the connected position of withdrawable parts. The ASSEMBLY manufacturer indicates the degree of protection obtained in the other positions and during the transfer between positions.		N/A
	PSC-ASSEMBLIES with withdrawable parts may be so designed that the degree of protection applying to the connected position is also maintained in the test and isolated positions and during transfer from one position to another.		N/A
	If, after the removal of a withdrawable part, the original degree of protection is not maintained, an agreement is reached between the ASSEMBLY manufacturer and user as to what measures are taken to ensure adequate protection.		N/A
8.3	**Clearances and creepage distances**		P
	The requirements for clearances and creepage distances are based on the principles of IEC 60664-1 and are intended to provide insulation co-ordination within the installation.		P
	The clearances and creepage distances of equipment that form part of the ASSEMBLY comply with the requirements of the relevant product standard.		P
	When incorporating equipment into the ASSEMBLY, the specified clearances and creepage distances are maintained during normal service conditions.		P
	For dimensioning clearances and creepage distances between separate circuits, the highest voltage ratings is used (rated impulse withstand voltage for clearances and rated insulation voltage for creepage distances).		P

IEC 61439-2			
Clause	Requirement + Test	Result - Remark	Verdict
	The clearances and creepage distances apply to phase to phase, phase to neutral, and except where a conductor is connected directly to earth, phase to earth and neutral to earth.		P
	For bare live conductors and terminations (e.g. busbars, connections between equipment and cable lugs), the clearances and creepage distances are at least equivalent to those specified for the equipment with which they are directly associated.		P
	The effect of a short-circuit up to and including the declared rating(s) of the ASSEMBLY does not reduce permanently the clearances or creepage distances between busbars and/or connections, below the values specified for the ASSEMBLY. Deformation of parts of the enclosure or of the internal partitions, barriers and obstacles due to a short-circuit do not reduce permanently the clearances or creepage distances below those specified in 8.3.2 and 8.3.3 (see also 10.11.5.5).		P
8.3.2	**Clearances**		P
	The clearances are sufficient to enable the declared rated impulse withstand voltage (Uimp) of a circuit to be achieved. The clearances is as specified in Table 1 unless a design verification test and routine impulse withstand voltage test is carried out in accordance with 10.9.3 and 11.3, respectively.		P
8.3.3	**Creepage distances**		P
	The original manufacturer selects a rated insulation voltage(s) (Ui) for the circuits of the ASSEMBLY from which the creepage distance(s) are determined. For any given circuit the rated insulation voltage is not less than the rated operational voltage (Ue).		P
	The creepage distances are not less than the associated minimum clearances.		P
8.4	**Protection against electric shock**		P
8.4.2	**Basic protection**		P
	Basic protection can be achieved either by appropriate constructional measures on the ASSEMBLY itself or by additional measures to be taken during installation; this may require information to be given by the ASSEMBLY manufacturer.		P
	Where basic protection is achieved by constructional measures one or more of the protective measures given in 8.4.2.2 and 8.4.2.3 may be selected.		P

IEC 61439-2			
Clause	Requirement + Test	Result - Remark	Verdict
	The choice of the protective measure is declared by the ASSEMBLY manufacturer if not specified within the relevant ASSEMBLY standard.		N/A
8.4.2.2	**Basic insulation provided by insulating material**		P
	Hazardous live parts are completely covered with insulation that can only be removed by destruction.	cover plate only removed by a tool	P
	The insulation is made of suitable materials capable of durably withstanding the mechanical, electrical and thermal stresses to which the insulation may be subjected in service.		P
	Paints, varnishes and lacquers alone are not considered to satisfy the requirements for basic insulation.		N/A
8.4.2.3	**Barriers or enclosures**		P
	Air insulated live parts are inside enclosures or behind barriers providing at least a degree of protection of IP XXB.		N/A
	Horizontal top surfaces of accessible enclosures having a height equal to or lower than 1,6 m above the standing area, provide a degree of protection of at least IP XXD.		N/A
	Barriers and enclosures are firmly secured in place and have sufficient stability and durability to maintain the required degrees of protection and appropriate separation from live parts under normal service conditions, taking account of relevant external influences. The distance between a conductive barrier or enclosure and the live parts they protect is not less than the values specified for the clearances and creepage distances in 8.3.		P
	Where it is necessary to remove barriers or open enclosures or to remove parts of enclosures, this is possible only if one of the conditions a) to c) is fulfilled:		P
	a) By the use of a key or tool, i.e. any mechanical aid, to open the door, cover or override an interlock.	by the aid of tool to open the cover	P
	b) After isolation of the supply to live parts, against which the barriers or enclosures afford basic protection, restoration of the supply being possible only after replacement or reclosure of the barriers or enclosures. In TN-C systems, the PEN conductor is not be isolated or switched. In TN-S systems and TN-C-S systems the neutral conductors need not be isolated or switched (see IEC 60364-5-53, 536.1.2).		P

IEC 61439-2			
Clause	Requirement + Test	Result - Remark	Verdict
	c) Where an intermediate barrier providing a degree of protection of at least IP XXB prevents contact with live parts, such a barrier being removable only by the use of a key or tool.		N/A
8.4.3	**Fault protection**		P
8.4.3.1	**Installation conditions**		P
	The ASSEMBLY includes protective measures and is suitable for installations designed to be in accordance with IEC 60364-4-41.		P
	Protective measures suitable for particular installations (e.g. railways, ships) are subject to agreement between the ASSEMBLY manufacturer and the user.		N/A
8.4.3.2	**Requirements for the protective conductor to facilitate automatic disconnection of the supply**		P
	Each ASSEMBLY has a protective conductor to facilitate automatic disconnection of the supply for:		P
	a) protection against the consequences of faults (e.g. failure of basic insulation) within the ASSEMBLY;		P
	b) protection against the consequences of faults (e.g. failure of basic insulation) in external circuits supplied through the ASSEMBLY.		P
8.4.3.2.2	**Requirements for earth continuity providing protection against the consequences of faults within the ASSEMBLY**		P
	All exposed conductive parts of the ASSEMBLY are interconnected together and to the protective conductor of the supply or via an earthing conductor to the earthing arrangement.		P
	These interconnections may be achieved either by metal screwed connections, welding or other conductive connections or by a separate protective conductor. In the case of a separate protective conductor Table 3 is used.	Screw-type	P
	For the continuity of these connections the following is applied:		P
	a) When a part of the ASSEMBLY is removed, for example for routine maintenance, the protective circuits (earth continuity) for the remainder of the ASSEMBLY is not interrupted. Means used for assembling the various metal parts of an ASSEMBLY are considered sufficient for ensuring continuity of the protective circuits if the precautions taken guarantee permanent good conductivity.		P

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Clause	Requirement + Test	Result - Remark	Verdict
	Flexible or pliable metal conduits are not used as protective conductors unless they are designed for that purpose.		N/A
	b) For lids, doors, cover plates and the like, the usual metal screwed connections and metal hinges are considered sufficient to ensure continuity provided that no electrical equipment exceeding the limits of extra low voltage (ELV) is attached to them.		P
	If apparatus with a voltage exceeding the limits of extra-low voltage are attached to lids, doors, or cover plates additional measures are taken to ensure earth continuity. These parts are fitted with a protective conductor (PE) whose cross-sectional area is in accordance with Table 3 depending on the highest rated operational current Ie of the apparatus attached or, if the rated operational current of the attached apparatus is less than or equal to 16 A, an equivalent electrical connection especially designed and verified for this purpose (sliding contact, hinges protected against corrosion).		P
	Exposed conductive parts of a device that cannot be connected to the protective circuit by the fixing means of the device are connected to the protective circuit of the ASSEMBLY by a conductor whose cross-sectional area is chosen according to Table 3.		P
	Certain exposed conductive parts of an ASSEMBLY that do not constitute a danger –either because they cannot be touched on large surfaces or grasped with the hand, – or because they are of small size (approximately 50 mm by 50 mm) or so located as to exclude any contact with live parts, need not be connected to a protective conductor. This applies to screws, rivets and nameplates. It also applies to electromagnets of contactors or relays, magnetic cores of transformers, certain parts of releases, or similar, irrespective of their size.		N/A
	When removable parts are equipped with a metal supporting surface, these surfaces are considered sufficient for ensuring earth continuity of protective circuits provided that the pressure exerted on them is sufficiently high.		N/A
8.4.3.2.3	**Requirements for protective conductors providing protection against the consequences of faults in external circuits supplied through the ASSEMBLY**		P

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Clause	Requirement + Test	Result - Remark	Verdict
	A protective conductor within the ASSEMBLY is so designed that it is capable of withstanding the highest thermal and dynamic stresses arising from faults in external circuits at the place of installation that are supplied through the ASSEMBLY. Conductive structural parts may be used as a protective conductor or a part of it.		P
	In principle, with the exception of the cases mentioned below, protective conductors within an ASSEMBLY does not include a disconnecting device (switch, disconnector, etc.):		P
	In the run of protective conductors links are permitted which are removable by means of a tool and accessible only to authorized personnel (these links may be required for certain tests).		P
	Where continuity can be interrupted by means of connectors or plug-and-socket devices, the protective circuit can be interrupted only after the live conductors have been interrupted and continuity is established before the live conductors are reconnected.		P
	In the case of an ASSEMBLY containing structural parts, frameworks, enclosures, etc., made of conducting material, a protective conductor, if provided, need not be insulated from these parts. Conductors to certain protective devices including the conductors connecting them to a separate earth electrode are insulated. This applies for instance to voltage-operated fault detection devices and can also apply to the earth connection of the transformer neutral.		P
	The cross-sectional area of protective conductors (PE, PEN) in an ASSEMBLY to which external conductors are intended to be connected are not less than the value calculated with the aid of the formula indicated in Annex B using the highest fault current and fault duration that may occur and taking into account the limitation of the short-circuit protective devices (SCPDs) that protect the corresponding live conductors (see 10.11.5.6).		P
	For PEN conductors, the following additional requirements apply:		N/A
	– the minimum cross-sectional area is 10 mm2 copper or 16 mm2 aluminium;		N/A
	– the PEN conductor has a cross-sectional area not less than that required for a neutral conductor (see 8.6.1);		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	– the PEN conductors need not be insulated within an ASSEMBLY;		N/A
	– structural parts are not used as a PEN conductor. However, mounting rails made of copper or aluminium may be used as PEN conductors;		N/A
	– for certain applications in which the current in the PEN conductor may reach high values, for example large fluorescent lighting installations, a PEN conductor having the same or higher current-carrying capacity as the phase conductors may be necessary, subject to special agreement between the ASSEMBLY manufacturer and the user.		N/A
8.4.3.3	**Electrical separation**		N/A
	Electrical separation of individual circuits is intended to prevent electrical shock through contact with exposed-conductive-parts, which may be energized by a fault in basic insulation of the circuit. For this type of protection, see Annex K.		N/A
8.4.4	**Protection by total insulation**		N/A
	For protection, by total insulation, against indirect contact the following requirements are met.		N/A
	a) The apparatus is completely enclosed in insulating material which is equivalent of double or reinforced insulation. The enclosure carries the symbol ⧈ which is visible from the outside.		N/A
	b) The enclosure is at no point pierced by conducting parts in such a manner that there is the possibility of a fault voltage being brought out of the enclosure.		N/A
	This means that metal parts, such as actuator shafts which for constructional reasons have to be brought through the enclosure, are insulated on the inside or the outside of the enclosure from the live parts for the maximum rated insulation voltage and the maximum rated impulse withstand voltage of all circuits in the ASSEMBLY.		N/A
	If an actuator is made of metal (whether covered by insulating material or not), it is provided with insulation rated for the maximum rated insulation voltage and the maximum impulse withstand voltage of all circuits in the ASSEMBLY.		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	If an actuator is principally made of insulating material, any of its metal parts which may become accessible in the event of insulation failure are also insulated from live parts for the maximum rated insulation voltage and the maximum rated impulse withstand voltage of all circuits in the ASSEMBLY.		N/A
	c) The enclosure, when the ASSEMBLY is ready for operation and connected to the supply, encloses all live parts, exposed conductive parts and parts belonging to a protective circuit in such a manner that they cannot be touched. The enclosure gives at least the degree of protection IP 2XC (see IEC 60529)		N/A
	If a protective conductor, which is extended to electrical equipment connected to the load side of the ASSEMBLY, is to be passed through an ASSEMBLY whose exposed conductive parts are insulated, the necessary terminals for connecting the external protective conductors are provided and identified by suitable marking.		N/A
	Inside the enclosure, the protective conductor and its terminal are insulated from the live parts and the exposed conductive parts in the same way as the live parts are insulated.		N/A
	d) Exposed conductive parts within the ASSEMBLY are not connected to the protective circuit, i.e. they are not included in a protective measure involving the use of a protective circuit. This applies also to built-in apparatus, even if they have a connecting terminal for a protective conductor.		N/A
	e) If doors or covers of the enclosure can be opened without the use of a key or tool, a barrier of insulating material is provided that will afford protection against unintentional contact not only with the accessible live parts, but also with the exposed conductive parts that are only accessible after the cover has been opened; this barrier, however, is not removable except with the use of a tool.		N/A
8.4.5	**Limitation of steady-state touch current and charge**		N/A
	If the ASSEMBLY contains items of equipment that may have steady-state touch current and charges after they have been switched off (capacitors, etc.) a warning plate is required.		N/A
	Small capacitors such as those used for arc extinction, for delaying the response of relays, etc., are not considered dangerous.		N/A
8.4.6	**Operating and servicing conditions**		P

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Clause	Requirement + Test	Result - Remark	Verdict
8.4.6.1	**Devices to be operated or components to be replaced by ordinary persons**		N/A
	Protection against any contact with live parts is maintained when operating devices or when replacing components.		N/A
	Openings larger than those defined by degree of protection IP XXC are allowed during the replacement of certain lamps or fuselinks.		N/A
8.4.6.2	**Requirements related to accessibility in service by authorized persons**		P
	If, for reasons of operation, the ASSEMBLY is fitted with a device permitting authorized persons to obtain access to live parts while the equipment is live (e.g by overriding the interlock or using a tool), the interlock is automatically restored on reclosing the door(s).		P
8.4.6.2.2	**Requirements related to accessibility for inspection and similar operations**		P
	The ASSEMBLY is constructed in such a way that certain operations, according to agreement between the ASSEMBLY manufacturer and the user, can be performed when the ASSEMBLY is in service and under voltage.		P
	Such operations may consist of:		P
	– visual inspection of switching devices and other apparatus, settings and indicators of relays and releases, conductor connections and marking;		P
	– adjusting and resetting of relays, releases and electronic devices;		N/A
	– replacement of fuse-links;		N/A
	– replacement of indicating lamps;		N/A
	– certain fault location operations, for example voltage and current measuring with suitably designed and insulated devices.		P
8.4.6.2.3	**Requirements related to accessibility for maintenance**		**P**
	To enable maintenance as agreed upon between the ASSEMBLY manufacturer and the user on an isolated functional unit or isolated group of functional units in the ASSEMBLY, with adjacent functional units or groups still under voltage, necessary measures are taken.		P
	The choice depends on such factors as service conditions, frequency of maintenance, competence of the authorized person, as well as local installation rules. Such measures may include:		P

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Clause	Requirement + Test	Result - Remark	Verdict
	– sufficient space between the actual functional unit or group and adjacent functional units or groups. It is recommended that parts likely to be removed for maintenance have, as far as possible, retainable fastening means;		N/A
	– use of barriers or obstacles designed and arranged to protect against direct contact with equipment in adjacent functional units or groups;		P
	– use of terminal shields;		P
	– use of compartments for each functional unit or group;		N/A
	– insertion of additional protective means provided or specified by the ASSEMBLY manufacturer.		N/A
8.4.6.2.4	**Requirements related to accessibility for extension under voltage**		N/A
	When it is required to enable future extension of an ASSEMBLY with additional functional units or groups, with the rest of the ASSEMBLY still under voltage, the requirements specified in 8.4.6.2.3 apply, subject to agreement between the ASSEMBLY manufacturer and the user.		N/A
	These requirements also apply for the insertion and connection of additional outgoing cables when the existing cables are under voltage.		N/A
	The extension of busbars and connection of additional units to their incoming supply are not made under voltage, unless the ASSEMBLY is designed for this purpose.		N/A
8.4.6.2.5	**Obstacles**		N/A
	Obstacles prevent either:		N/A
	– unintentional bodily approach to live parts, or		N/A
	– unintentional contact with live parts during the operation of live equipment in normal service.		N/A
	Obstacles may be removed without using a key or tool but are so secured as to prevent unintentional removal. The distance between a conductive obstacle and the live parts they protect is not less than the values specified for the clearances and creepage distances in 8.3.		N/A
	Where a conductive obstacle is separated from hazardous live parts by basic protection only, it is an exposed conductive part, and measures for fault protection are also applied.		N/A
8.5	**Incorporation of switching devices and components**		**P**
8.5.1	**Fixed parts**		**P**

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Clause	Requirement + Test	Result - Remark	Verdict
	For fixed parts (see 3.2.1), the connections of the main circuits (see 3.1.3) is only connected or disconnected when the ASSEMBLY is not under voltage.		P
	Removal and installation of fixed parts requires the use of a tool.		P
	The disconnection of a fixed part requires the isolation of the complete ASSEMBLY or part of it.		P
	In order to prevent unauthorized operation, the switching device may be provided with means to secure it in one or more of its positions.		P
8.5.2	**Removable and withdrawable parts**		N/A
	The removable and withdrawable parts are so constructed that their electrical equipment can be safely isolated from or connected to the main circuit whilst this circuit is live.		N/A
	The removable and withdrawable parts may be provided with an insertion interlock		N/A
	Minimum clearances and creepage distances are complied with in the different positions as well as during transfer from one position to another.		N/A
8.5.2.101	**Withdrawable parts**		N/A
	Withdrawable parts have in addition an isolated position and may have a test position or a test situation		N/A
	Withdrawable parts are distinctly located in these positions. These positions are clearly discernible.		N/A
	In PSC-ASSEMBLIES with withdrawable parts all live parts are protected in such a manner that they cannot unintentionally be touched when the door, if any, is open and the withdrawable part is withdrawn from the connected position or removed.		N/A
	Where an obstacle or shutter is used they meet the requirements of 8.4.5.2.5 of Part 1, and warning labels are provided.		N/A
8.5.2.102	**Interlocking and padlocking of withdrawable parts**		N/A
	Unless otherwise specified, withdrawable parts are fitted with a device, which ensures that the apparatus can only be withdrawn and/or re-inserted after its main circuit has been interrupted.		N/A
	In order to prevent unauthorized operation, withdrawable parts may be provided with means for a padlock or lock to secure them in one or more of their positions.		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
8.5.3	**Selection of switching devices and components**		**P**
	Switching devices and components incorporated in ASSEMBLIES comply with the relevant IEC standards.		P
	The switching devices and components having a short-circuit withstand strength and/or a breaking capacity which is insufficient to withstand the stresses likely to occur at the place of installation, are protected by means of current-limiting protective devices, for example fuses or circuit-breakers.		P
	When selecting current-limiting protective devices for built-in switching devices, account is taken of the maximum permissible values specified by the device manufacturer, having due regard to co-ordination (see 9.3.4).		P
	Co-ordination of switching devices and components, for example co-ordination of motor starters with short-circuit protective devices, comply with the relevant IEC standards.		N/A
8.5.4	**Installation of switching devices and components**		**P**
	Switching devices and components are installed and wired in the ASSEMBLY in accordance with instructions provided by their manufacturer and in such a manner that their proper functioning is not impaired by interaction, such as heat, switching emissions, vibrations, electromagnetic fields, which are present in normal operation.		P
	In the case of electronic assemblies, this may necessitate the separation or screening of all electronic signal processing circuits.		N/A
	When fuses are installed the original manufacturer states the type and rating of the fuselinks to be used.		N/A
8.5.5	**Accessibility**		**P**
	Adjusting and resetting devices, which have to be operated inside the ASSEMBLY are easily accessible.		P
	Functional units mounted on the same support (mounting plate, mounting frame) and their terminals for external conductors are so arranged as to be accessible for mounting, wiring, maintenance and replacement.		P
	Unless otherwise agreed between the ASSEMBLY manufacturer and the user the following accessibility requirements associated with floor-mounted ASSEMBLIES apply:		P

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Clause	Requirement + Test	Result - Remark	Verdict
	The terminals, excluding terminals for protective conductors, are situated at least 0,2 m above the base of the ASSEMBLIES and, moreover, be so placed that the cables can be easily connected to them.		P
	Indicating instruments that need to be read by the operator are located within a zone between 0,2 m and 2,2 m above the base of the ASSEMBLY.		P
	Operating devices such as handles, push buttons, or similar are located at such a height that they can easily be operated; this means that their centreline are located within a zone between 0,2 m and 2 m above the base of the ASSEMBLY.		P
	Actuators for emergency switching devices (see 536.4.2 of IEC 60364-5-53) are accessible within a zone between 0,8 m and 1,6 m above the base of the ASSEMBLY		P
8.5.6	**Barriers**		**P**
	Barriers for manual switching devices are so designed that the switching emissions do not present a danger to the operator.		P
	To minimize danger when replacing fuse-links, interphase barriers are applied, unless the design and location of the fuses makes this unnecessary.		N/A
8.5.7	**Direction of operation and indication of switching positions**		**P**
	The operational positions of components and devices are clearly identified. If the direction of operation is not in accordance with IEC 60447, then the direction of operation is clearly identified.		P
8.5.8	**Indicator lights and push-buttons**		**N/A**
	Unless otherwise specified in the relevant product standard the colours of indicator lights and push-buttons are in accordance with IEC 60073.		**N/A**
8.5.101	**Description of the types of electrical connections of functional units**		**P**
	The types of electrical connections of functional units within PSC-ASSEMBLIES or parts of PSCASSEMBLIES can be denoted by a three-letter code:		-
	– the first letter denotes the type of electrical connection of the main incoming circuit; – the second letter denotes the type of electrical connection of the main outgoing circuit; – the third letter denotes the type of electrical connection of the auxiliary circuits.	FFF	P

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Clause	Requirement + Test	Result - Remark	Verdict
	The following letters are used:		P
	– F for fixed connections (see 3.101.1);		P
	– D for disconnectable connections (see 3.101.2);		N/A
	– W for withdrawable connections (see 3.101.3).		N/A
8.6	**Internal electrical circuits and connections**		**P**
8.6.1	**Main circuits**		**P**
	The busbars (bare or insulated) are arranged in such a manner that an internal short-circuit is not to be expected.		P
	They are rated at least in accordance with the information concerning the short-circuit withstand strength (see 9.3) and designed to withstand at least the short-circuit stresses limited by the protective device(s) on the supply side of the busbars.		P
	Within one section, the conductors (including distribution busbars) between the main busbars and the supply side of functional units as well as the components included in these units may be rated on the basis of the reduced short-circuit stresses occurring on the load side of the respective short-circuit protective device within each unit, provided that these conductors are arranged so that under normal operation an internal short-circuit between phases and/or between phases and earth is not to be expected (see 8.6.4).		P
	Unless otherwise agreed between the ASSEMBLY manufacturer and the user, the minimum cross-sectional area of the neutral within a three phase and neutral circuit is:		P
	For circuits with a phase conductor cross-sectional area up to and including 16 mm2, 100 % of that of the corresponding phases.		P
	For circuits with a phase conductor cross-sectional area above 16 mm², 50 % of that of the corresponding phases with a minimum of 16 mm2.		N/A
	It is assumed that the neutral currents do not exceed 50 % of the phase currents.		P
8.6.2	**Auxiliary circuits**		N/A
	The design of the auxiliary circuits takes into account the supply earthing system and ensures that an earth-fault or a fault between a live part and an exposed conductive part does not cause unintentional dangerous operation.		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	In general, auxiliary circuits are protected against the effects of short circuits.		N/A
	However, a short-circuit protective device is not provided if its operation is liable to cause a danger. In such a case, the conductors of auxiliary circuits are arranged in such a manner that a short-circuit is not to be expected (see 8.6.4).		N/A
8.6.3	**Bare and insulated conductors**		P
	The connections of current-carrying parts do not suffer undue alteration as a result of normal temperature rise, ageing of the insulating materials and vibrations occurring in normal operation.		P
	The effects of thermal expansion and of the electrolytic action in the case of dissimilar metals, and the effects of the endurance of the materials to the temperatures attained, are taken into consideration		P
	Connections between current-carrying parts are established by means that ensure a sufficient and durable contact pressure.		P
	If verification of temperature rise is carried out on the basis of tests (see 10.10.2) the selection of conductors and their cross-sections used inside the ASSEMBLY is the responsibility of the ASSEMBLY manufacturer.		P
	If verification of temperature rise is made following the rules of 10.10.3, the conductors have a minimum cross-section according to IEC 60364-5-52. Examples on how to adapt this standard for conditions inside an ASSEMBLY are given in the tables included in Annex H.		N/A
	In the case of insulated solid or flexible conductors:		P
	– They are rated for at least the rated insulation voltage (see 5.2.3) of the circuit concerned.		P
	– Conductors connecting two termination points have no intermediate joint, e.g. spliced or soldered.		P
	– Conductors with only basic insulation are prevented from coming into contact with bare live parts at different potentials.		P
	– Contact of conductors with sharp edges are prevented.		P

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Clause	Requirement + Test	Result - Remark	Verdict
	- Supply conductors to apparatus and measuring instruments in covers or doors are so installed that no mechanical damage can occur to the conductors as a result of movement of these covers or doors.		P
	– Soldered connections to apparatus are permitted in ASSEMBLIES only in cases where provision is made for this type of connection on the apparatus and the specified type of conductor is used.		P
	- For apparatus other than those mentioned above, soldering cable lugs or soldered ends of stranded conductors are not acceptable under conditions of heavy vibration. In locations where heavy vibrations exist during normal operation, for example in the case of dredger and crane operation, operation on board ships, lifting equipment and locomotives, attention is given to the support of conductors.		P
	– Generally only one conductor is connected to a terminal; the connection of two or more conductors to one terminal is permissible only in those cases where the terminals are designed for this purpose.		P
	The dimensioning of solid insulation between separate circuits are based on the circuit of highest rated insulation voltage.		P
8.6.4	**Selection and installation of non-protected live conductors to reduce the possibility of short-circuits**		**P**
	Live conductors in an ASSEMBLY that are not protected by short-circuit protective devices (see 8.6.1 and 8.6.2) are selected and installed throughout the entire ASSEMBLY in such a manner that an internal short-circuit between phases or between phase and earth is a remote possibility. See Table 4.		P
	Non-protected live conductors selected and installed as in Table 4 and having a SCPD on the load side do not exceed 3 m in length.		P
8.6.5	**Identification of the conductors of main and auxiliary circuits**		**P**
	With the exception of the cases mentioned in 8.6.6, the method and the extent of identification of conductors, for example by arrangement, colours or symbols, on the terminals to which they are connected or on the end(s) of the conductors themselves, is the responsibility of the ASSEMBLY manufacturer and is in agreement with the indications on the wiring diagrams and drawings.		P
	Where appropriate, identification according to IEC 60445 and IEC 60446 are applied		P

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Clause	Requirement + Test	Result - Remark	Verdict
8.6.6	**Identification of the protective conductor (PE, PEN) and of the neutral conductor (N) of the main circuits**		**P**
	The protective conductor is readily distinguishable by location and/or marking or colour.		P
	If identification by colour is used, it is only green and yellow (twin-coloured), which is strictly reserved for the protective conductor.		P
	When the protective conductor is an insulated single-core cable, this colour identification is used, preferably throughout the whole length.		P
	Any neutral conductor of the main circuit is readily distinguishable by location and/or marking or colour. If identification by colour only is used, it is blue (see IEC 60446).		P
8.7	**Cooling**		N/A
	ASSEMBLIES can be provided with both natural and forced cooling. If special precautions are required at the place of installation to ensure proper cooling, the ASSEMBLY manufacturer furnishes the necessary information (for instance indication of the need for spacing with respect to parts that are liable to impede the dissipation of heat or produce heat themselves).		N/A
8.8	**Terminals for external conductors**		**P**
	The ASSEMBLY manufacturer indicates whether the terminals are suitable for connection of copper or aluminium conductors, or both.		P
	The terminals are such that the external conductors may be connected by a means (screws, connectors, etc.) which ensures that the necessary contact pressure corresponding to the current rating and the short-circuit strength of the apparatus and the circuit is maintained.	screw-type	P
	In the absence of a special agreement between the ASSEMBLY manufacturer and the user, terminals are capable of accommodating copper conductors from the smallest to the largest cross-sectional areas corresponding to the appropriate rated current (see Annex A).		P
	Where aluminium conductors are to be terminated, the type, size and termination method of the conductors are as agreed between the ASSEMBLY manufacturer and the user.		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	In the case where external conductors for electronic circuits with low level currents and voltages (less than 1 A and less than 50 V a.c. or 120 V d.c.) have to be connected to an ASSEMBLY, Table A.1 does not apply.		N/A
	The available wiring space permits proper connection of the external conductors of the indicated material and, in the case of multicore cables, spreading of the cores.		P
	The conductors are not subjected to stresses		P
	Unless otherwise agreed between the ASSEMBLY manufacturer and the user, on three-phase and neutral circuits, terminals for the neutral conductor allow the connection of copper conductors having a current-carrying capacity:		P
	– equal to half the current-carrying capacity of the phase conductor, with a minimum of 16 mm2, if the size of the phase conductor exceeds 16 mm2;		N/A
	– equal to the full current-carrying capacity of the phase conductor, if the size of the latter is less than or equal to 16 mm2.		P
	If connecting facilities for incoming and outgoing neutral, protective and PEN conductors are provided; they are arranged in the vicinity of the associated phase conductor terminals.		P
	Openings in cable entries, cover plates, etc., are so designed that, when the cables are properly installed, the stated protective measures against contact and degree of protection are obtained.		P
	The terminals for external protective conductors are marked according to IEC 60445.		P
	The terminals for external protective conductors (PE, PEN) and metal sheathing of connecting cables (steel conduit, lead sheath, etc.) are, where required, bare and, unless otherwise specified, suitable for the connection of copper conductors.		P
	A separate terminal of adequate size is provided for the outgoing protective conductor(s) of each circuit.		P
	Unless otherwise agreed between the ASSEMBLY manufacturer and the user, terminals for protective conductors allow the connection of copper conductors having a cross-section depending on the cross-section of the corresponding phase conductors according to Table 5.		P

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Clause	Requirement + Test	Result - Remark	Verdict
	In the case of enclosures and conductors of aluminium or aluminium alloys, particular consideration are given to the danger of electrolytic corrosion.		N/A
9	**PERFORMANCE REQUIREMENTS**		P
9.1	**Dielectric properties**		P
9.1.2	**Power-frequency withstand voltage**		P
	The circuits of the ASSEMBLY are capable of withstanding the appropriate power frequency withstand voltages given in Tables 8 and 9. The rated insulation voltage of any circuit of the ASSEMBLY is equal to or higher than its maximum operational voltage.		P
9.1.3	**Impulse withstand voltage**		**P**
9.1.3.1	**Impulse withstand voltages of main circuits**		**P**
	Clearances from live parts to parts intended to be earthed and between poles are capable of withstanding the test voltage given in Table 10 appropriate to the rated impulse withstand voltage.		P
	The rated impulse withstand voltage for a given rated operational voltage is not be less than that corresponding in Annex G to the nominal voltage of the supply system of the circuit at the point where the ASSEMBLY is to be used and the appropriate overvoltage category.		P
9.1.3.2	**Impulse withstand voltages of auxiliary circuits**		N/A
	a) Auxiliary circuits that are connected to the main circuit and operate at the rated operational voltage without any means for reduction of overvoltage comply with the requirements of 9.1.3.1.		N/A
	b) Auxiliary circuits that are not connected to the main circuit may have an overvoltage withstand capacity different from that of the main circuit. The clearances of such circuits – a.c. or d.c. – are capable of withstanding the appropriate impulse withstand voltage in accordance with Annex G.		N/A
9.1.4	**Protection of surge protective devices**		N/A
	When overvoltage conditions require surge protective devices (SPD's) to be connected to the main busbars, such SPD's are protected to prevent uncontrolled short-circuit conditions as specified by the SPD manufacturer.		N/A
9.2	**Temperature rise limits**		**P**

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Clause	Requirement + Test	Result - Remark	Verdict
	The ASSEMBLY and its circuits can carry their rated currents under specified conditions (see 5.3.1, 5.3.2 and 5.3.3 without exceeding the limits given in Table 6 when verified in accordance with 10.10.		P
	The temperature rise of an element or part is the difference between the temperature of this element or part measured in accordance with 10.10.2.3.3 and the ambient air temperature outside the ASSEMBLY.		P
	The temperature rises obtained during the test do not cause damage to current-carrying parts or adjacent parts of the ASSEMBLY. In particular, for insulating materials, the ASSEMBLY Manufacturer demonstrates compliance either by reference to the insulation temperature index (determined for example by the methods of IEC 60216) or by compliance with IEC 60085.		P
9.3	**Short-circuit protection and short-circuit withstand strength**		**P**
	ASSEMBLIES are capable of withstanding the thermal and dynamic stresses resulting from short-circuit currents not exceeding the rated values.		P
	ASSEMBLIES are protected against short-circuit currents by means of, for example, circuitbreakers, fuses or combinations of both, which may either be incorporated in the ASSEMBLY or arranged outside it.		P
9.3.2	**Information concerning short-circuit withstand strength**		**P**
	For ASSEMBLIES with a short-circuit protective device (SCPD) incorporated in the incoming unit, the ASSEMBLY manufacturer indicates the maximum allowable value of prospective short-circuit current at the input terminals of the ASSEMBLY.		N/A
	This value does not exceed the appropriate rating(s) (see 5.3.4, 5.3.5 and 5.3.6). The corresponding power factor and peak values are those shown in 9.3.3.		P
	If a circuit breaker with time-delay release is used as the short-circuit protective device, the ASSEMBLY manufacturer states the maximum time-delay and the current setting corresponding to the indicated prospective short-circuit current.		N/A
	For ASSEMBLIES where the short-circuit protective device is not incorporated in the incoming unit, the ASSEMBLY manufacturer indicates the short-circuit withstand strength in one or more of the following ways:		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	a) rated short-time withstand current (Icw) together with the associated duration (see 5.3.5) and rated peak withstand current (Ipk) ((see 5.3.4);		N/A
	b) rated conditional short-circuit current (Icc) (see 5.3.6).		N/A
	For times up to a maximum of 3 s, the relationship between the rated short-timer current and the associated duration is given by the formula I2t = constant , provided that the peak value does not exceed the rated peak withstand current.		N/A
	The ASSEMBLY manufacturer indicates the characteristics of the short-circuit protective devices necessary for the protection of the ASSEMBLY.		P
	For an ASSEMBLY having several incoming units which are unlikely to be in operation simultaneously, the short-circuit withstand strength can be indicated for each of the incoming units in accordance with the above.		N/A
	For an ASSEMBLY having several incoming units which are likely to be in operation simultaneously, and for an ASSEMBLY having one incoming unit and one or more outgoing high-power units likely to contribute to the short-circuit current, it is necessary to determine the values of the prospective short-circuit current in each incoming unit, in each outgoing unit and in the busbars based on data provided by the user.		N/A
9.3.3	**Relationship between peak current and short-time current**		**P**
	For determining the electrodynamic stresses, the value of peak current is obtained by multiplying the r.m.s.value of the short-circuit current by the factor n. The values for the factor n and the corresponding power factor are given in Table 7.		P
9.3.4	**Co-ordination of protective devices**		**P**
	The co-ordination of protective devices within the ASSEMBLY with those to be used external to the ASSEMBLY are the subject of an agreement between the ASSEMBLY manufacturer and the user. Information given in the ASSEMBLY manufacturer's catalogue may take the place of such an agreement.		P

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Clause	Requirement + Test	Result - Remark	Verdict
	If the operating conditions require maximum continuity of supply, the settings or selection of the short-circuit protective devices within the ASSEMBLY are, where possible, so coordinated that a short circuit occurring in any outgoing circuit is cleared by the switching device installed in the circuit without affecting the other outgoing circuits, thus ensuring selectivity of the protective system.		P
	Where short-circuit protective devices are connected in series and are intended to operate simultaneously to reach the required short-circuit switching capability (i.e. back-up protection), the ASSEMBLY Manufacturer informs the User (e.g. by a warning label in the ASSEMBLY or in the operating instructions, see 6.2) that none of the protective devices are allowed to be replaced by another device which is not of identical type and rating, since the switching capability of the whole combination may otherwise be compromised.		P
9.4	**Electromagnetic compatibility (EMC)**		N/A
	For EMC related performance requirements, see J.9.4 of Annex J.		N/A
10	**DESIGN VERIFICATION**		P
	Design verification is intended to verify compliance of the design of an ASSEMBLY or ASSEMBLY system with the requirements of this series of standards.		-
	Where tests on the ASSEMBLY have been conducted in accordance with the IEC 60439 series, prior to the publication of the relevant product standard in the IEC 61439 series, and the test results fulfil the requirements of the relevant part of IEC 61439, the verification of these requirements need not be repeated.		P
	Repetition of verifications in the product standards of switching devices or components incorporated in the ASSEMBLY, which have been selected in accordance with 8.5.3 and installed in accordance with the instructions of their manufacturer is not required.		P
	Tests on individual devices to their respective product standards are not an alternative to the design verifications in this standard for the ASSEMBLY.		-

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Clause	Requirement + Test	Result - Remark	Verdict
	Modifications on a verified ASSEMBLY have been checked with Clause 10 and do not affect the performance of the ASSEMBLY.		N/A
	The tests are performed on a representative sample of an ASSEMBLY in a clean and new condition		N/A
	The performance of the ASSEMBLY may be affected by the verification tests (e.g. short-circuit test). These tests are not performed on an ASSEMBLY that is intended to be placed in service.		-
	An ASSEMBLY which is verified in accordance with this standard by an original manufacturer (see 3.10.1) and manufactured or assembled by another does not require the original design verifications to be repeated if all the requirements and instructions specified and provided by the Original Manufacturer are met in full.		N/A
	Where the ASSEMBLY manufacturer incorporates their own arrangements not included in the original manufacturer's verification, the ASSEMBLY manufacturer is deemed to be the original manufacturer in respect of these arrangements.		N/A
	The number of ASSEMBLIES or parts thereof used for verification and the order in which the verification is carried out is at the discretion of the original manufacturer.		P
	The data used, calculations made and comparison undertaken for the verification of ASSEMBLIES are recorded in a verification report.		P
10.2	**STRENGTH OF MATERIALS AND PARTS**		**P**
10.2.1	**General**		**P**
	The mechanical, electrical and thermal capability of constructional materials and parts of the ASSEMBLY are deemed to be proven by verification of construction and performance characteristics.		P
	Where an empty enclosure in accordance with IEC 62208 is used, and it has not been modified so as to degrade the performance of the enclosure, no repetition of the enclosure testing to 10.2 is required.		N/A
10.2.2	**Resistance to corrosion**		P
	The resistance to corrosion of representative samples of ferrous metallic enclosures and internal and external ferrous metallic parts of the ASSEMBLY are verified.		-

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Clause	Requirement + Test	Result - Remark	Verdict
	The test are carried out on an enclosure or representative sample showing the same constructional detail as the enclosure itself.		P
	In all cases hinges, locks and fastenings are also tested unless they have previously been subjected to an equivalent test and their resistance to corrosion has not been compromised by their application.		P
	Where the enclosure is subjected to the test it is mounted as for normal use according to the original manufacturer's instructions.		P
	The test specimens is new and in a clean condition and is subjected to severity test A or B, as detailed in 10.2.2.2 and 10.2.2.3.	test B	P
10.2.2.4	**Results to be obtained**		P
	After the test, the enclosure or samples are washed in running tap water for 5 min, rinsed in distilled or demineralized water then shaken or subjected to air blast to remove water droplets. The specimen under test is then stored under normal service conditions for 2 h.		P
	Compliance is checked by visual inspection to determine that:		-
	– there is no evidence of iron oxide, cracking or other deterioration more than that allowed by ISO 4628-3 for a degree of rusting Ri1. However surface deterioration of the protective coating is allowed. In case of doubt associated withpaints and varnishes, reference is made to ISO 4628-3 to verify that the samples conform to the specimen Ri1;	No iron oxide and no surface deterioration	P
	– the mechanical integrity is not impaired;		P
	– seals are not damaged,		P
	– doors, hinges, locks, and fastenings work without abnormal effort.		P
10.2.3	**Properties of insulating materials**		P
10.2.3.1	**Verification of thermal stability of enclosures**		N/A
	The thermal stability of enclosures manufactured from insulated material is verified by the dry heat test. The test is carried out according to IEC 60068-2-2 Test Bb, at a temperature of 70 °C, with natural air circulation, for a duration of 168 h and with a recovery of 96 h.		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	Parts, intended for decorative purposes that have no technical significance are not considered for the purpose of this test.		N/A
	The enclosure, mounted as for normal use, is subjected to a test in a heating cabinet with an atmosphere having the composition and pressure of the ambient air and ventilated by natural circulation. If the dimensions of the enclosure are inconsistent with those of the heating cabinet, the test may be carried out on a representative sample of the enclosure.		N/A
	The use of an electrically heated cabinet is recommended.		N/A
	The enclosure or sample shows no crack visible to normal or corrected vision without additional magnification nor does the material have become sticky or greasy, this being judged as follows:		N/A
	With the forefinger wrapped in a dry piece of rough cloth, the sample is pressed with a force of 5 N.		N/A
	No traces of the cloth remains on the sample and the material of the enclosure or sample does not stick to the cloth.		N/A
10.2.3.2	**Verification of resistance of insulating materials to abnormal heat and fire due to internal electric effects**		P
	The glow-wire test principles of IEC 60695-2-10 and the details given in IEC 60695-2-11 are used to verify the suitability of materials used:		-
	a) on parts of ASSEMBLIES, or		P
	b) on parts taken from these parts.		N/A
	The test is carried out on material with the minimum thickness used for the parts in a) or b).		P
	The temperature of the tip of the glow-wire is as follows:		-
	– 960 °C for parts necessary to retain current-carrying parts in position;	terminal block	P
	- 850 °C for enclosures intended for mounting in hollow walls;		N/A
	– 650 °C for all other parts, including parts necessary to retain the protective conductor.		N/A
	The specimen is considered to have withstood the glow-wire test if		-
	– there is no visible flame and no sustained glowing, or if		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	– flames and glowing of the specimen extinguish within 30 s after removal of the glow-wire.		P
	There is no burning of the tissue paper or scorching of the pinewood board.		P
	As an alternative the original manufacturer may provide data on the suitability of materials from the insulating material supplier to demonstrate compliance with the requirements of 8.1.3.2.3		N/A
10.2.4	**Resistance to ultra-violet (UV) radiation**		P
	This test applies only to enclosures and external parts of ASSEMBLIES intended to be installed outdoors and which are constructed of insulating materials or metals that are entirely coated by synthetic material. Representative samples of such parts are subjected to the test		P
	UV test according to ISO 4892-2 method A; 1 000 cycles of 5 min of watering and 25 min of dry period with xenon lamp providing a total test period of 500 h.		P
	The values of temperature and humidity used for the test are (65 ±3) °C and (65±5) % respectively, unless declared otherwise by the original manufacturer.		P
	For enclosures constructed of insulating materials compliance is checked by verification that the flexural strength (according to ISO 178) and Charpy impact (according to ISO 179) of insulating materials have 70 % minimum retention.		N/A
	For the test carried out in accordance with ISO 178, the surface of the sample exposed to UV is turned face down and the pressure applied to the non exposed surface.		N/A
	For the test carried out in accordance with ISO 179 no grooves are cut into the sample and the impact is applied to the exposed surface.		N/A
	After the test, samples are subjected to the glow-wire test of 10.2.3.3.		N/A
	For compliance, enclosures constructed of metals entirely coated by synthetic material, the adherence of the synthetic material (according to ISO 2409) have 50 % minimum retention.		P
	Samples show no cracks or deterioration visible to normal or corrected vision without additional magnification.		P

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Clause	Requirement + Test	Result - Remark	Verdict
	This test need not be carried out if the original manufacturer can provide data from the material supplier to demonstrate that materials of the same thickness or thinner comply with this requirement.		N/A
10.2.5	**Lifting**		N/A
	The maximum number of sections allowed by the original manufacturer to be lifted together are equipped with components and/or weights to achieve a weight of 1,25 times its maximum shipping weight. ..... :		N/A
	With doors closed it is lifted with the specified lifting means and in the manner defined by the original manufacturer.		N/A
	From a standstill position, the ASSEMBLY is raised smoothly without jerking in a vertical plane to a height of ≥1 m and lowered in the same manner to a standstill position. This test is repeated a further two times after which the ASSEMBLY is raised up and suspended clear of the floor for 30 min without any movement.		N/A
	Following this test the ASSEMBLY is raised smoothly without jerking from a standstill position to a height of (≥1 m and moved (10 ± 0,5) m horizontally, then lowered to a standstill position. This sequence, is carried out three times at uniform speed, each sequence being carried out within 1 min.		N/A
	During the test, with the test weights in place, the ASSEMBLY shows no deflections and after the test show no cracks or permanent distortions visible to normal or corrected vision without additional magnification, which could impair any of its characteristics.		N/A
10.2.6	**Mechanical impact**		P
	Mechanical impact tests where required by the specific ASSEMBLY standard are to be carried out in accordance with IEC 62262.		P
10.2.7	**Marking**		**P**
	Marking made by moulding, pressing, engraving or similar, including labels with a laminated plastic covering, is not submitted to the following test.		P
	The test is made by rubbing the marking by hand for 15 s with a piece of cloth soaked in water and then for 15 s with a piece of cloth soaked with petroleum spirit.		P

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Clause	Requirement + Test	Result - Remark	Verdict
	After the test the marking is legible to normal or corrected vision without additional magnification.		P
10.3	**DEGREE OF PROTECTION OF PCS-ASSEMBLIES**		**P**
	The degree of protection provided is verified in accordance with IEC 60529; the test may be carried out on a representative equipped ASSEMBLY.	IP65	P
	Where an empty enclosure in accordance with IEC 62208 is used, a verification assessment shall be performed to ensure that any external modification that has been carried out does not result in a deterioration of the degree of protection. In this case no further testing is required.		N/A
	ASSEMBLIES having a degree of protection of IP 5X are tested according to category 2 in 13.4 of IEC 60529.		N/A
	ASSEMBLIES having a degree of protection of IP 6X are tested according to category 1 in 13.4 of IEC 60529.		P
	The test device for IP X3 and IP X4 as well as the type of support for the enclosure during the IP X4 test is stated in the test report.		N/A
	The IP X1 to IP X6 tests on an ASSEMBLY are deemed to be a failure if any water comes into contact with electrical equipment housed within the enclosure. Ingress of water is permissible only if its route of entry is obvious and the water is only in contact with the enclosure at a location where it will not impair safety.	IPX5	P
10.4	**CLEARANCES AND CREEPAGE DISTANCES**		**P**
	The clearances are sufficient to enable the declared rated impulse withstand voltage (Uimp) of a circuit to be achieved. Rated impulse withstands voltage. ..... :	4kV	P
	Required clearances as specified in Table 1. ..... :	See appended table	P
	Measured clearances ..... :	See appended table	P
	The original manufacturer selects a rated insulation voltage(s) (Ui) for the circuits of the ASSEMBLY from which the creepage distance(s) is determined. For any given circuit the rated insulation voltage is not less than the rated operational voltage (Ue). Insulation voltage Ui ..... :	500V	P
	Pollution degree. ..... :	3	P
	Material group . ..... :	IIIa	P

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Clause	Requirement + Test	Result - Remark	Verdict
	Minimum clearances required..... :	See appended table	P
	The creepage distances measured..... :	See appended table	P
	Where functional units are mounted on withdrawable parts, the isolation provided in the isolated position is at least comply with the requirements in the relevant specification for disconnectors (see IEC 60947-3).		N/A
	The isolating distance between the withdrawable unit main contacts and their associated fixed contacts in the isolated position is capable of withstanding the test voltage for the declared impulse withstand voltage as specified in Table 102.		N/A
10.5	**PROTECTION AGAINST ELECTRIC SHOCK AND INTEGRITY OF PROTECTIVE CIRCUITS**		**P**
10.5.2	**Effective earth continuity between the exposed conductive parts of the ASSEMBLY and the protective circuit**		**P**
	It is verified that the different exposed conductive parts of the ASSEMBLY are effectively connected to the terminal for the incoming external protective conductor and that the resistance of the circuit does not exceed 0,1 Ω		P
	Verification is made using a resistance measuring instrument which is capable of driving a current of at least 10 A (a.c. or d.c.).		P
	The current is passed between each exposed conductive part and the terminal for the external protective conductor. The resistance does not exceed 0,1 Ω		P
10.5.3	**Short-circuit withstand strength of the protective circuit**		**P**
	The short-circuit withstand strength is verified.		P
	The original manufacturer determines the reference design(s) that will be used in 10.5.3.3 and 10.5.3.4.		P
10.5.3.2	**Protective circuits that are exempted from short-circuit withstand verification**		**P**
	Where a separate protective conductor is provided in accordance with 8.4.3.2.3, short-circuit testing is not required if one of the conditions of 10.11.2. is fulfilled.		P
10.5.3.3	**Verification by comparison with a reference design – Utilising a check list**		N/A
	Verification by design rules is achieved when comparison of the ASSEMBLY to be verified with an already tested design utilising items 1 to 6 and 8 to 10 of the check list in Table 13 shows no deviations.		N/A
10.5.3.4	**Verification by comparison with a reference design – Utilising calculation**		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	Verification by comparison with a reference design based on calculation is to be in accordance with 10.11.4		N/A
10.5.3.5	**Verification by test**		N/A
	Subclause 10.11.5.6 applies.		N/A
10.6	**INCORPORATION OF SWITCHING DEVICES AND COMPONENTS**		**P**
	Compliance with the design requirements of 8.5 for the incorporation of switching devices and components is confirmed by inspection and verified to the requirements of this standard.		P
10.6.2	**Electromagnetic compatibility**		**N/A**
	The performance requirements of J.9.4 for electromagnetic compatibility is confirmed by inspection or where necessary by test (see J.10.12).		N/A
10.7	**INTERNAL ELECTRICAL CIRCUITS AND CONNECTIONS**		**P**
	Compliance with the design requirements of 8.6 for internal electrical circuits and connections is confirmed by inspection and verified to this standard.		P
10.8	**TERMINALS FOR EXTERNAL CONDUCTORS**		**P**
	Compliance with the design requirements of 8.8 for terminals for external conductors is confirmed by inspection.		P
10.9	**DIELECTRIC PROPERTIES**		**P**
10.9.1	**General**		**P**
	For this test, all the electrical equipment of the ASSEMBLY is connected, except those items of apparatus which, according to the relevant specifications, are designed for a lower test voltage; current-consuming apparatus (e.g. windings, measuring instruments, voltage surge suppression devices) in which the application of the test voltage would cause the flow of a current, are disconnected.		P
	Such apparatus are disconnected at one of their terminals unless they are not designed to withstand the full test voltage, in which case all terminals may be disconnected.		P
10.9.2	**Power-frequency withstand voltage**		**P**
10.9.2.1	**Main, auxiliary and control circuits**		**P**
	Main, auxiliary and control circuits that are connected to the main circuit are subjected to the test voltage according to Table 8.		P

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Clause	Requirement + Test	Result - Remark	Verdict
	Auxiliary and control circuits, whether a.c. or d.c., that are not connected to the main circuit are subjected to the test voltage according to Table 9.		N/A
10.9.2.2	**Test voltage**		**P**
	The test voltage has a practically sinusoidal waveform and a frequency between 45 Hz and 65 Hz.		P
	The high-voltage transformer used for the test is so designed that, when the output terminals are short-circuited after the output voltage has been adjusted to the appropriate test voltage, the output current is at least 200 mA.		P
	The overcurrent relay does not trip when the output current is less than 100 mA.		P
	The value of the test voltage is that specified in Table 8 or 9 as appropriate with a permitted tolerance of ±3 %.		P
10.9.2.3	**Application of the test voltage**		**P**
	The power frequency voltage at the moment of application does not exceed 50 % of the full test value. It is then be increased progressively to this full value and maintained for 5 s as follows:		P
	a) between all live parts of the main circuit connected together (including the control and auxiliary circuits connected to the main circuit) and exposed conductive parts, with the main contacts of all switching devices in the closed position or bridged by a suitable low resistance link		P
	b) between each live part of different potential of the main circuit and, the other live parts of different potential and exposed conductive parts connected together, with the main contacts of all switching devices in the closed position or bridged by a suitable low resistance link;		P
	c) between each control and auxiliary circuit not normally connected to the main circuit and the – main circuit; – other circuits; – exposed conductive parts including the earthed enclosure.		N/A
	The overcurrent relay does not operate and there are no disruptive discharge (see 3.6.18) during the tests.		P
10.9.3	**Impulse withstand voltage**		**P**
10.9.3.1	**General**		**-**

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Clause	Requirement + Test	Result - Remark	Verdict
	Verification shall be made by test or by assessment		P
	In place of the impulse withstand voltage test the original manufacturer may perform, at his discretion, an equivalent a.c. or d.c. voltage test, in accordance with 10.9.3.3 or 10.9.3.4, but consideration is given to the fact that such a tests exert a higher stress.		P
10.9.3.2	**Impulse withstand voltage test**		**P**
	The impulse voltage generator is adjusted to the required impulse voltage with the ASSEMBLY connected. The value of the test voltage is that specified in 9.1.3. The accuracy of the applied peak voltage is ±3 %.		P
	Impulse withstand voltage (Uimp) ..... :	4kV	P
	Auxiliary circuits not connected to main circuits are connected to earth.		N/A
	The 1,2/50 µs impulse voltage is applied to the ASSEMBLY five times for each polarity at intervals of 1 s minimum as follows:		P
	a) between all live parts of the main circuit connected together (including the control and auxiliary circuits connected to the main circuit) and exposed conductive parts, with the main contacts of all switching devices in the closed position or bridged by a suitable low resistance link		P
	b) between each live part of different potential of the main circuit and, the other live parts of different potential and exposed conductive parts connected together, with the main contacts of all switching devices in the closed position or bridged by a suitable low resistance link;		P
	For an acceptable result there are no unintentional disruptive discharge during the tests.		P
	The impulse withstand voltage capability of the isolating distance between the withdrawable units' main contacts and their associated fixed contacts are verified to confirm compliance with 8.3.2.		N/A
10.9.3.3	**Alternative power-frequency voltage test**		N/A
	The test voltage has a practically sinusoidal waveform and a frequency between 45 Hz and 65 Hz.		N/A
	The overcurrent relay does not trip when the output current is less than 100 mA.		N/A
	The value of the test voltage is that specified in 9.1.3 and Table 10 as appropriate with a permitted tolerance of ±3 %.		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	Power-frequency ..... :		N/A
	The power-frequency voltage is applied once, at full value, for a duration sufficient for the magnitude to be ascertained, but it is not less than 15 ms.		N/A
	It is applied:		N/A
	a) between all live parts of the main circuit connected together (including the control and auxiliary circuits connected to the main circuit) and exposed conductive parts, with the main contacts of all switching devices in the closed position or bridged by a suitable low resistance link		N/A
	b) between each live part of different potential of the main circuit and, the other live parts of different potential and exposed conductive parts connected together, with the main contacts of all switching devices in the closed position or bridged by a suitable low resistance link;		N/A
	c) between each control and auxiliary circuit not normally connected to the main circuit and the – main circuit; – other circuits; – exposed conductive parts including the earthed enclosure.		N/A
	For an acceptable result the overcurrent relay does not operate and there is no disruptive discharge during the tests.		N/A
10.9.3.4	**Alternative d.c. voltage test**		N/A
	The test voltage has negligible ripple.		N/A
	The high-voltage source used for the test is so designed that, when the output terminals are short-circuited after the output voltage has been adjusted to the appropriate test voltage, the output current is at least 200 mA.		N/A
	The overcurrent relay does not trip when the output current is less than 100 mA.		N/A
	The value of the test voltage is that specified in 9.1.3 and Table 10 as appropriate with a permitted tolerance of ±3 %.		N/A
	Alternative d.c. voltage ..... :		N/A
	The d.c. voltage is applied once for each polarity for a duration sufficient for the magnitude to be ascertained, but it isl not less than 15 ms or greater than 100 ms.		N/A
	It is applied:		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	a) between all live parts of the main circuit connected together (including the control and auxiliary circuits connected to the main circuit) and exposed conductive parts, with the main contacts of all switching devices in the closed position or bridged by a suitable low resistance link		N/A
	b) between each live part of different potential of the main circuit and, the other live parts of different potential and exposed conductive parts connected together, with the main contacts of all switching devices in the closed position or bridged by a suitable low resistance link;		N/A
	c) between each control and auxiliary circuit not normally connected to the main circuit and the – main circuit; – other circuits; – exposed conductive parts including the earthed enclosure.		N/A
	For an acceptable result the overcurrent relay does not operate and there is no disruptive discharge during the tests.		N/A
10.9.3.5	**Verification assessment**		**P**
	Clearances are verified by measurement, or verification of measurements on design drawings, employing the measurement methods stated in Annex F.		P
	The clearances are at least 1,5 times the values specified in Table 1.		N/A
	It is verified by assessment of the device manufacturer's data that all incorporated devices are suitable for the specified rated impulse withstand voltage (Uimp).		P
10.9.4	**Testing of enclosures made of insulating material**		N/A
	For ASSEMBLIES with enclosures made of insulating material, an additional dielectric test is carried out by applying an a.c. test voltage between a metal foil laid on the outside of the enclosure over openings and joints, and the interconnected live and exposed conductive parts within the ASSEMBLY located next to the openings and joints.		N/A
	For this additional test, the test voltage is equal to 1,5 times the values indicated in Table 8.		N/A
10.9.5	**External operating handles of insulating material**		**N/A**

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Clause	Requirement + Test	Result - Remark	Verdict
	A dielectric test is carried out on handles made of or covered by insulating material by applying a test voltage equal to 1,5 times the test voltage indicated in Table 8 between the live parts and a metal foil wrapped round the whole surface of the handle.		N/A
10.10	**VERIFICATION OF TEMPERATURE RISE**		**P**
10.10.1	**General**		**P**
	It is verified that the temperature-rise limits specified in 9.2 for the different parts of the ASSEMBLY or ASSEMBLY system will not be exceeded.		P
	Verification is made by one or more of the following methods:		P
	a) testing (10.10.2);		P
	b) derivation (from a tested design) of ratings for similar variants (10.10.3); or		N/A
	c) calculation (10.10.4).		N/A
	In ASSEMBLIES rated for frequencies above 60 Hz verification of temperature rise by test (10.10.2) or by derivation from a similar design tested at the same intended frequency (10.10.3) is always required.		N/A
10.10.2	**Verification by testing**		P
10.10.2.1	**General**		P
	1) If the ASSEMBLY to be verified comprises a number of variants, the most onerous arrangement(s) of the ASSEMBLY is selected according to 10.10.2.2.		P
	2) The ASSEMBLY is verified by one of the following methods:		P
	a) considering individual functional units, the main and distribution busbars and the ASSEMBLY collectively according to 10.10.2.3.5;		P
	b) considering individual functional units separately and the complete ASSEMBLY including the main and distribution busbars according to 10.10.2.3.6;		N/A
	c) considering individual functional units and the main and distribution busbars separately as well as the complete ASSEMBLY according to 10.10.2.3.7.		N/A
	3) When the ASSEMBLIES tested are the most onerous variants out of a larger product range then the test results can be used to establish the ratings of similar variants without further testing. Rules for such derivations are given in 10.10.3		P

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Clause	Requirement + Test	Result - Remark	Verdict
10.10.2.2	**Selection of the representative arrangement**		N/A
	The test is made on one or more representative arrangements loaded with one or more representative load combinations chosen to obtain with reasonable accuracy the highest possible temperature rise.		N/A
	The selection of the representative arrangements to be tested is given in 10.10.2.2.2 and 10.10.2.2.3 and is the responsibility of the original manufacturer		N/A
	The original manufacturer takes into consideration in his selection for test, the configurations to be derived from the tested arrangements according to 10.10.3		N/A
10.10.2.2.2	**Busbars**		**N/A**
	variants of which differ only in the reduction of height, or reduction of thickness or quantity of bars per conductor, but which have the same arrangement of bars, the same conductor spacing, the same enclosure and busbar compartment (if any), as a minimum for the test, the busbars with the greatest cross-sectional area is selected as the representative arrangement.		N/A
	For ratings of smaller busbar size variants or other materials see 10.10.3.3.		N/A
10.10.2.2.3	**Functional units**		**N/A**
	a) Selection of comparable functional unit groups		**N/A**
	Functional units intended to be used at different rated currents can be considered to have a similar thermal behaviour and form a comparable range of units, if they fulfil the following conditions:		N/A
	1) the function and basic wiring diagram of the main circuit is the same (e.g. incoming unit, reversing starter, cable feeder);		N/A
	2) the devices are of the same frame size and belong to the same series;		N/A
	3) the mounting structure is of the same type;		N/A
	4) the mutual arrangement of the devices is the same;		N/A
	5) the type and arrangement of conductors is the same;		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	6) the cross-section of the main circuit conductors within a functional unit has a rating at least equal to that of the lowest rated device in the circuit. Selection of conductors are as tested or in accordance with IEC 60364-5-52. Examples on how to adapt this standard for conditions inside an ASSEMBLY are given in the tables included in Annex H.		N/A
	b) Selection of a critical variant out of each comparable group as a specimen for test		**N/A**
	For the critical variant the most onerous compartment (where applicable) and enclosure conditions (with respect to shape, size, design of partitions and enclosure ventilation) is tested.	Tested as delivered	N/A
	The maximum possible current rating for each variant of functional unit is established.		N/A
	For functional units containing only one device this is the rated current of the device.		N/A
	For functional units with several devices, it is that of the device with the lowest rated current.		N/A
	If a combination of devices connected in series is intended to be used at a lower current (e.g. motor starter combination), this lower current is used.		N/A
	For each functional unit the power loss is calculated at the maximum possible current using the data given by the device manufacturer for each device together with the power losses of the associated conductors.		N/A
	For functional units with currents up to and including 630 A, the critical unit in each range is the functional unit with the highest total power loss.		N/A
	For functional units with currents above 630 A the critical unit in each range is that which has the highest rated current. This ensures that additional thermal effects relating to eddy currents and current displacement are taken into consideration.		N/A
	The critical functional unit is at least tested inside the smallest compartment (if any) which is intended for this functional unit; and with the worst variant of internal separation (if any) with respect to size of ventilation openings; and the enclosure with the highest installed power loss per volume; and the worst variant of ventilation of the enclosure with respect to kind of ventilation (natural or forced convection) and size of ventilation openings.		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	If the functional unit can be arranged in different orientations (horizontal, vertical), then the most onerous arrangement is tested.		N/A
10.10.2.3	**Methods of test**		**P**
	The temperature-rise test on the individual circuits is made with the type of current for which they are intended, and at the design frequency.		P
	Coils of relays, contactors, releases, etc., are supplied with rated operational voltage		P
	The ASSEMBLY is mounted as in normal use, with all covers including bottom cover plates, etc., in place.		P
	If the ASSEMBLY includes fuses, these are fitted for the test with fuse-links as specified by the manufacturer.		N/A
	The power losses of the fuse-links used for the test are stated		N/A
	The size and the disposition of external conductors used for the test are stated in the test report.		P
	The test is made for a time sufficient for the temperature rise to reach a constant value. In practice, this condition is reached when the variation at all measured points (including the ambient air temperature) does not exceed 1 K/h.		P
	To shorten the test, if the devices allow it, the current may be increased during the first part of the test, it being reduced to the specified test current afterwards.		N/A
	When a control electro-magnet is energized during the test, the temperature is measured when thermal equilibrium is reached in both the main circuit and the control electro-magnet.		N/A
	Temperature-rise tests on the circuit(s) carried out at 50 Hz are applicable to 60 Hz for rated currents up to and including 800 A.		N/A
	For currents above 800 A, the rated current at 60 Hz is reduced to 95 % of that at 50 Hz.		N/A
	Alternatively, where the maximum temperature rise at 50 Hz does not exceed 90 % of the permissible value, then de-rating for 60 Hz is not required.		N/A
	Tests on an individual section of the ASSEMBLY are acceptable provided the conditions of 10.10.2.2 are met.		P

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Clause	Requirement + Test	Result - Remark	Verdict
	To make the test representative the external surfaces at which additional sections may be connected are thermally insulated with a covering to prevent any undue cooling.		P
	When testing individual functional units within a section, the adjacent functional units can be replaced by heating resistors if the rating of each does not exceed 630 A and their rating is not to be verified with this test.		N/A
	In ASSEMBLIES where there is a possibility that additional control circuits or devices may be incorporated, heating resistors simulate the power dissipation of these additional items.		N/A
10.10.2.3.2	**Test conductors**		**P**
	In the absence of detailed information concerning the external conductors and the service conditions, the cross-section of the external test conductors are in accordance with the following.		P
	1) **For values of rated current up to and including 400 A:**		**P**
	a) the conductors are single-core, copper cables or insulated wires with cross-sectional areas as given in Table 11;		P
	b) as far as practicable, the conductors are in free air;		P
	c) the minimum length of each temporary connection from terminal to terminal is: – 1 m for cross-sections up to and including 35 mm2; – 2 m for cross-sections larger than 35 mm2.		P
	2) **For values of rated current higher than 400 A but not exceeding 800 A:**		N/A
	a) The conductors are single-core copper cables with cross-sectional areas as given in Table 12, or the equivalent copper bars given in Table 12 as specified by the original manufacturer.		N/A
	b) Cables or copper bars are spaced at approximately the distance between terminals. Multiple parallel cables per terminal are bunched together and arranged with approximately 10 mm air space between each other. Multiple copper bars per terminal are spaced at a distance approximately equal to the bar thickness. If the sizes stated for the bars are not suitable for the terminals or are not available, it is allowed to use other bars having the same cross-sectional dimensions 10 % and the same or smaller cooling surfaces. Cables or copper bars are not interleaved.		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	c) For single-phase or multi-phase tests, the minimum length of any temporary connection to the test supply is 2 m. The minimum length to a star point may be reduced to 1,2 m where agreed by the original manufacturer.		N/A
	3) **For values of rated current higher than 800 A but not exceeding 4000 A:**		N/A
	a) The conductors are copper bars of the sizes stated in Table 12 unless the ASSEMBLY is designed only for cable connection. In this case, the size and arrangement of the cables are as specified by the original manufacturer.		N/A
	b) Copper bars are spaced at approximately the distance between terminals. Multiple copper bars per terminal are spaced at a distance approximately equal to the bar thickness. If the sizes stated for the bars are not suitable for the terminals or are not available, it is allowed to use other bars having the same cross-sectional dimensions 10 % and the same or smaller cooling surfaces. Copper bars are not interleaved.		N/A
	c) For single-phase or multi-phase tests, the minimum length of any temporary connection to the test supply is 3 m, but this can be reduced to 2 m provided that the temperature rise at the supply end of the connection is not more than 5 K below the temperature rise in the middle of the connection length. The minimum length to a star point is 2 m.		N/A
	4) **For values of rated current higher than 4 000 A:**		N/A
	The original manufacturer determines all relevant items of the test, such as type of supply, number of phases and frequency (where applicable), cross-sections of test conductors, etc. This information is part of the test report.		N/A
10.10.2.3.3	**Measurement of temperatures**		**P**
	Thermocouples or thermometers are used for temperature measurements.		P
	For windings, the method of measuring the temperature by resistance variation is used.		N/A
	The thermometers or thermocouples is protected against air currents and heat radiation.		P
	The temperature is measured at all points where a temperature-rise limit (see 9.2) must be observed.		P
	Particular attention is given to joints in conductors and terminals within the main circuits.		P

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Clause	Requirement + Test	Result - Remark	Verdict
	For measurement of the temperature of air inside an ASSEMBLY, several measuring devices are arranged in convenient places.		P
10.10.2.3.4	**Ambient air temperature**		P
	The ambient air temperature is measured by means of at least two thermometers or thermocouples equally distributed around the ASSEMBLY at approximately half its height and at a distance of approximately 1 m from the ASSEMBLY.		P
	The thermometers or thermocouples are protected against air currents and heat radiation.		P
	The ambient temperature during the test is between +10 °C and +40 °C.		P
10.10.2.3.5	**Verification of the complete ASSEMBLY**		**P**
	Incoming and outgoing circuits of the ASSEMBLY are loaded with their rated currents that result in the rated diversity factor being equal to 1.		P
	If the rated current of the incoming circuit or distribution busbar system is less than the sum of the rated currents of all outgoing circuits, then the outgoing circuits shall be split into groups corresponding to the rated current of the incoming circuit or distribution busbar system.		P
	The groups are formed in a manner so that the highest possible temperature rise is obtained.		P
	Sufficient groups are formed and tests undertaken so as to include all different variants of functional units in at least one group.		P
	Where the fully loaded circuits do not distribute exactly the total incoming current, the remaining current is distributed via any other appropriate circuit.		N/A
	This test is repeated until all types of outgoing circuit have been verified at their rated current.		P
	Change in the arrangement of functional units within a verified ASSEMBLY, or section of an ASSEMBLY may necessitate additional tests as the thermal influence of the adjacent units may differ significantly.		N/A
10.10.2.3.6	**Verification considering individual functional units separately and the complete ASSEMBLY**		N/A
	The rated currents of the circuits according to 5.3.2 and the rated diversity factor according to 5.3.3 are verified in two stages.		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	Individual functional units are verified separately in accordance with 10.10.2.3.7 c).		N/A
	The ASSEMBLY is verified by loading the incoming circuit to its rated current and all outgoing functional units collectively to their rated current multiplied by the diversity factor.		N/A
	If the rated current of the incoming circuit or distribution busbar system is less than the sum of the test currents of all outgoing circuits (i.e. the rated currents multiplied by the diversity factor), then the outgoing circuits shall be split into groups corresponding to the rated current of the incoming circuit or distribution busbar system.		N/A
	The groups as defined by the original manufacturer are formed in a manner so that the highest possible temperature rise is obtained.		N/A
	Sufficient groups are formed and tests undertaken so as to include all different variants of functional units in at least one group.		N/A
	Where the fully loaded circuits do not distribute exactly the total incoming current, the remaining current is distributed via any other appropriate circuit.		N/A
	This test is repeated until all types of outgoing circuit have been verified at their rated current.		N/A
	Change in the arrangement of functional units within a verified ASSEMBLY, or section of an ASSEMBLY may necessitate additional tests as the thermal influence of the adjacent units may differ significantly.		N/A
10.10.2.3.7	**Verification considering individual functional units and the main and distribution busbars separately as well as the complete ASSEMBLY**		N/A
	ASSEMBLIES are verified by separate verification of standard elements (a) to c)) as selected in accordance with 10.10.2.2.2 and 10.10.2.2.3, and verification of a complete ASSEMBLY (d)) under worst case conditions as detailed below:		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	a) Main busbars are tested separately. They are mounted in the ASSEMBLY enclosure as in normal use with all covers and all partitions that separate the main busbars from other compartments, in place. If the main busbar has joints, then they are included in the test. The test is carried out at rated current. The test current passes through the full length of the busbars. Where the design of the ASSEMBLY permits, and, to minimise the influence of the external test conductors on the temperature rise, the length of the main busbar within the enclosure for the test has a minimum of 2 m and include a minimum of one joint when the busbars are extendable.		N/A
	b) Distribution busbars are tested separately from the outgoing units. They are mounted in the enclosure as in normal use with all covers and all partitions that separate the busbar from other compartments, in place. Distribution busbars are connected to the main busbar. No other conductors, e.g. connections to functional units, are connected to the distribution busbar. In order to consider the most onerous condition, the test is carried out at rated current and the test current passes through the full length of the distribution busbar. If the main busbar is rated for a higher current, it is fed with additional current so that it carries its rated current to its junction with the distribution busbar.		N/A
	c) Functional units are tested individually. The functional unit is mounted in the enclosure as in normal use with all covers and all internal partitions in place. If it can be mounted at different places the most unfavourable place is used. It is connected to the main or the distribution busbar as in normal use. If the main busbar and/or the distribution busbar (if any) are rated for a higher current, they are fed with additional currents so that they carry their individual rated currents to the respective junction points. The test is carried out at rated current for the functional unit.		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	d) The complete ASSEMBLY shall be verified by temperature rise testing of the most onerous arrangement(s) possible in service and as defined by the original manufacturer. For this test the incoming circuit is loaded to its rated current and each outgoing functional unit to its rated current multiplied by the rated diversity factor. The groups shall be formed in a manner so that the highest possible temperature rise is obtained. Sufficient groups shall be formed and tests undertaken so as to include all different variants of functional units in at least one group.		N/A
10.10.2.3.8	**Results to be obtained**		P
	At the end of the test, the temperature rise does not exceed the values specified in Table 6.	See table	P
	The apparatus operates satisfactorily within the voltage limits specified for them at the temperature inside the ASSEMBLY.		P
10.10.3	**Derivation of ratings for similar variants**		N/A
10.10.3.2	**ASSEMBLIES**		N/A
	The ASSEMBLY that incorporates non-tested variants are verified by derivation from similar tested arrangements.		N/A
	ASSEMBLIES verified in this manner comply with the following:		N/A
	a) the functional units belong to the same group as the functional unit selected for test (see 10.10.2.2.3);		N/A
	b) the same type of construction as used for the test;		N/A
	c) the same or increased overall dimensions as used for the test;		N/A
	d) the same or increased cooling conditions as used for the test (forced or natural convection, same or larger ventilation openings);		N/A
	e) the same or reduced internal separation as used for the test (if any);		N/A
	f) the same or reduced power losses in the same section as used for the test;		N/A
	g) the same or reduced number of outgoing circuits for every section		N/A
	The ASSEMBLY being verified may comprise all or only part of the electrical circuits of the ASSEMBLY previously verified.		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	Alternative arrangement(s) of functional units within the ASSEMBLY or section compared to the tested variant is allowed as long as the thermal influences of the adjacent units are not more severe.		N/A
	Thermal tests performed on 3-phase, 3-wire ASSEMBLIES are considered as representing 3-phase, 4-wire and single-phase, 2-wire or 3-wire ASSEMBLIES, provided that the neutral conductor is sized equal to or greater than the phase conductors arranged in the same manner.		N/A
10.10.3.3	**Busbars**		**N/A**
	Ratings established for aluminium busbars are valid for copper busbars with the same cross sectional dimensions and configuration.	Copper busbar	N/A
	The ratings of variants not selected for test according to 10.10.2.2.2 are determined by multiplying their cross-section with the current density of a larger cross-section busbar that has been verified by test.		N/A
10.10.3.4	**Functional units**		**N/A**
	After the critical variants of a group of comparable functional units (see 10.10.2.2.3 a)) have been subjected to a test for verification of temperature rise limits, the actual rated currents of all other functional units in the group are calculated using the results of these tests.		N/A
	For each functional unit tested a de-rating factor (rated current, resulting from the test divided by the maximum possible current of this functional unit, see 10.10.2.2.3 b)) is calculated.		N/A
	The rated current of each non-tested functional unit in the range is the maximum possible current of the functional unit multiplied by the lowest de-rating factor established for the variants tested in the range.		N/A
10.10.3.5	**Functional units – Device substitution**		N/A
	A device may be substituted with a similar device from another series to that used in the original verification, provided that the power loss and terminal temperature rise of the device, when tested in accordance with its product standard, is the same or lower.		N/A
	In addition, the physical arrangement within the functional unit and the rating of the functional unit is maintained.		N/A
10.10.4	**Verification by calculation**		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	Determine the approximate air temperature rise inside the enclosure, which is caused by the power losses of all circuits, and compare this temperature with the limits for the installed equipment.		N/A
	Because the actual local temperatures of the current-carrying parts cannot be calculated by these methods, some limits and safety margins are necessary and are included.		N/A
10.10.4.2	**Single compartment assembly with rated current not exceeding 630 A**		**N/A**
	Verification of the temperature rise of a single compartment ASSEMBLY with the total supply current not exceeding 630 A and for rated frequencies up to and including 60 Hz may be made by calculation if all the following conditions are fulfilled:		-
	a) the power loss data for all built-in components is available from the component manufacturer;		N/A
	b) there is an approximately even distribution of power losses inside the enclosure;		N/A
	c) the rated current of the circuits of the ASSEMBLY as verified (see 10.10.1) does not exceed 80 % of the rated conventional free air thermal current (Ith) if any, or the rated current (In) of the switching devices and electrical components included in the circuit. Circuit protection devices shall be selected to ensure adequate protection to outgoing circuits, e.g. thermal motor protection devices at the calculated temperature in the ASSEMBLY;		N/A
	d) the mechanical parts and the installed equipment are so arranged that air circulation is not significantly impeded;		N/A
	e) conductors carrying currents in excess of 200 A, and the adjacent structural parts are so arranged that eddy-current and hysteresis losses are minimised;		N/A
	f) all conductors have a minimum cross-sectional area based on the current rating of the functional unit according to IEC 60364-5-52. Examples on how to adapt this standard for conditions inside an ASSEMBLY are given in the tables included in Annex H. Where the device manufacturer specifies a conductor with a larger cross sectional area this is used;		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	g) the temperature rise depending on the power loss installed in the enclosure for the different installation methods (e.g. flush mounting, surface mounting), is: – available from the enclosure manufacturer; – determined in accordance with 10.10.4.2.2; or – in accordance with performance and installation criteria from the cooling equipment manufacturer when active cooling (e.g. forced cooling, internal air conditioning, heat exchanger etc.) is incorporated.		N/A
	The effective power losses of all circuits including interconnecting conductors are calculated based on maximum load currents of the circuits.		N/A
	The total power loss of the ASSEMBLY is calculated by adding the power losses of the circuits taking additionally into account that the total load current is limited to the rated current of the ASSEMBLY.		N/A
	The power losses of the conductors are determined by calculation (see Annex H).		N/A
10.10.4.2.2	**Determination of the power loss capability of an enclosure by test**		N/A
	The power loss is simulated by means of heating resistors that produce heat equivalent to the intended power loss capability of the enclosure.		N/A
	The heating resistors are distributed evenly over the height of the enclosure and installed in suitable places inside the enclosure.		N/A
	The cross-section of the leads to these resistors are such that no appreciable amount of heat is conducted away from the enclosure.		N/A
	The test is carried out in accordance with 10.10.2.3.1 –10.10.2.3.4 and the air temperature rise is measured in the top of the enclosure.		N/A
	Enclosure temperatures do not exceed the values given in Table 6.		N/A
10.10.4.2.3	**Results to be obtained**		N/A
	The ASSEMBLY is verified if the air temperature determined from the calculated power loss does not exceed the permissible operating air temperature as declared by the device manufacturer.		N/A
	This means for switching devices or electrical components in the main circuits that the continuous load does not exceed its permissible load at the calculated air temperature and not more than 80 % of its rated current		N/A
10.10.4.3	**ASSEMBLY with rated current not exceeding 1 600 A**		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
10.10.4.3.1	**Verification method**		N/A
	Verification of the temperature-rise of a multiple compartment ASSEMBLY with the total supply current not exceeding 1 600 A and for rated frequencies up to and including 60 Hz, may be made by calculation in accordance with the method of IEC 60890 if all the following conditions are fulfilled:		-
	a) the power loss data for all built-in components is available from the component manufacturer;		N/A
	b) there is an approximately even distribution of power losses inside the enclosure;		N/A
	c) the rated current of the circuits of the ASSEMBLY as verified (see 10.10.1) do not exceed 80 % of the rated conventional free air thermal current (Ith) if any, or the rated current (In) of the switching devices and electrical components included in the circuit.		N/A
	d) the mechanical parts and the installed equipment are so arranged that air circulation is not significantly impeded;		N/A
	e) conductors carrying currents in excess of 200 A, and the adjacent structural parts are so arranged that eddy-current and hysteresis losses are minimised;		N/A
	f) all conductors have a minimum cross-sectional area based on the current rating of the functional unit according to IEC 60364-5-52. Examples on how to adapt this standard for conditions inside an ASSEMBLY are given in the tables included in Annex H.		N/A
	Where the device manufacturer specifies a conductor with a larger cross sectional area this conductor is used;		N/A
	g) for enclosures with natural ventilation, the cross section of the air outlet openings is at least 1,1 times the cross section of the air inlet openings;		N/A
	h) there are no more than three horizontal partitions in the ASSEMBLY or a section of an ASSEMBLY;		N/A
	i) for enclosures with compartments and natural ventilation the cross section of the ventilating openings in each horizontal partition is at least 50 % of the horizontal cross section of the compartment.		N/A
	The effective power losses of all circuits including interconnecting conductors are calculated based on maximum load currents of the circuits.		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	The total power loss of the ASSEMBLY is calculated by adding the power losses of the circuits taking additionally into account that the total load current is limited to the rated current of the ASSEMBLY.		N/A
	The power losses of the conductors are determined by calculation (see Annex H).	See attachment xxx	N/A
	The temperature rise within the ASSEMBLY is then determined from the total power loss using the method of IEC 60890.		N/A
10.10.4.3.2	**Results to be obtained**		N/A
	The ASSEMBLY is verified if the calculated air temperature at the mounting height of any device does not exceed the permissible ambient air temperature as declared by the device manufacturer.		N/A
	Switching devices or electrical components in the main circuits that the continuous load do not exceed its permissible load at the calculated local air temperature and not more than 80 % of its rated current		N/A
10.11	**SHORT-CIRCUIT WITHSTAND STRENGTH**		P
	The short-circuit withstand strength declared is verified. Verification may be by the application of design rules, by calculation or by test.		P
10.11.3	**Verification by comparison with a reference design – Utilising a check list**		N/A
	Verification by the application of design rules is undertaken by comparison of the assembly to be verified with an already tested design using the check list provided in Table 13.		N/A
10.11.4	**Verification by comparison with a reference design – Utilising a check list**		N/A
	Assessment of the rated short-time withstand current of an ASSEMBLY and its circuits, by calculation and the application of design rules, is undertaken by a comparison of the ASSEMBLY to be assessed with an ASSEMBLY or an ASSEMBLY module, already verified by test.		N/A
	The assessment is in accordance with IEC/TR 61117.		N/A
	In addition each of the circuits of the ASSEMBLY to be assessed meets the requirements of items 6, 8, 9 and 10 in Table 13.		N/A
	The data used, calculations made and comparison undertaken are recorded.		N/A
10.11.5	**Verification by test**		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	The ASSEMBLY or its parts as necessary to complete the test are mounted as in normal use.		N/A
	It is sufficient to test a single functional unit if the remaining functional units are of the same construction.		N/A
	Similarly it is sufficient to test a single busbar configuration if the remaining busbar configurations are of the same construction.		N/A
10.11.5.2	**Performance of the test – General**		N/A
	If the test circuit incorporates fuses, fuse-links with the maximum let-through current and, if required, of the type indicated by the original manufacturer as being acceptable, they are used.		N/A
	The supply conductors and the short-circuit connections required for testing the ASSEMBLY have sufficient strength to withstand short-circuits and be so arranged that they do not introduce any additional stresses on the ASSEMBLY.		N/A
	Unless otherwise agreed, the test circuit is connected to the input terminals of the ASSEMBLY. Three-phase ASSEMBLIES are connected on a three-phase basis.		N/A
	All parts of the equipment intended to be connected to the protective conductor in service, including the enclosure, are connected as follows:		N/A
	1) for ASSEMBLIES suitable for use on three-phase four-wire systems (see also IEC 60038) with an earthed star point and marked accordingly, to the neutral point of supply or to a substantially inductive artificial neutral permitting a prospective fault current of at least 1500 A;		N/A
	2) for ASSEMBLIES also suitable for use in three-phase three-wire as well as on three-phase four-wire systems and marked accordingly, to the phase conductor least likely to arc to earth.		N/A
	The connection mentioned in 1) and 2) include a fusible element consisting of a copper wire of 0,8 mm diameter and at least 50 mm long, or of an equivalent fusible element for the detection of a fault current.		N/A
10.11.5.3	**Testing of main circuits**		N/A
	Circuits are tested with the highest thermal and dynamic stresses that may result from short circuit currents up to the rated values for one or more of the following conditions as declared by the original manufacturer.		N/A

IEC 61439-2			
Clause	Requirement + Test	Result - Remark	Verdict
	a). Not dependent upon a SCPD. The ASSEMBLY is tested with the rated peak withstand current and the rated short-time withstand current for the specified duration		N/A
	b). Dependent upon an incoming SCPD included within the ASSEMBLY. The assembly is tested with an incoming prospective short-circuit current for a period time that is limited by the incoming SCPD.		N/A
	c). Dependent upon an upstream SCPD. The ASSEMBLY is tested to the let through values permitted by the upstream SCPD as defined by the original manufacturer.		N/A
	Where an incoming or outgoing circuit includes a SCPD that reduces the peak and/or duration of the fault current, then the circuit is tested allowing the SCPD to operate and interrupt the fault current		N/A
	If the SCPD contains an adjustable short-circuit release, then this is set to the maximum allowed value		N/A
	One of each type of circuit is subject to a short-circuit test		N/A
10.11.5.3.2	**Outgoing circuits**		N/A
	The outgoing terminals of outgoing circuits are provided with a bolted short-circuit connection.		N/A
	When the protective device in the outgoing circuit is a circuit-breaker, the test circuit may include a shunting resistor in accordance with 8.3.4.1.2 b) of IEC 60947-1 in parallel with the reactor used to adjust the short-circuit current.		N/A
	For circuit-breakers having a rated current up to and including 630 A, a conductor 0,75 m in length having a cross-sectional area corresponding to the rated current (see Tables 11 and 12) is included in the test circuit.		N/A
	The switching device is closed and held closed in the manner normally used in service. The test voltage is then applied once and,		N/A
	a) for a time sufficiently long to enable the short-circuit protective device in the outgoing unit to operate to clear the fault and, in any case, for not less than 10 cycles (test voltage duration), or		N/A
	b) in cases where the outgoing circuit does not include a SCPD, for a magnitude and duration as specified for the busbars by the original manufacturer. Testing of outgoing circuits may also result in the operation of the incoming circuit SCPD.		N/A

IEC 61439-2			
Clause	Requirement + Test	Result - Remark	Verdict
10.11.5.3.3	**Incoming circuit and main busbars**		N/A
	ASSEMBLIES containing main busbars are tested to prove the short-circuit withstand strength of the main busbars and the incoming circuit including at least one joint where the busbars are intended to be extendable.		N/A
	The short-circuit is placed such that the length of main busbar included in the test is (2 0,4) m.		N/A
	For the verification of rated short-time withstand current (see 5.3.5) and rated peak withstand current (see 5.3.4), this distance may be increased and the test conducted at any convenient voltage providing the test current is the rated value		N/A
	Where the design of the ASSEMBLY is such that the length of the busbars to be tested is less than 1,6 m and the ASSEMBLY is not intended to be extended, then the complete length of busbar is tested, the short-circuit being established at the end of these busbars.		N/A
	If a set of busbars consists of different sections (as regards cross-sections, distance between adjacent busbars, type and number of supports per metre), each section is tested separately or concurrently, provided that the above conditions are met.		N/A
10.11.5.3.4	**Connections to the supply side of outgoing units**		N/A
	Where an ASSEMBLY contains conductors between a main busbar and the supply side of outgoing functional units that do not fulfil the requirements of 8.6.4 one circuit of each type is subject to an additional test.		N/A
	A short-circuit is obtained by bolted connections on the conductors connecting the busbars to a single outgoing unit, as near as practicable to the terminals on the busbar side of the outgoing unit. The value of the short-circuit current is the same as that for the main busbars.		N/A
10.11.5.3.5	**Neutral conductor**		N/A
	If a neutral conductor exists within a circuit it is subjected to one test to prove its short-circuit withstand strength in relation to the nearest phase conductor of the circuit under test including any joints.		N/A
	Unless otherwise agreed between the original manufacturer and the User, the value of the test current in the neutral is at least 60 % of the phase current during the three-phase test.		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	The test need not be executed if the test is intended to be made with a current of 60 % of the phase current and if the neutral conductor is:		N/A
	– the same shape and cross- section as the phase conductors		N/A
	– supported in an identical manner as the phase conductors and with support centres along the length of the conductor not greater than that of the phases;		N/A
	– spaced at a distance from the nearest phase(s) not less than that between phases;		N/A
	– spaced at a distance from earthed metalwork not less than the phase conductors.		N/A
10.11.5.5	**Results to be obtained**		N/A
	After the test deformation of busbars and conductors is acceptable provided that the clearances and creepage distances specified in 8.3 are still complied with.		N/A
	The characteristics of the insulation remains such that the mechanical and dielectric properties of the equipment satisfy the requirements of the relevant ASSEMBLY standard.		N/A
	A busbar insulator or support or cable restraint has not separated into two or more pieces.		N/A
	There are no cracks appearing on opposite sides of a support and no cracks, including surface cracks, running the full length or width of the support.		N/A
	There are no loosening of parts used for the connection of conductors and the conductors are not separated from the outgoing terminals.		N/A
	Distortion of the busbars or structure of the ASSEMBLY that impairs its normal use are a failure.		N/A
	Any distortion of the busbars or structure of the ASSEMBLY that impairs normal insertion or removal of the removable parts is a failure.		N/A
	Deformation of the enclosure or of the internal partitions, barriers and obstacles due to short-circuit is permissible to the extent that the degree of protection is not impaired and the clearances or creepage distances are not reduced to values, which are less than those specified		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	Additionally after the tests incorporating short-circuit protective devices, the tested equipment is capable of withstanding the dielectric test at a value of voltage for the “after test” condition prescribed in the relevant short-circuit protective device standard for the appropriate short-circuit test, as follows:		N/A
	a) between all live parts and the exposed conductive parts of the ASSEMBLY, and		N/A
	b) between each pole and all other poles connected to the exposed conductive parts of the ASSEMBLY.		N/A
	If tests a) and b) above are conducted, they are carried out with any fuses replaced and with any switching device closed.		N/A
	The fusible element (see 10.11.5.2.), if any, does not indicate a fault current.		N/A
10.11.5.6	**Testing of the protective circuit**		N/A
	A single-phase test supply is connected to the incoming terminal of one phase and to the terminal for the incoming protective conductor.		N/A
	When the ASSEMBLY is provided with a separate protective conductor, the nearest phase conductor is used.		N/A
	For each representative outgoing unit, a separate test is made with a bolted short-circuit connection between the corresponding outgoing phase terminal of the unit and the terminal for the relevant outgoing protective conductor.		N/A
	Each outgoing unit on test is fitted with its intended protective device. Where alternative protective devices can be incorporated in the outgoing unit, the protective device which lets through the maximum values of peak current and I 2t is used.		N/A
	For this test, the frame of the ASSEMBLY is insulated from earth. The test voltage is equal to 1,05 times the single-phase value of the rated operational voltage.		N/A
	Unless otherwise agreed between the original manufacturer and the user, the value of the test current in the protective conductor is at least 60 % of the phase current during the three-phase test of the ASSEMBLY.		N/A
	All other conditions of this test are analogous to 10.11.5.2 to 10.11.5.4 inclusive.		N/A
10.11.5.6.2	**Results to be obtained**		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	The continuity and the short-circuit withstand strength of the protective circuit, whether it consists of a separate conductor or the frame, are not significantly impaired.		N/A
	Besides visual inspection, this may be verified by measurements with a current in the order of the rated current of the relevant outgoing unit.		N/A
10.12	**ELECTROMAGNETIC COMPATIBILITY (EMC)**		N/A
	For EMC tests, see J.10.12.		N/A
10.13	**MECHANICAL OPERATION**		N/A
	This verification test is not made on such devices of the ASSEMBLY which have already been type tested according to their relevant product standard unless their mechanical operation is impaired by their mounting.		N/A
	For parts, which need verification by test, satisfactory mechanical operation is verified after installation in the ASSEMBLY. The number of operating cycles is 200.		N/A
	At the same time, the operation of the mechanical interlocks associated with these movements is checked.		N/A
	The test is passed if the operating conditions of the apparatus, interlocks, specified degree of protection etc., have not been impaired and if the effort required for operation is practically the same as before the test.		N/A
	In the case of withdrawable parts, the operating cycle includes any physical movements from the connected to the isolated position and back to the connected position.		N/A

IEC 61439-2			
Clause	Requirement + Test	Result - Remark	Verdict
	ANNEX J: ELECTROMAGNETIC COMPATIBILITY (EMC)		N/A
J.9.4	**Performance requirements**		N/A
J.9.4.1	The environmental condition A and/or B for which the ASSEMBLY is suitable is stated by the ASSEMBLY manufacturer.		N/A
J.9.4.2	**Requirement for testing**		N/A
	No EMC immunity or emission tests are required on final ASSEMBLIES if the following conditions are fulfilled:		N/A
	a) The incorporated devices and components are in compliance with the requirements for EMC for the stated environment (see J.9.4.1) as required by the relevant product or generic EMC standard.		N/A
	b) The internal installation and wiring is carried out in accordance with the devices and Components Manufacturers' instructions (arrangement with regard to mutual influences, cable, screening, earthing etc.)		N/A
	In all other cases the EMC requirements are to be verified by tests as per J.10.12.		N/A
J.9.4.3	**Immunity**		N/A
J.9.4.3.1	**ASSEMBLIES not incorporating electronic circuits**		N/A
	Under normal service conditions, ASSEMBLIES not incorporating electronic circuits are not sensitive to electromagnetic disturbances and therefore no immunity tests are required.		N/A
J.9.4.3.2	**ASSEMBLIES incorporating electronic circuits**		N/A
	Electronic equipment incorporated in ASSEMBLIES comply with the immunity requirements of the relevant product or generic EMC standard and are suitable for the specified EMC environment stated by the ASSEMBLY manufacturer.		N/A
	In all other cases the EMC requirements are to be verified by tests as per J.10.12.		N/A
	Equipment utilizing electronic circuits in which all components are passive (for example diodes, resistors, varistors, capacitors, surge suppressors, inductors) are not required to be tested.		N/A
	The ASSEMBLY manufacturer obtains from the device and or component manufacturer the specific performance criteria of the product based on the acceptance criteria given in the relevant product standard.		N/A
J.9.4.4	**Emission**		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
J.9.4.4.1	**ASSEMBLIES not incorporating electronic circuits**		N/A
	For ASSEMBLIES not incorporating electronic circuits, electromagnetic disturbances can only be generated by equipment during occasional switching operations. The duration of the disturbances is of the order of milliseconds. The frequency, the level and the consequences of these emissions are considered as part of the normal electromagnetic environment of lowvoltage installations. Therefore, the requirements for electromagnetic emission are deemed to be satisfied, and no verification is necessary.		N/A
J.9.4.4.2	**ASSEMBLIES incorporating electronic circuits**		N/A
	Electronic equipment incorporated in the ASSEMBLY comply with the emission requirements of the relevant product or generic EMC standard and are suitable for the specific EMC environment stated by the ASSEMBLY manufacturer.		N/A
J.9.4.4.2.1	**Frequencies of 9 kHz or higher**		N/A
	ASSEMBLIES incorporating electronic circuits (such as switched mode power supplies, circuits incorporating microprocessors with high-frequency clocks) may generate continuous electromagnetic disturbances.		N/A
	For such emissions, these do not exceed the limits specified in the relevant product standard, or the requirements of Table J.1 for environment A and/or Table J.2 for environment B applies. These tests are only required when the main and/or auxiliary circuits contain components with fundamental switching frequencies equal or greater than 9 kHz.		N/A
	Tests are to be carried out as detailed in the relevant product standard, if any, otherwise according to J.10.12.		N/A
J.9.4.4.2.2	**Frequencies lower than 9 kHz**		N/A
	ASSEMBLIES incorporating electronic circuits, which generate low frequency harmonics on the mains supply, comply with the requirements of IEC 61000-3-2 where applicable.		N/A
J.10.12	**Tests for EMC**		N/A
	The emission and immunity tests are carried out in accordance with the relevant EMC standard (see Tables J.1, J.2, J.3 and J.4); however, the ASSEMBLY manufacturer specifies any additional measures necessary to verify the criteria of performance for the ASSEMBLIES if necessary (e.g. application of dwell times).		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
J.10.12.1	**Immunity tests**		N/A
J.10.12.1.1	**ASSEMBLIES not incorporating electronic circuits**		N/A
	No tests are necessary.		N/A
J.10.12.1.2	**ASSEMBLIES incorporating electronic circuits**		N/A
	Tests are made according to the relevant environment: A or B		N/A
	The values used are given in Tables J.3 and/or J.4 except where a different test level is given in the relevant specific product standard and justified by the electronic components manufacturer.		N/A
	Electrostatic discharge immunity test IEC 61000-4-2	Performance criterion A/B/C	N/A
	Radiated radio-frequency electromagnetic field immunity test IEC 61000-4-3 at 80 MHz to 1 GHz and 1,4 GHz to 2 GHz	Performance criterion A/B/C	N/A
	Electrical fast transient/burst immunity test IEC 61000-4-4	Performance criterion A/B/C	N/A
	1,2/50 µs and 8/20 µs surge immunity test IEC 61000-4-5	Performance criterion A/B/C	N/A
	Conducted radio-frequency immunity test IEC 61000-4-6 at 150 kHz to 80 MHz	Performance criterion A/B/C	N/A
	Immunity to power-frequency magnetic fields IEC 61000-4-8	Performance criterion A/B/C	N/A
	Immunity to voltage dips and interruptions IEC 61000-4-11	Performance criterion A/B/C	N/A
	Immunity to harmonics in the supply IEC 61000-4-13	Performance criterion A/B/C	N/A
J.10.12.2	**Emission tests**		N/A
J.10.12.2.1	**ASSEMBLIES not incorporating electronic circuits**		N/A
	No tests are necessary		N/A
J.10.12.2.2	**ASSEMBLIES incorporating electronic circuits**		N/A
	Tests are made according to the relevant environment: A or B		N/A
	The test methods used; see J.9.4.4.2.		N/A
	If the ASSEMBLY incorporates telecommunication ports, the emission requirements of CISPR 22, relevant to that port and to the selected environment, applies.		N/A

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Clause	Requirement + Test	Result - Remark	Verdict

	ANNEX K: PROTECTION BY ELECTRICAL SEPARATION		N/A
K.2	**Electrical separation**		N/A
K.2.1	**Supply source**		N/A
	The circuit is supplied through a source that provides separation i.e.		N/A
	• an isolating transformer, or		N/A
	• a source of current providing a degree of safety equivalent to that of the isolating transformer specified above, for example a motor generator with windings providing equivalent isolation.		N/A
	Mobile sources of supply connected to a supply system are selected in accordance with Clause K.3 (class II equipment or equivalent insulation).		N/A
	Fixed sources of supply are either:		N/A
	• selected in accordance with Clause K.3, or		N/A
	• such that the output is separated from the input and from the enclosure by an insulation satisfying the conditions of Clause K.3; if such a source supplies several items of equipment, the exposed conductive parts of that equipment are not connected to the metallic enclosure of the source.		N/A
K.2.2	Selection and installation of supply source		N/A
K.2.2.1	Voltage		N/A
	The voltage of the electrically separated circuit does not exceed 500 V.		N/A
K.2.2.2	Installation		N/A
K.2.2.2.1	Live parts of the separated circuit are not connected at any point to another circuit or to earth.		N/A
	To avoid the risk of a fault to earth, particular attention is given to the insulation of such parts from earth, especially for flexible cables and cords.		N/A
	Arrangements ensure electrical separation not less than that between the input and output of an isolating transformer.		N/A
K.2.2.2.2	Flexible cables and cords are visible throughout any part of their length liable to mechanical damage.		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
K.2.2.2.3	For separated circuits, the use of separate wiring systems is necessary. If the use of conductors of the same wiring system for the separated circuits and other circuits is unavoidable, multi-conductor cables without metallic covering, or insulated conductors in insulating conduit, ducting or trunking is used, provided that their rated voltage is not less than the highest voltage likely to occur, and that each circuit is protected against overcurrent.		N/A
K.2.3	Supply of a single item of apparatus		N/A
	Where a single item of apparatus is supplied, the exposed conductive parts of the separated circuit is not connected either to the protective conductor or exposed conductive parts of other circuits.		N/A
K.2.4	Supply of more than one item of apparatus		N/A
	If precautions are taken to protect the separated circuit from damage and insulation failure, a source of supply, complying with K.2.1, may supply more than one item of apparatus provided that all the following requirements are fulfilled.		N/A
	a) The exposed-conductive-parts of the separated circuit is connected together by insulated non-earthed equipotential bonding conductors. Such conductors are not connected to the protective conductors or exposed-conductive-parts of other circuits or to any extraneous conductive parts.		N/A
	b) All socket-outlets are provided with protective contacts which are connected to the equipotential bonding system provided in accordance with item a).		N/A
	c) Except where supplying class II equipment, all flexible cables embody a protective conductor for use as an equipotential bonding conductor.		N/A
	d) It is ensured that if two faults affecting two exposed conductive parts occur and these are fed by conductors of different polarity, a protective device disconnects the supply in a disconnecting time conforming to Table K.1.		N/A
	For voltages which are within the tolerance band stated in IEC 60038, the disconnecting time appropriate to the nominal voltage applies.		N/A
	For intermediate values of voltage, the next higher value in table K.1 is to be used.		N/A
K.3	**Class II equipment or equivalent insulation**		N/A
	Protection is provided by electrical equipment of the following types:		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	• Electrical equipment having double or reinforced insulation (class II equipment)		N/A
	• ASSEMBLIES having total insulation see 8.4.3.4.		N/A
	This equipment is marked with the symbol 		N/A

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Clause	Requirement + Test	Result - Remark	Verdict

ATTACHMENT TO TEST REPORT IEC 61439-2 (AUSTRALIA / NEW ZEALAND) NATIONAL DIFFERENCES (LOW VOLTAGE SWITCHGEAR AND CONTROLGEAR ASSEMBLIES) (PART 2: POWER SWITCHGEAR AND CONTROLGEAR ASSEMBLIES)	
Differences according to..... :	AS/NZS 61439.2:2016 AS/NZS 61439.1:2016
Attachment Form No. ..... : **Attachment Originator**..... : **Master Attachment**..... :	AU_NZ_ND_IEC61439_2B JAS-ANZ 2017-05

	National Differences		
Appendix ZA	Variations to IEC 61439-1 Ed 2.0 (2011) Normative		P
ZA1 Introduction	This Appendix sets out variations to IEC 61439-1, Ed. 2.0 (2011) for Australia and New Zealand, including additional requirements to cover issues not addressed by the International Standard (AS/NZS 61439.1:2016		–
ZA2	Variations		--
Appendix ZZ1	This Appendix sets out variations to IEC 61439-2, Ed. 2.0 (2011) for Australia and New Zealand, including additional requirements to cover issues not addressed by the International Standard (AS/NZS61439.2:2016)		–
2	**NORMATIVE REFERENCES**		--
	Add the following new normative references: IEC TR 61641, Enclosed low-voltage switchgear and controlgear assemblies—Guide for testing under conditions of arcing due to internal fault AS 2467, Maintenance of electrical switchgear AS/NZS 3000, Electrical installations (known as the Australian/New Zealand Wiring Rules) AS/NZS 3008, Electrical installations—Selection of cables—Cables for alternating voltages up to and including 0.6/1 kV (series) AS/NZS 3493, Low-voltage switchgear and controlgear assemblies (series) AS/NZS 5000, Electric cables— Polymeric insulated (series) AS/NZS 5112, *Neutral links with tunnel terminals for the connection of copper conductors— Requirements for brass neutral links with ratings up to and including 125 A* (AS/NZS 61439.1:2016)		--
	Add the following new normative reference: *AS 60529, Degrees of protection provided by enclosures for electrical equipment (IP Code)* (AS/NZS61439.2:2016)		–
3	**TERMS AND DEFINITIONS**		--
3.7.1	Variation **Live part** refer to AS/NZS 3000 for the definition of a live part (AS/NZS 61439.1:2016)		--

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Clause	Requirement + Test	Result - Remark	Verdict
3.7.2	Addition At the end of Clause 3.7.2, add the following Notes: NOTE 1 As a guide to hazardous live voltages the PELV values in AS/NZS 3000:2007 are:		N/A
	–25 V a.c. or 60 V ripple-free d.c., when electrical equipment is normally used in a dry location only and large-area contact with the human body is not to be expected; or		N/A
	–6 V a.c. or 15 V ripple-free d.c., in all other cases. NOTE 2 For internal separation for protection against contact with hazardous parts (subject to agreement) refer to AS/NZS 61439.2 Clause 8.101. (AS/NZS 61439.1:2016)		N/A
5	**INTERFACE CHARACTERISTICS**		P
5.3.1	Variation *Delete* Note 1 and *replace* with the following: NOTE 1 The rated current of an incoming circuit may be lower than the rated current of the incoming device (according to the respective device standard) installed in the assembly, which is the value determined from the markings on the device. (AS/NZS 61439.1:2016)		P
5.3.2	Replacement *Delete* Note 1 and *replace* with the following: NOTE 1 The rated current of a circuit may be lower than the rated currents of the devices (according to the respective device standard) installed in this circuit, which is the value determined from the markings on the device. (AS/NZS 61439.1:2016)		P
6	**INFORMATION**		P
6.1	Addition *Add* after the Note for the last paragraph the following: Where access to live parts is required, the following symbolic electric shock risk sign shall be displayed in locations where additional attention is required to be given to the removal of covers and the like. 		P
	In addition, a DANGER sign as illustrated below, with an additional message of appropriate wording, should be conspicuously displayed on the enclosure of the ASSEMBLY to alert persons to the hazard. 		P
	Where an item of equipment or enclosure contains live parts connected to more than one supply, a notice shall be placed in such a position that any person gaining access to live parts will be warned of the need to isolate those parts from the various supplies. (AS/NZS 61439.1:2016)		N/A

IEC 61439-2			
Clause	Requirement + Test	Result - Remark	Verdict
6.2	Addition *Add* after the last paragraph the following: It is the responsibility of the owner of the ASSEMBLY to institute a system of maintenance. Are the manufacturer's recommendations included, together with the recommendations of AS 2467, in a planned preventative maintenance programme. This will minimize the risk of injury or breakdown and the consequences thereof. (AS/NZS 61439.1:2016)		P
8	**CONSTRUCTIONAL REQUIREMENTS**		P
8.1.1	Addition *Add* after the last paragraph the following: NOTE The construction of an ASSEMBLY to this Standard is considered to be adequate for most applications. However, for applications where an increased degree of protection against internal arcing or its effects is essential, guidance may be obtained from Appendix ZC and internal arcing fault tests are specified in Appendix ZD. (AS/NZS 61439.1:2016)		N/A
8.5.5	Variation *Replace* the last list item with the following: Actuators for emergency switching devices (see 536.4.2 of IEC 60364-5-53:2001) shall be readily accessible. (AS/NZS 61439.1:2016)		N/A
8.6.1	Variation *Replace* the first sentence of the third paragraph with the following: AS/NZS 3000 has requirements for the size of the neutral conductor on three-phase and neutral circuits. Neutral conductors shall satisfy these requirements and unless otherwise agreed between the ASSEMBLY manufacturer and the user, shall be not less than the following (AS/NZS 61439.1:2016)		P
8.8	Addition 1. After the second paragraph, add new Note 1 as follows: NOTE 1 AS/NZS 5112 has requirements for tunnel type terminal neutral bars for connecting copper neutral conductors from 1 mm^2 up to and including 50 mm^2.		N/A
	2. Renumber the existing Notes 1, 2, 3, 4 and 5 as 2, 3, 4, 5 and 6.		—
	3. Replace the first sentence of the seventh paragraph with the following: AS/NZS 3000 has requirements for the size of the neutral conductor on three-phase and neutral circuits. Terminals for the neutral conductors shall allow the connection of copper conductors satisfying these requirements and unless otherwise agreed between the ASSEMBLY manufacturer and the user, shall be not less than the following:		P

IEC 61439-2			
Clause	Requirement + Test	Result - Remark	Verdict
	4. Replace the third last paragraph with the following: Unless otherwise agreed between the ASSEMBLY manufacturer and the user, terminals for protective conductors shall allow the connection of copper conductors having a cross-section according to AS/NZS 3000. (AS/NZS 61439.1:2016)		P
10	**DESIGN VERIFICATION**		P
10.1	Variation *Delete* the second paragraph and *replace* with the following: Where tests on the ASSEMBLY have been conducted in accordance with the IEC 60439, IEC 61439 or AS/NZS 3439 series, and the test results fulfil the requirements of the relevant part of AS/NZS 61439, the verification of these requirements need not be repeated. (AS/NZS 61439.1:2016)		N/A
10.3	Addition At the end of the Clause 10.3, *insert* the following text: IP tests shall be carried out with all barriers and partitions fixed in place as in normal service (AS/NZS 61439.2:2016)		P
10.9.2.1	Addition *Add* the following after the first paragraph: NOTE Refer to Clause 8.5.3 for the value of the test voltage of the equipment, which may be specified to its own standard at a lower value than shown in Table 8. (AS/NZS 61439.1:2016)		N/A
10.9.6	Addition *Add* new Clause 10.9.6 as follows: **Testing of insulation to comply with Clause 8.101** Insulation required for forms of internal separation to Clause 8.101 shall comply with the power frequency withstand tests of Clause 10.9.3.2 at a voltage of 1.5 times the value applicable to the rated Ui in Table 8 of Part 1. e.g. for Ui >300V to ≤690V the test voltage is 1.5×1890=2835V		N/A
	The voltage shall be applied between hazardous live parts and metal foil laid on the outer surface of relevant insulating surfaces and over any joints and openings in the insulation which are accessible after opening of a compartment and are contactable by the standard jointed test finger (STF).		N/A
	NOTE 1 The test may be limited to places where the insulation is likely to be weak, for example where there are openings or sharp metal edges under the insulation		N/A
	NOTE 2 Care should be taken that the metal foil is placed so that no flashover occurs at the edges of the insulation and to ensure no edges of the foil enter openings in the insulation.		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	NOTE 3 The foil may be pushed into corners and the like by means of the STF but it is not pressed into openings.		N/A
	NOTE 4 For similar tests refer to Clause 10.9.4 for testing of assemblies with enclosures made of insulating material (contactable in normal service) and to IEC TR 61641 Clause 6.2 for tests relating to arc ignition protected fault zones (AS/NZS 61439.2:2016)		N/A
10.10.3.5	Variation *Replace* the existing text with the following: A device may be substituted with a similar device to that used in the original verification, provided that—		N/A
	a) if the device is not from the same manufacturer, the device rating does not exceed 3150A;		N/A
	b) the power loss and terminal temperature rise of the device are the same or lower when tested in accordance with the relevant product standard; and		N/A
	c) the physical arrangement within the functional unit and the rating of the functional unit are maintained or bettered with respect to thermal considerations. NOTE The physical arrangements include terminal shields, conductor type, material, and connection sizes, mounting orientation, clearances to other parts, ventilation arrangements and terminal arrangement. (AS/NZS 61439.1:2016)		N/A
10.10.4.3.1	Addition At the end of the Clause, *add* new Note 4 as follows: NOTE 4 Annex N of AS 60890 provides guidance on calculating operating current and power loss for copper busbars of size 5 mm, 6.3 mm and 10 mm. (AS/NZS 61439.1:2016)		N/A
Table 5	Variation Delete Table 5 (AS/NZS 61439.1:2016)		–
Table 6	Variation Replace Table 6		P

Parts of ASSEMBLIES	Temperature Rise K
Built-in components [a, h]	In accordance with the relevant product standard requirements for the individual components or, in accordance with the component manufacturer's instructions [f], taking into consideration the temperature in the ASSEMBLY
Terminals for external insulated conductors	70 [b] (see Note 3)

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Clause	Requirement + Test	Result - Remark	Verdict

Busbars and conductors [h]	Limited by [f]: – mechanical strength of conducting material [g]; – possible effect on adjacent equipment; – permissible temperature limit of the insulating materials in contact with the conductor; – effect of the temperature of the conductor on the apparatus connected to it; – for plug-in contacts, nature and surface treatment of the contact material	
Manual operating means: – of metal – of insulating material	 15 [c] 25 [c]	
Accessible external enclosures and covers: – metal surfaces – insulating surfaces	 30 [d] 40 [d]	
Discrete arrangements of plug and socket-type connections	Determined by the limit for those components of the related equipment of which they form part [e]	

NOTE 1 The 105 K relates to the temperature above which annealing of copper is likely to occur. Other materials may have a different maximum temperature rise.

NOTE 2 The temperature rise limits given in this table apply for a mean ambient air temperature up to 35 °C under service conditions (see 7.1). During verification a different ambient air temperature is permissible (see 10.10.2.3.4).

NOTE 3 The temperature rise allowed for terminals for external insulated conductors is 70 K V75 cables are deemed to be acceptable because there is a temperature drop to the point where insulation is relied upon and the load current is generally not more than 80 % of the calculated maximum demand.

If the temperature rise of the terminals, determined when the ASSEMBLY is tested at maximum rating as described in Clause 10.10, is within 25 K of the rating of the cable and if a circuit of the ASSEMBLY is to be loaded above 80 % of its rated current, one of the following actions should be taken:

– separate the cable cores to provide electrical clearance for a minimum distance of 100 mm back from the terminals;

– apply high temperature covering over the cores for 100 mm back from the terminals;

– use a higher temperature grade cable of the same conductor cross-section as selected for V75 grade cable; or

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Clause	Requirement + Test	Result - Remark	Verdict
	– use a larger conductor. a) The term 'built-in components' means: – conventional switchgear and controlgear; – electronic sub-assemblies (e.g. rectifier bridge, printed circuit); and – parts of the equipment (e.g. regulator, stabilized power supply unit, operational amplifier). b) The temperature-rise limit of 70 K is a value based on the conventional test of 10.10. An ASSEMBLY used or tested under installation conditions may have connections, the type, nature and disposition of which will not be the same as those adopted for the test, and a different temperature rise of terminals may result and may be required or accepted. Where the terminals of the built-in component are also the terminals for external insulated conductors, the lower of the corresponding temperature-rise limits shall be applied. The temperature rise limit is the lower of the maximum temperature rise specified by the component manufacturer and 70 K. In the absence of manufacturer's instructions it is the limit specified by the built-in component product standard but not exceeding 70 K. c) Manual operating means within ASSEMBLIES which are only accessible after the ASSEMBLY has been opened, for example draw-out handles which are operated infrequently, are allowed to assume a 25 K increase on these temperature-rise limits. d) Unless otherwise specified, in the case of covers and enclosures, which are accessible but need not be touched during normal operation, a 10 K increase on these temperature-rise limits is permissible. External surfaces and parts over 2 m from the base of the ASSEMBLY are considered inaccessible. e) This allows a degree of flexibility in respect of equipment (e.g. electronic devices) which is subject to temperature-rise limits different from those normally associated with switchgear and controlgear. f) For temperature-rise tests according to 10.10, the temperature-rise limits have to be specified by the original manufacturer taking into account any additional measuring points and limits imposed by the component manufacturer. g) Assuming all other criteria listed are met a maximum temperature rise of 105 K for bare copper busbars and conductors shall not be exceeded. h) A temperature rise of not more than 70 K for H.C. copper busbars and 55 K for H.C. aluminium busbars is applicable unless supported by additional original component manufacturer's instructions and is deemed to comply for: – The terminals of individual component parts, including terminals for other than external insulated conductors. – Bare copper or aluminium busbars. The component manufacturers instructions and the original manufacturers temperature rise limits as per Note f) may not be required for these specific items. A temperature rise of more than 70 K for H.C. copper busbars and 55 K for H.C. aluminium busbars may be acceptable if supported by component manufacturer's declaration.		

IEC 61439-2			
Clause	Requirement + Test	Result - Remark	Verdict
	Greater temperature than these values are allowed as long as the mechanical strength of the conducting material is not affected. (AS/NZS 61439.1:2016)		
Table 13	Addition 1 *Add* a new Item 6 as follows Does the short-circuit protective devices of each circuit of the ASSEMBLY to be assessed— – have a breaking capacity not less than the short-circuit rating of the assembly at the rated operational voltage of the assembly? – in case of a current limiting protective device: Have a peak let through current and let through energy at the short-circuit rating and the rated operational voltage of the assembly equal to or smaller than the reference design? – in case of a non-current limiting device: Have a rated short-time withstand current (*I*cw) equal to or higher than the reference design? – fulfil the requirements of co-ordination with upstream and downstream devices (see 9.3.4). – have equal or smaller critical distances (safety perimeter) to the reference design. – maintain identical mechanical orientation, including the direction and position of venting of the arc chutes		P
	Variation 2 Renumber items 6 to 10 as 7		P
	Addition 3 *Replace* Note[a] in Table 13 with the following: [a] Short-circuit protective devices of the same manufacturer but of a different series, or devices from a different manufacturer, may be considered equivalent and be substituted for the original device if the requirements of the device manufacturer are complied with and the assembly manufacturer declares the performance characteristics to be the same or better in all relevant respects to the series used for verification, e.g. breaking capacity, limitation characteristics (I^2t, I_{pk}), and the critical distances (safety perimeters) (AS/NZS 61439.1:2016)		P
Table C1	Addition *1 Add* after the second paragraph the following: NOTE: Appendix ZB sets out the various standard IEC types of system earthing referred to in this Standard.	(see appended table)	–

IEC 61439-2			
Clause	Requirement + Test	Result - Remark	Verdict

<table>
<tr><td></td><td>Addition

the following at the end of the rows of characteristics for short-circuit withstand capability
<table><tr><th>Internal arcing faults</th><th></th><th></th><th></th><th></th></tr><tr><td>Protection against internal arcing fault currents

Applies to switchboards rated ≥800 A</td><td>AS/NZS 3000</td><td>Mandatory</td><td>None</td><td></td></tr><tr><td>Guidelines for assemblies intended to provide increased security against the occurrence or the effects of internal arcing fault</td><td>ZC</td><td>Informative only</td><td>Refer ZC6 and ZD</td><td></td></tr><tr><td>Internal arcing fault tests</td><td>ZD</td><td>Subject to agreement</td><td>Standard or special tests to ZD or IEC TR 61641</td><td></td></tr><tr><td>Selection of components</td><td>ZE</td><td>Manufacturers standard</td><td>None</td><td></td></tr></table>(AS/NZS 61439.1:2016)</td><td></td><td>N/A</td></tr>
<tr><td>Paragraph E2</td><td>Addition
The rated current of a device according to its product standard (for example, In of a circuit breaker according to AS 60947.2) is its free air rating: In = 630 A</td><td></td><td>N/A</td></tr>
<tr><td></td><td>The rated current of the functional unit (the circuit) in a specific switchboard, as tested according to 10.10.2.3.7 c), may yield, for example, a lower rating of Inc = 534 A</td><td></td><td>N/A</td></tr>
<tr><td></td><td>When conducting a complete ASSEMBLY test according to 10.10.2.3.7 d) or 10.10.2.3.6 (stage two) the test current used on the circuit is the rated current of the circuit (Inc) multiplied by rated diversity factor (RDF) of the assembly. If the RDF of the assembly is 0.9 for example, the test current would therefore be 0.9 × Inc = 0.9 × 534 A = 481 A</td><td></td><td>N/A</td></tr>
<tr><td></td><td>In addition for the tests of 10.10.2.3.5 I_{nc} becomes 481 A and the diversity factor is 1
(AS/NZS 61439.1:2016).</td><td></td><td>N/A</td></tr>
<tr><td>Table E2</td><td>Variation
Third row, first column, delete ‘(In)’ and replace with ‘(Inc)’
(AS/NZS 61439.1:2016)</td><td></td><td>N/A</td></tr>
</table>

IEC 61439-2			
Clause	Requirement + Test	Result - Remark	Verdict
Table E3	Variation Third row, first column, *delete* '(*I*n)' and *replace* with '(*I*nc)'. (AS/NZS 61439.1:2016)		N/A
Annex H	Addition Reference may also be made to AS/NZS 3008. (AS/NZS 61439.1:2016)		N/A
	Special national conditions (if any)		--
8	**CONSTRUCTIONAL REQUIREMENTS**		P
8.101	Addition 1. After the first paragraph, *insert* the following text: For examples of ASSEMBLIES using internal separation see Appendices ZA, ZB and ZC		N/A
	2. *Delete* Note 1 and *replace* with the following: NOTE 1 The degree of protection IP 2X covers the degree of protection IP XXB. Separation may be achieved by means of partitions or barriers (metallic or non-metallic). Insulation of live parts or the integral housing of a device, e.g. a molded case circuit breaker may be used as a partition or barrier (see Clause 8.101.1 for alternative means of construction). The IP rating shall be verified by the tests of Clause 10.3		P
	3. At the end of the Clause 8.101, *insert* the following text: NOTE 3 The need for separation between the neutral busbar and functional units, as well as the neutral busbar and terminals for outgoing conductors (including outgoing neutral conductor) should be an agreement between manufacturer and user.		N/A
8.101.1.1	**Integral housing of a device** The integral housing of a device may be used to provide internal separation between functional units, e.g. a moulded case circuit-breaker.		N/A
	The suffix h' shall be used to denote this construction, e.g. 3bh NOTE The integral housing of a device does not provide separation between the related functional unit and the busbar.		N/A
	Terminal covers may be required to provide IP protection on terminals for outgoing conductors and terminals for busbar connections		N/A
	Terminal covers, if required to provide IP protection, shall be firmly secured in place and have sufficient stability and durability to maintain the required degrees of protection. They may be removable without a tool.		N/A
8.101.1.2	**Insulation** Insulation may be used to provide internal separation. The suffix 'i' shall be used to denote this construction, e.g. 3bi.		N/A

IEC 61439-2			
Clause	Requirement + Test	Result - Remark	Verdict
	Insulation which provides IP protection and which is accessible in normal service or after opening of a compartment shall comply with the following:		N/A
	a. Insulation on conductors, including busbar insulation coating and shrink tubing shall comply with 8.4.2.2 of Part 1 and the tests of 10.9.6. NOTE Cables which comply with the requirements of the relevant cable standard are deemed to comply		N/A
	b. Insulation of busbar enclosures and insulating caps (boots) fitted to busbars tee offs shall be firmly secured in place and have sufficient stability and durability to maintain the required degrees of protection		N/A
	c. Insulating caps may be removable without a tool		N/A
	d. Insulation shall comply with the tests of 10.9.6		N/A
8.101.1.3	**Combination of insulation and integral housing of a device** The combination of integral housings to 8.101.2.1 and insulation to 8.101.2.2 may be used to provide internal separation. The suffix 'ih' shall be used to denote this construction, e.g. 3bih		N/A
	Insulation shall comply with the tests of 10.9.6		N/A
8.102	*Add* a new Clause 8.102 as follows: **8.102 Additional protection** Protection against direct contact with live non-isolated line side connections to a functional unit inside a functional unit compartment which remain energised after access by an authorised person may be required. This requirement is not a standard form of separation and an agreement between the assembly manufacturer and the user is required Refer to Figure ZB1(B). (AS/NZS 61439.2:2016)		N/A
Table 104.101	Addition Add new Table 104.101 as follows		N/A

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Clause	Requirement + Test	Result - Remark	Verdict

Form	1	2	3	4	5	6	7	–8
	Separation of	Separation of terminals for external conductors				Separation of external conductors		
	Busbars from all functional units	All functional units from one another	From the busbars	From the functional units	From the terminals of other functional units	From the busbars	From the functional units	From the terminals of other functional units
Form 1	Not separated							
Form 2a	Separated		Not separated					
Form 2b	Separated		Separated					
Form 3a	Separated	Separated	Not separated	Separated	Not separated		Separated	Not separated
Form 3b	Separated	Separated	Separated	Separated	Not separated	Separated	Separated	Not separated
Form 4a	Separated	Separated	Separated	In the same compartment (Note 1)	Separated (Note 2)	Separated		Separated (Note 2, 3)
Form 4b	Separated	Separated	Separated	Not in the same compartment (Note 1, 4)	Separated (Note 3)	Separated		Separated (Note 2, 3)

NOTE 1 Includes “Associated with a functional unit”.

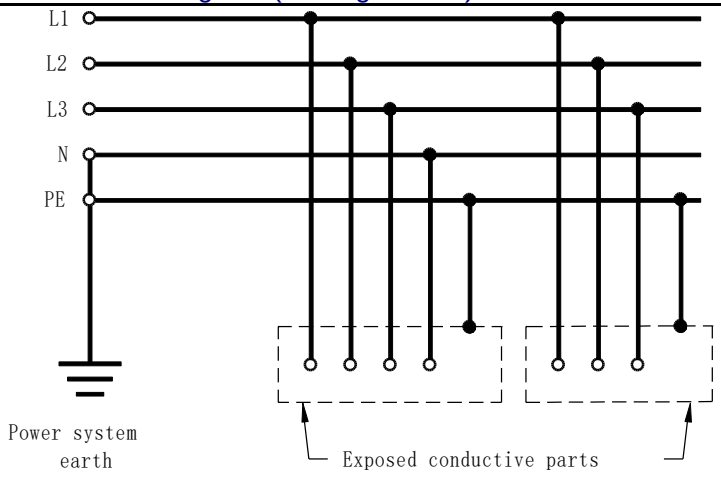
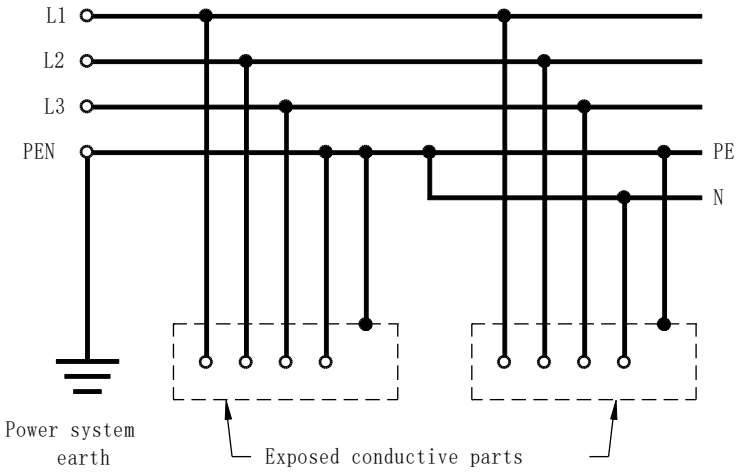
NOTE 2 Includes “any other functional unit”.

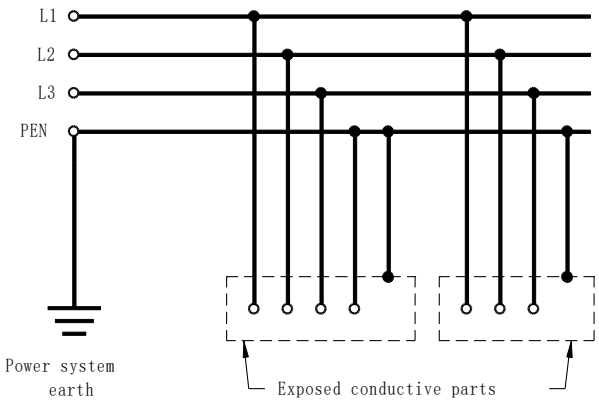
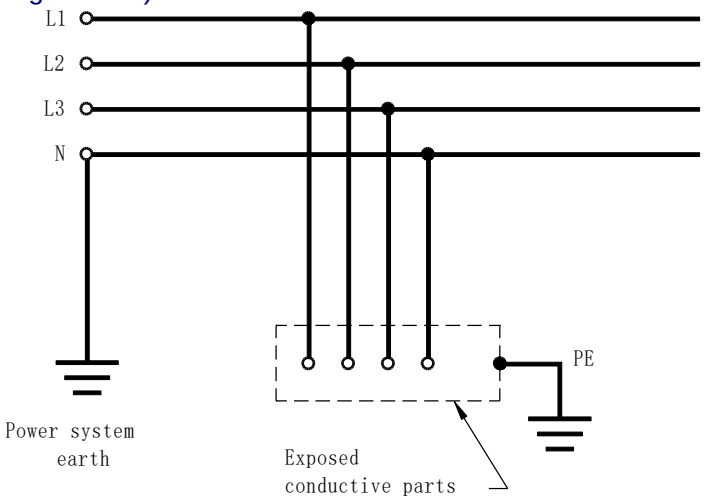
NOTE 3 Form 4a and 4b, External conductors need not be separated from each other.

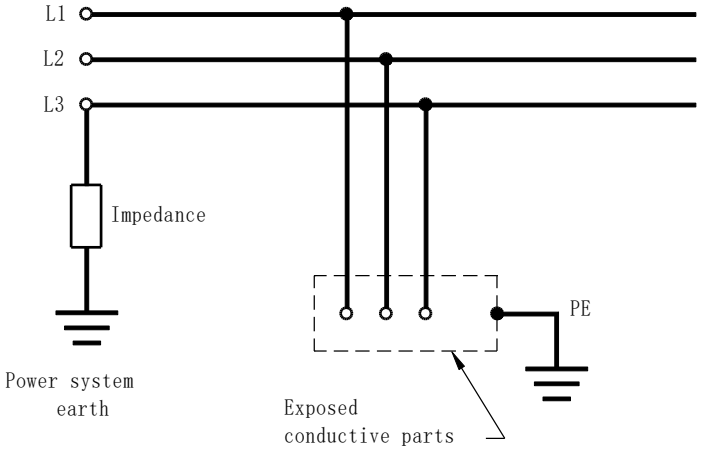
NOTE 4 Form 4b, Terminals for external conductors not in the same compartment as the functional unit, but in individual, separate, enclosed protected spaces or compartments.

(AS/NZS 61439.2:2016)

Appendix ZB	TYPES OF SYSTEM EARTHING (Informative)	--
ZB1 SCOPE	This Appendix sets out the various standard IEC types of system earthing referred to in this Standard	--

IEC 61439-2			
Clause	Requirement + Test	Result - Remark	Verdict
ZB2 TN SYSTEMS	TN power systems have one point directly earthed, the exposed conductive parts of the installation being connected to that point by protective conductors. Three types of TN systems are recognized, according to the arrangement of neutral and protective conductors, as follows: (a) TN-S system A system having separate neutral and protective conductors throughout (see Figure ZB1). (b) TN-C-S system A system in which neutral and protective functions are combined in a single conductor in a part of the system (see Figure ZB2). (c) TN-C system A system in which neutral and protective functions are combined in a single conductor throughout (see Figure ZB3).		--
	 FIGURE ZB1 TN-S SYSTEM		--
	 NOTE: The TN-C-S system is similar to the MEN system except that the— (a) PEN is earthed multiple times;		--

IEC 61439-2			
Clause	Requirement + Test	Result - Remark	Verdict
	(b) PEN is connected directly to N (neutral) not the PE (protective earth); (c) neutral is connected via a MEN connection to the earth bar; (d) installation PE conductors are connected to the earth bar; and (e) earth bar is connected to an earth electrode. For details refer to AS/NZS 3000, Figure 5.1. FIGURE ZB2 TN-C-S SYSTEM		
	 FIGURE ZB3 TN-C SYSTEM		--
ZB3 TT SYSTEM	The TT power system has one point directly earthed, and the exposed conductive parts of the installation being connected to earth electrodes are electrically independent of the earth electrodes of the power system (see Figure ZB4).  FIGURE ZB4 TT SYSTEM		--

IEC 61439-2			
Clause	Requirement + Test	Result - Remark	Verdict
ZB4 IT SYSTEM	The IT power system has no direct connection between live parts and earth, and the exposed conductive parts of the electrical installation being earthed (see Figure ZB5).  FIGURE ZB5 IT SYSTEM		--
APPENDIX ZC	GUIDELINES FOR ASSEMBLIES INTENDED TO PROVIDE INCREASED SECURITY AGAINST THE OCCURRENCE OR THE EFFECTS OF INTERNAL ARCING FAULTS (Informative)		N/A
ZC1	**INTRODUCTION**		N/A
	Many factors may influence the ability of an ASSEMBLY to satisfactorily limit the effects of an internal arc. This Appendix, the application of which is subject to agreement between the purchaser and the manufacturer, describes the problem of internal arcing which may occur in an ASSEMBLY during service, and covers the design principles that should be considered to reduce the risk of its occurrence or to limit its effects. The tests set out in Appendix ZD are intended to verify the degree of security provided by the design. This Standard does not define requirements for arc flash protection.		N/A
ZC2	**OBJECT**		N/A
	The object of this Appendix is to give guidance to manufacturers with regard to design objectives and to give guidance to purchasers for the selection of an ASSEMBLY which will provide increased security by the prevention or control of arcing faults within ASSEMBLIES under normal operating conditions, with all doors closed and all covers and internal barriers in place. Specific objectives cover one or more of the following: (d) To provide means to reduce the probability of the initiation of an internal arcing fault.		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	(e) To protect personnel from injury in the event of a fault under the normal operating conditions of the ASSEMBLY. (f) To limit as far as possible the extent of damage to equipment in the event of a fault. It should be appreciated that while some design features may give increased protection during maintenance, the tests set out in Appendix ZD are not intended to apply to a maintenance situation where work is being carried out within the ASSEMBLY		
ZC3	**POSSIBLE CAUSES OF FAILURE**		N/A
	Examples of possible causes of failure of the ASSEMBLY due to the initiation of internal arcing are as follows: (a) Failure of a component, the connections to it or the busbar system during commissioning. (b) Failure due to incorrect selection or application of components or faulty maintenance, such as— (i) the omission of barriers or shrouds; (ii) damaged insulation; (iii) incorrect installation of a protective device; (iv) replacement of a protective device by an inappropriate one; (v) the presence of a foreign object; (vi) the substitution of a component by an inappropriate one; (vii) loose connections; (viii) the incorrect adjustment of a component; and (ix) plug in contacts. (c) Failure in service due to one or more of the following: (i) Ingress of pollution. (ii) Ageing of insulation. (iii) Damage caused by rodents and vermin. (iv) Corrosion. (v) Component fatigue or breakage. (vi) Overheating due to, for example — (A) loose connections; (B) contact wear; (C) pollution; (D) overloading; or		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	(E) lack of ventilation.		
ZC4	**ARC FAULT CONDITIONS**		N/A
	When an arcing fault occurs between phases or to earth, the current flowing at any given instant is determined by the applied voltage, the source impedance and the arc voltage. The effect of the arc voltage is to reduce the current to a value below that which would flow under bolted fault conditions. Because of the dynamic nature of the arc it is difficult to predict the value of arc voltage, which varies as the arc moves under the effect of the thermal and magnetic forces acting on it. Depending upon the electrode configuration, at any time the instantaneous value of arc current could assume a relatively high value approaching the bolted fault current or a much lower value possibly approximating load current. Generally, an arc will continue until it becomes unstable and self-extinguishes, or until it is extinguished as a result of the operation of a circuit breaker or fuse interrupting the current, or by other means designed into the ASSEMBLY. Some such methods are described in Paragraph ZC5. The arc should not be relied on to become unstable and self-extinguishing		N/A
ZC5	**MINIMIZATION OF ARCING**		N/A
	It is recognized that the increased security against personal injury and damage to equipment may be obtained by a number of means, such as the following: (a) Taking precautions in the design, construction, insulation or arrangement of the ASSEMBLY which would make the occurrence of an arcing fault extremely unlikely (see Paragraph ZC6(a)). (b) Mitigation of the arcing fault (see Paragraph ZC6(b)). (c) Provision of adequate means for detection or limitation, or both, of a fault (see Items (c), (d) and (e) of Paragraph ZC6).		N/A
ZC6	**MEANS OF ACHEIVEMENT**		N/A
	Typical means of reducing the probability of initiation of internal arcing or minimizing its magnitude or duration, or both, and limiting its effects, as outlined in Paragraph ZC5, are as follows: (d) By the provision of one or more insulation systems providing IPXXB degree of protection. NOTE: For example, completely surrounding live conductors to include substantial insulation which alone is capable of withstanding the dielectric test voltage of the ASSEMBLY. Such provision is able to resist without damage all likely mechanical forces and temperatures that may occur in service and during maintenance by resin encapsulation or other insulation, in addition to clearance in air or other insulating media. (e) By the arrangement of the busbars and functional units of the ASSEMBLY in vented compartments designed to promote rapid		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	extinction of the arc and to prevent the arc or arc products affecting other parts of the ASSEMBLY (refer to Paragraph ZC5(b)). (f) By the use of devices (e.g. fuses or circuit breakers), designed to limit the magnitude and duration of the arcing current by interruption thereof, so as to limit the risk of injury to personnel or damage to the ASSEMBLY. (g) By the use of devices sensitive to the energy radiated from an arc which are designed to reliably initiate the interruption of the arcing current (e.g. by means of a circuit breaker). (h) By the use of earth current detection devices (e.g. earth current relays) designed to initiate the interruption of the arcing current (e.g. by means of a circuit breaker). (i) Combinations of Items (a) to (e) above, or other methods designed to either prevent the initiation of an arc, or to reduce the damage or risk of injury resulting from an arc by sensing of the fault followed by interruption. (AS/NZS 61439.1:2016)		

TEST REPORT
IEC 61439-3
Low-voltage switchgear and controlgear assemblies - Part 3: Distribution boards intended to be operated by ordinary persons (DBO)

Report Number.....:	CN217OBX001
Date of issue .....:	See cover page
Total number of pages.....:	See cover page
Name of Testing Laboratory preparing the Report.....:	see page 2
Applicant's name.....:	see page 2
Address .....:	see page 2
Test specification:	
Standard.....:	EN 61439-3:2012
Test procedure .....:	Report of CE_LVD
Non-standard test method.....:	N/A
Test Report Form No.....:	IEC61439_3B
Test Report Form(s) Originator....:	VDE Prüf- und Zertifizierungsinstitut GmbH
Master TRF.....:	Dated 2017-06

If this Test Report Form is used by non-IECEE members, the IECEE/IEC logo and the reference to the CB Scheme procedure shall be removed.

This report is not valid as a CB Test Report unless signed by an approved CB Testing Laboratory and appended to a CB Test Certificate issued by an NCB in accordance with IECEE 02.

General disclaimer:

The test results presented in this report relate only to the object tested.
This report shall not be reproduced, except in full, without the written approval of the Issuing CB Testing Laboratory. The authenticity of this Test Report and its contents can be verified by contacting the NCB, responsible for this Test Report.

Test item description..... :	see page 3
Trade Mark ..... :	see page 3
Manufacturer ..... :	see page 3
Model/Type reference..... :	see page 3
Ratings..... :	see page 3

Responsible Testing Laboratory (as applicable), testing procedure and testing location(s): N/A			
☐	**CB Testing Laboratory:**		
Testing location/ address..... :			
Tested by (name, function, signature)..... :			
Approved by (name, function, signature) . :			
☐	**Testing procedure: CTF Stage 1:**		
Testing location/ address..... :			
Tested by (name, function, signature)..... :			
Approved by (name, function, signature) . :			
☐	**Testing procedure: CTF Stage 2:**		
Testing location/ address..... :			
Tested by (name + signature) ..... :			
Witnessed by (name, function, signature) :			
Approved by (name, function, signature) . :			
☐	**Testing procedure: CTF Stage 3:**		
☐	**Testing procedure: CTF Stage 4:**		
Testing location/ address..... :			
Tested by (name, function, signature)..... :			
Witnessed by (name, function, signature) :			
Approved by (name, function, signature) . :			
Supervised by (name, function, signature):			

List of Attachments (including a total number of pages in each attachment): AU/ NZ National Differences (page 155 - 172)	
Summary of testing:	
Tests performed (name of test and test clause): All applicable tests performed.	**Testing location:** see page 4
Summary of compliance with National Differences: No EU Group Difference, AU/NZ ☒ **The product fulfils the requirements of EN 61439-3:2012 and AS/NZS 61439.3:2016**	

Copy of marking plate:

The artwork below may be only a draft. The use of certification marks on a product must be authorized by the respective NCBs that own these marks.

see page 4

Test item particulars.....:	see page 5
Classification of installation and use .....:	see page 5
Supply Connection.....:	see page 5
.....:	
Possible test case verdicts:	
- test case does not apply to the test object..... :	N/A
- test object does meet the requirement ..... :	P (Pass)
- test object does not meet the requirement..... :	F (Fail)
Testing..... :	
Date of receipt of test item ..... :	see cover page
Date (s) of performance of tests..... :	see cover page

General remarks:

"(See Enclosure #)" refers to additional information appended to the report.
"(See appended table)" refers to a table appended to the report.

Throughout this report a ☐ comma / ☒ point is used as the decimal separator.

Manufacturer's Declaration per sub-clause 4.2.5 of IECEE 02:

The application for obtaining a CB Test Certificate includes more than one factory location and a declaration from the Manufacturer stating that the sample(s) submitted for evaluation is (are) representative of the products from each factory has been provided ..... :	☐ **Yes** ☒ **Not applicable**

When differences exist; they shall be identified in the General product information section.

Name and address of factory (ies) . : --

General product information and other remarks:

see page 6

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Clause	Requirement + Test	Result - Remark	Verdict

5	**INTERFACE CHARACTERISTICS**		**P**
5.2	**Voltage ratings**		
	Rated voltage (U_n) (of the ASSEMBLY) ..... :	See page 6	P
	Rated operational voltage (U_e) ..... : (of a circuit of an ASSEMBLY)	See page 6	P
	Rated insulation voltage (U_i) ..... : (of a circuit of an ASSEMBLY)	See page 6	P
	Rated impulse withstand voltage (U_{imp}) ..... : (of the ASSEMBLY)	See page 6	P
	DGO´s comply with minimum overvoltage category III according IEC 60364-4-44	See page 6	P
5.3	**Current ratings**		--
	Rated current of the ASSEMBLY (I_{nA}) ..... :	See page 6	P
	Rated current of a circuit (I_{nc}) ..... :	See page 6	P
	Rated peak withstand current (I_{pk}) ..... :	See page 6	P
	Rated short-time withstand current (I_{cw}) ..... : (of a circuit of an ASSEMBLY)	See page 6	P
	Rated conditional short-circuit current of an ASSEMBLY (I_{cc}) ..... :		N/A
5.4	**Rated diversity factor (RDF)**		N/A
	Based on the values in table 101 or agreement between manufacturer an user		N/A
5.5	**Rated frequency (f_n)**		**P**
5.6	**Other characteristics**		**P**
	a) additional requirements (e.g. type of coordination, overload characteristics);		N/A
	b) pollution degree..... :	see page 7	P
	c) types of system earthing..... :	see page 7	P
	d) indoor and/or outdoor installation..... :	see page 7	P
	e) stationary or movable ..... :	see page 7	P
	f) degree of protection ..... :	see page 7	P
	g) intended for use by skilled or ordinary persons . :	see page 7	P
	h) electromagnetic compatibility (EMC) classification ..... :		N/A
	i) special service conditions, if applicable ..... :		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	j) external design..... :	see page 7	**P**
	k) mechanical impact protection, if applicable ..... :	see page 7	**P**
	l) type of construction - fixed, removable or withdrawable parts..... :	see page 7	P
	m) nature of short-circuit protective device(s)..... :		N/A
	n) measures for protection against electric shock . :		N/A
	o) overall dimensions (including projections e.g handles, covers, doors), if required..... :	see page 7	P
	p) the weight, if required ..... :	see page 7	P
	q) type A or type B DBO	type B	P

6	**INFORMATION**		**P**
6.1	**ASSEMBLY designation marking**		**P**
	Information regarding the ASSEMBLY provided on the designation label(s):		P
	a) ASSEMBLY manufacturer's name or trade mark		P
	b) type designation or identification number or any other means of identification		**P**
	c) means of identifying date of manufacture		**P**
	d) IEC 61439-3		**P**
	e) rated current of the DBO		**P**
	d) degree of protection if greater than IP 2XC	IP65	**P**
6.2	**Documentation**		**P**
6.2.1	**Information relating to the ASSEMBLY**		**P**
	All applicable interface characteristics according cl. 5, provided in technical documentation.		P
6.2.2	**Instructions for handling, installation, operation and maintenance**		**P**
	The ASSEMBLY manufacturer provides in documents or catalogues:		P
	Conditions for handling, installation, operation and maintenance and equipment contained		**P**
	proper and correct transport, handling, installation and operation		P
	provision of weight details		P
	correct location and installation of lifting means and the thread size of lifting attachments		P
	The measures to be taken, if any, with regard to EMC		P

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Clause	Requirement + Test	Result - Remark	Verdict
	If an ASSEMBLY specifically intended for environment A is to be used in environment B a warning is included		P
	Circuitry - suitable information is supplied, e. g. wiring diagrams or tables.		P
6.3	**Device and/or component identification**		**P**
	it is possible to identify individual circuits and their protective devices.		P
	Identification tags are legible, permanent and appropriate		P
	Any designations used are according IEC 61346-1 and IEC 61346-2 and identical to wiring diagrams, in accordance with IEC 61082-1.		N/A
7	**SERVICE CONDITIONS**		**P**
7.1	**Normal service conditions**		**P**
7.1.3	**Pollution degree**		**P**
	A minimum pollution degree 2 applies for DBO	PD 3	P
7.1.4	**Altitude**		**P**
	The altitude of installation site not exceed 2 000 m.		P
7.2	**Special service conditions**		**N/A**
	Special service conditions, agreements manufacturer and user.		N/A
	a) values of temperature, relative humidity and/or altitude differing from those specified in 7.1		N/A
	b) exceptional condensation inside the ASSEMBLY		N/A
	c) heavy pollution		N/A
	d) exposure to strong electric or magnetic fields		N/A
	e) exposure to extreme climatic conditions		N/A
	f) attack by fungus or small creatures		N/A
	g) fire or explosion hazards		N/A
	h) heavy vibration, shocks, seismic occurrences		N/A
	i) current-carrying capacity or breaking capacity affected		N/A
	j) exposure to conducted and radiated disturbances other than described in 9.4		N/A
	k) exceptional overvoltage conditions		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	l) harmonics in the supply voltage or load current		N/A
7.3	**Conditions during transport, storage and installation**		P
	transport, storage and installation conditions differ from 7.1.		P
8	**CONSTRUCTIONAL REQUIREMENTS**		**P**
8.1	**Strength of materials and parts**		**P**
	Materials capable of withstanding mechanical, electrical, thermal and environmental stresses		P
8.1.2	**Protection against corrosion**		**P**
	Corrosion prevented by use of suitable materials, coatings. Compliance checked by 10.2.2.		P
8.1.3	**Properties of insulating materials**		**P**
8.1.3.1	**Thermal stability**		N/A
	For enclosures or parts of enclosures made of insulating materials, thermal stability is verified according to 10.2.3.1.		N/A
8.1.3.2	**Resistance of insulating materials to heat and fire**		N/A
8.1.3.2.2	**Resistance of insulating materials to heat**		N/A
	Compliance either by reference to the insulation temperature index (determined for example by the methods of IEC 60216) or by compliance with IEC 60085.		N/A
8.1.3.2.3	**Resistance of insulating materials to abnormal heat and fire due to internal electric effects**		**P**
	Insulating materials withstand glow-wire test in 10.2.3.3.		P
	Alternative test method for small parts		P
8.1.4	**Resistance to ultra-violet radiation**		P
	External insulating materials for outdoor use resistive to ultra-violet radiation according to 10.2.4.		P
8.1.5	**Mechanical strength**		**P**
	All enclosures, locking means, etc. have sufficient mechanical strength (see also 10.13).		P
	The mechanical operation of removable parts, including any insertion interlock, is verified by test according to 10.13.		p
8.1.6	**Lifting provision**		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	Provision for lifting complies with 10.2.5.		N/A
8.2	**Degree of protection provided by an ASSEMBLY enclosure**		P
8.2.1	**Protection against mechanical impact**		**P**
	The DBO complies with IK codes according to IEC 62262. Compliance verified according to 10.2.6.		P
	- IK 05 for a DBO for indoor use		N/A
	- IK 07 for a DBO for outdoor use		P
8.2.2	**Protection against contact with live parts, ingress of solid foreign bodies and liquids**		**P**
	IP code verified according to 10.3		P
	IP degree for indoor at least 2XC after installation		N/A
	IP degree for outdoor at least IP X3.		P
	IP rating for separate parts		N/A
	Enclosed ASSEMBLIES, for use in locations with high humidity and temperatures varying within wide limits, are provided with suitable arrangements to prevent harmful condensation		N/A
	Suitable arrangements (ventilation and/or internal heating, drain holes, etc.) are available		N/A
	The specified degree of protection is maintained.		P
8.2.3	**Assembly with removable parts**		N/A
	measures to ensure adequate protection given		N/A
	Shutters prevented from unintentional removal.		N/A
8.3	**Clearances and creepage distances**		P
	clearances and creepage distances of equipment comply with their product standard.		P
8.3.2	**Clearances**		P
	Clearances as specified in IEC 61439-1, table 1 or design verification test and routine impulse withstand voltage test according 10.9.3 and 11.	see table 8.3	P
8.3.3	**Creepage distances**		**P**
	Creepage distances according to IEC 61439-1 in table 2. The creepage distances are not less than the associated minimum clearances.	see table 8.3	P
8.4	**Protection against electric shock**		**P**
8.4.1	**General**		**P**
	Arrangement ensures necessary degree of safety.		P

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Clause	Requirement + Test	Result - Remark	Verdict

8.4.2	**Basic protection**		**P**
	Basic protection achieved by appropriate constructional measures or during installation.		P
	Manufacturer provides relevant information.		P
8.4.2.2	**Basic insulation provided by insulating material**		**P**
	Hazardous live parts completely covered with insulation, only removable by destruction or tool.		P
	Insulation suitable		P
	Paints, varnishes and not used as basic insulation.		N/A
8.4.2.3	**Barriers or enclosures**		**P**
	Air insulated live parts at least IP XXB.		P
	Horizontal top surfaces of accessible height ≤1,6 m at least IP XXD.		P
	Barriers and enclosures firmly secured in place		P
	distance between conductive barrier or enclosure and live parts not less than distances in 8.3.		P
	For removal, opening enclosures one of conditions a) to c) is fulfilled:		P
	a) use of a key or tool	barriers	P
	b) restoration of supply possible only after replacement or reclosure.		N/A
	In TN-C systems, PEN conductor not switched		N/A
	c) Intermediate barrier removable only by key or tool		P
8.4.3	**Fault protection**		P
8.4.3.1	**Installation conditions**		**P**
	protective measures according IEC 60364-4-41		P
	For TT system incoming circuits fulfil a) or b)		N/A
	a) double or reinforced insulation		N/A
	b) RCD protection		N/A
8.4.3.2	**Requirements for the protective conductor to facilitate automatic disconnection of the supply**		**P**
8.4.3.2.1	**General**		**P**
	protective conductor for automatic disconnection provided		P
8.4.3.2.2	**Requirements for earth continuity providing protection against the consequences of faults within the ASSEMBLY**		**P**

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Clause	Requirement + Test	Result - Remark	Verdict
	exposed conductive parts connected together and to the protective conductor of the supply		P
	Connections achieved by metal screwed connections, welding or other conductive connections or separate protective conductor.		P
	For the continuity of these connections the following is applied:		P
	a) When a part is removed, protective circuits not interrupted. Means are sufficient for permanent conductivity.		P
	Flexible or pliable metal conduits not used as protective conductors unless designed therefore		P
	b) Sufficient connection of lids, doors, cover plates, etc. If apparatus with voltages exceeding ELV is attached, sufficient PE conductor acc tab 3 is assembled		P
	Removable parts equipped with a metal supporting surface, sufficient pressure ensured		P
8.4.3.2.3	**Requirements for protective conductors providing protection against the consequences of faults in external circuits supplied through the ASSEMBLY**		**P**
	Protective conductor capable of stresses by external faults.		P
	Protective conductors don't include disconnecting device , except the following: - Links only with access limited or by tool - Connectors: Interruption of PE last break, first make		P
	Conductors to voltage-operated fault detection devices insulated		P
	cross-sectional area not less than value calculated from Annex B		P
	For PEN conductors, the following additional requirements apply:		N/A
	– minimum cross-sectional area 10 mm² copper or 16 mm² aluminium		N/A
	–PEN conductor cross-sectional area not less than for neutral conductor		N/A
	– structural parts, except mounting rails, not used as a PEN conductor		N/A
8.4.3.3	**Electrical separation**		N/A
	see Annex K		N/A
8.4.4	**Protection by total insulation**		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	For protection, by total insulation, against indirect contact the following requirements are met:		N/A
	a) Enclosure completely of insulating material and carrying symbol ⧈ visible from outside.		N/A
	b) Fault voltages not possible , if enclosure pierced by conducting parts		N/A
	c) All live parts enclosed, at least IP 2XC		N/A
	Assemblies for protective conductor through-wiring have terminals and are marked adequately.		N/A
	Inside the enclosure, the protective conductor and its terminals insulated		N/A
	d) Exposed conductive parts not connected to the protective circuit		N/A
	e) barrier of insulating material against unintentional contact and not removable without tool		N/A
8.4.5	**Limitation of steady-state touch current and charge**		N/A
	Warning plate for steady-state touch current and charges		N/A
8.4.6	**Operating and servicing conditions**		P
8.4.6.1	**Devices to be operated or components to be replaced by ordinary persons**		N/A
	Protection against contact with live parts maintained when operating devices or replacing components.		N/A
8.4.6.2	**Requirements related to accessibility in service by authorized persons**		**P**
	interlock automatically restored		N/A
8.4.6.2.2	**Requirements related to accessibility for inspection and similar operations**		**P**
	Operations in service and under voltage performable		P
	Such operations may consist of:		P
	– visual inspection		P
	– adjusting and resetting of relays, releases and electronic devices		P
	– replacement of fuse-links		N/A
	– replacement of indicating lamps		N/A
	– certain fault location operations, e. g. measuring		P
8.4.6.2.3	**Requirements related to accessibility for maintenance**		**P**
	maintenance on isolated functional unit or isolated group of functional units, necessary measures are enabled		P

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Clause	Requirement + Test	Result - Remark	Verdict
	Such measures may include:		P
	– sufficient space		P
	– use of barriers or obstacles		P
	– use of terminal shields		P
	– use of compartments		N/A
	– insertion of additional protective means		N/A
8.4.6.2.4	**Requirements related to accessibility for extension under voltage**		N/A
	extension with additional functional units or groups, with the rest of the ASSEMBLY still under voltage		N/A
8.4.6.2.5	**Obstacles**		N/A
	This subclause of Part 1 does not apply.		N/A
8.5	**Incorporation of switching devices and components**		P
8.5.1	**Fixed parts**		P
	For fixed parts, the connections of the main circuits is only connected or disconnected when the ASSEMBLY is not under voltage.		P
	Removal and installation of fixed parts requires the use of a tool.		P
	The disconnection of a fixed part requires the isolation of the complete ASSEMBLY or part of it.		P
8.5.2	**Removable and withdrawable parts**		N/A
	The removable and withdrawable parts can be safely isolated from or connected to the main circuit .		N/A
	clearances and creepage distances comply during transfer		N/A
	Removable parts fitted with a device, which ensures that it can only be removed and inserted after its main circuit has been switched off from the load.		N/A
	unauthorized operation prevented		N/A
8.5.3	**Selection of switching devices and components**		P
	Switching devices and components comply with the relevant IEC standards.	See attachment Table 11	P
	Switching devices and components suitable for application		P
	Switching devices and components with insufficient short-circuit withstand strength and/or a breaking capacity protected by means of current-limiting protective devices		P

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Clause	Requirement + Test	Result - Remark	Verdict
	Co-ordination of current-limiting protective devices		P
	Co-ordination of switching devices and components		P
	Outgoing circuits contain protective devices, intended to be operated by ordinary persons		N/A
	Re-closing of the incoming protective device not complying with the above standards, require a key or tool or instruction label	incoming protective device shall be provided and only authorized person allowed	N/A
	Modifications on circuit breaker settings not possible without tool and visible indication		P
	Incoming protective device contains fuse-links not complying with IEC 60269-3, a key or is required for access		N/A
8.5.4	**Installation of switching devices and components**		**P**
	Switching devices and components installed and wired in accordance with instructions and proper function not impaired		P
	When fuses are installed the original manufacturer states the type and rating of the fuselinks to be used.	See attachment Table 10	N/A
8.5.5	**Accessibility**		**P**
	Adjusting and resetting devices easily accessible.		P
	Functional units on the same support so arranged as accessible for mounting, wiring, maintenance and replacement.		P
	Following accessibility requirements associated with floor-mounted ASSEMBLIES apply:		P
	- Terminals so placed that the cables can easily connected		P
	- Indicating instruments within a zone between 0,2 m and 2,2 m above the base		P
	- Operating devices centreline located within a zone between 0,2 m and 2 m		P
	- Actuators for emergency switching devices are accessible within a zone between 0,8 m and 1,6 m		P
8.5.6	**Barriers**		**P**
	Barriers for manual switching devices are so designed that the switching emissions do not present a danger to the operator.		P
	To minimize danger when replacing fuse-links, interphase barriers are applied		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
8.5.7	**Direction of operation and indication of switching positions**		**P**
	The operational positions of components and devices are clearly identified.		P
8.5.8	**Indicator lights and push-buttons**		N/A
	Unless otherwise specified in the relevant product standard the colours of indicator lights and push-buttons are in accordance with IEC 60073.		N/A
8.6	**Internal electrical circuits and connections**		**P**
8.6.1	**Main circuits**		**P**
	The busbars (bare or insulated) are arranged in such a manner that an internal short-circuit is not to be expected.		P
	They are rated at least in accordance with the information concerning the short-circuit withstand strength and designed to withstand at least the short-circuit stresses limited by the protective device(s) on the supply side of the busbars.		P
	minimum cross-sectional area of the neutral within a three phase and neutral circuit is:		P
	- For circuits with a phase conductor cross-sectional area up to and including 16 mm², 100 % of that of the corresponding phases		P
	- For circuits with a phase conductor cross-sectional area above 16 mm², 50 % of that of the corresponding phases with a minimum of 16 mm²		N/A
	neutral currents not exceed 50 % of phase currents.		P
8.6.2	**Auxiliary circuits**		N/A
	Faults do not cause unintentional dangerous operation.		N/A
	auxiliary circuits are protected against the effects of short circuits.		N/A
	However, a short-circuit protective device is not provided if its operation is liable to cause a danger. In such a case, the conductors of auxiliary circuits are arranged in such a manner that a short-circuit is not to be expected (see 8.6.4).		N/A
8.6.3	**Bare and insulated conductors**		**P**
	current-carrying parts not suffer undue alteration		P
	effects of thermal expansion , electrolytic action		P
	connections: sufficient and durable contact pressure		P

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Clause	Requirement + Test	Result - Remark	Verdict
	selection of conductors and their cross-sections		P
	minimum cross-section according to IEC 60364-5-52		N/A
	In the case of insulated solid or flexible conductors:		P
	- rated for insulation voltage of circuit		P
	- Conductors connecting two termination points have no intermediate joint, e.g. spliced or soldered		P
	- basic insulated conductors prevented from coming into contact with bare live parts at different potentials		P
	- Contact of conductors with sharp edges prevented		P
	mechanical damage can occur by moving covers or doors		P
	- Soldered connections only where provision is made for this type of connection		P
	- For other apparatus ,soldering cable lugs or soldered ends of stranded conductors are not used under conditions of heavy vibration.		P
	In locations where heavy vibrations exist during normal operation, attention is given to the support of conductors		P
	- only one conductor connected to a terminal		P
	two or more conductors to one terminal only where the terminals are designed for this purpose.		P
	solid insulation between separate circuits based on the circuit of highest rated insulation voltage.		P
8.6.4	**Selection and installation of non-protected live conductors to reduce the possibility of short-circuits**		**P**
	Non protected live conductors installed so that an internal short-circuit between phases or between phase and earth is a remote possibility.		P
	Non-protected live conductors not exceed 3m length.		P
8.6.5	**Identification of the conductors of main and auxiliary circuits**		**P**
	identification of conductors agrees with indications on the wiring diagrams and drawings.		P
	Where appropriate, identification according to IEC 60445 and IEC 60446 are applied		P
8.6.6	**Identification of the protective conductor (PE, PEN) and of the neutral conductor (N) of the main circuits**		**P**
	The protective conductor is readily distinguishable by location and/or marking or colour.		P

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Clause	Requirement + Test	Result - Remark	Verdict
	only green and yellow for protective conductor.		P
	When the protective conductor is an insulated single-core cable, this colour identification is used		P
	Any neutral conductor of the main circuit is readily distinguishable by location and/or marking or colour. If identification by colour only is used, it is blue (see IEC 60445).		P
8.7	**Cooling**		N/A
	natural and active or forced cooling.		N/A
8.8	**Terminals for external conductors**		**P**
	The terminals are suitable for connection of copper or aluminium conductors, or both.		P
	The terminals provided sufficient contact pressure		P
	Terminals are capable of accommodating copper conductors from the smallest to the largest cross-sectional areas corresponding to the appropriate rated current.		P
	Where aluminium conductors are to be terminated, the type, size and termination method of the conductors are as agreed between the ASSEMBLY manufacturer and the user.		N/A
	The available wiring space permits proper connection		P
	The conductors are not subjected to stresses		P
	Terminals for the neutral conductor allow the connection of copper conductors having a current-carrying capacity:		P
	– equal to half the current-carrying capacity of the phase conductor, with a minimum of 16 mm²,		N/A
	– equal to the full current-carrying capacity of the phase conductor, if less than or equal to 16 mm²		P
	If connecting facilities for incoming and outgoing neutral, protective and PEN conductors are provided.		P
	They are arranged in the vicinity of the associated phase conductor terminals		P
	Openings so designed that, stated protective measures against contact and degree of protection are obtained.		P
	The terminals for external protective conductors are marked according to IEC 60445.		P

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Clause	Requirement + Test	Result - Remark	Verdict
	The terminals for external protective conductors (PE, PEN) and metal sheathing of connecting cables are suitable for the connection of copper conductors.		P
	A separate terminal of adequate size is provided for the outgoing protective conductor(s) of each circuit.		P
	Terminals for protective having a cross-section depending on corresponding phase conductors.		P
	consideration to the danger of electrolytic corrosion if aluminium used		P
	The connecting means to ensure the continuity of the conductive parts with external protective conductors have no other function.		P
	Identification of terminals shall comply with IEC 60445.		P
	The number of neutral terminals not less than one outgoing terminal for each outgoing circuit requiring a neutral terminal.		P
	These Terminals are located or identified in the same sequence as their respective phase conductor terminals.		P
	DBOs are a minimum of two terminals for electrical installation protective bonding conductors.		P
9	**PERFORMANCE REQUIREMENTS**		**P**
9.1	**Dielectric properties**		**P**
9.1.2	**Power-frequency withstand voltage**		**P**
	withstanding temporary and transient overvoltages	see test 10.9	–
	The rated insulation voltage of any circuit equal higher than its maximum operational voltage.		P
9.1.3	**Impulse withstand voltage**		**P**
9.1.3.1	**Impulse withstand voltages of main circuits**		**P**
	Clearances capable of withstanding the test voltage given appropriate to the rated impulse withstand voltage.	see test 10.9.3	–
	The rated impulse withstand voltage not less than that corresponding to the nominal voltage and appropriate overvoltage category in Annex G		P
9.1.3.2	**Impulse withstand voltages of auxiliary circuits**		N/A
	a) Auxiliary circuits without overvoltage reduction comply with 9.1.3.1.		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	b) Auxiliary circuits not connected to main circuit capable of withstanding the appropriate impulse withstand voltage.		N/A
9.1.4	**Protection of surge protective devices**		N/A
	SPDs on main busbars protected to prevent uncontrolled short-circuit conditions		N/A
9.2	**Temperature rise limits**		**P**
	Currents can be carried without exceeding any temperature limits	see test 10.10	P
	No damages during test		P
	For insulating materials, the ASSEMBLY Manufacturer demonstrates compliance either by reference to the insulation temperature index (determined for example by the methods of IEC 60216) or by compliance with IEC 60085.		P
9.3	**Short-circuit protection and short-circuit withstand strength**		**P**
9.3.1	**General**		**P**
	ASSEMBLIES are capable of withstanding the thermal and dynamic stresses resulting from short-circuit currents not exceeding the rated values.	see test 10.11	P
	ASSEMBLIES protected against short-circuit currents		P
9.3.2	**Information concerning short-circuit withstand strength**		N/A
	For short-circuit protective device (SCPD) incorporated in the incoming unit, maximum value of prospective short-circuit current indicated.		N/A
	value does not exceed the appropriate rating(s) (see 5.3.4, 5.3.5 and 5.3.6). The corresponding power factor and peak values are those shown in 9.3.3.		P
	If a circuit breaker with time-delay release is used as the short-circuit protective device, settings corresponding		N/A
	where the short-circuit protective device is not incorporated in the incoming unit, short-circuit withstand strength indicated in one or more of the following ways:		P
	a) rated short-time withstand current (I_{cw}) together with the associated duration (see 5.3.5) and rated peak withstand current (I_{pk}) (see 5.3.4)		P
	b) rated conditional short-circuit current (I_{cc}) (see 5.3.6)		N/A
	characteristics of the short-circuit protective devices necessary for the protection indicated		P

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Clause	Requirement + Test	Result - Remark	Verdict
	For several incoming units which are unlikely to be in operation simultaneously, the short-circuit withstand strength can be indicated for each of the incoming units in accordance with the above.		P
	incoming units likely operated simultaneously, and one incoming unit and one or more outgoing high-power units likely to contribute to the short-circuit current, prospective short-circuit current values determined in each incoming unit, in each outgoing unit and in the busbars		P
9.3.3	**Relationship between peak current and short-time current**		**P**
	For determining the electrodynamic stresses, the value of peak current is obtained by multiplying the r.m.s. value of the short-circuit current by the factor *n*.		P
9.3.4	**Co-ordination of protective devices**		**P**
	co-ordination of protective devices agreed between manufacturer user or given in catalogue		P
	Selectivity of protective devices		P
	Series connected short-circuit protective devices: warning notice for replacing devices		P
9.4	**Electromagnetic compatibility (EMC)**		N/A
	For EMC related performance requirements, see J.9.4 of Annex J.		N/A
10	**DESIGN VERIFICATION**		**P**
10.2	**STRENGTH OF MATERIALS AND PARTS**		**P**
10.2.1	**General**		**P**
	Enclosure fulfils IEC 62208, no enclosure testing to 10.2 required.		N/A
10.2.2	**Resistance to corrosion**		**P**
10.2.2.2	**Severity test A**		N/A
	This test is applies to:		N/A
	- metallic indoor enclosures		N/A
	- external metallic parts of indoor ASSEMBLIES		N/A
	- internal metallic parts of indoor and outdoor ASSEMBLIES		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	6 cycles of 24 h each to damp heat cycling test (Test Db) at 40 ± 3°C and relative humidity of 95% 2 cycles of 24 h each to salt mist test (Test Ka: Salt mist) at 35 ± 2°C		-
	The following is an alternative test on parts or representative samples of the steel enclosures of the DBO:		N/A
	- Immersion in cold chemical degreaser such as methylchloroform or refined petrol for 10 min.		N/A
	- Then the parts are immersed in a 10% solution of ammonium chloride in water at a temperature of 20 ± 5°C for 10 min.		N/A
	- The parts placed in a box containing air saturated with moisture at 20 ± 5°C for 10 min.		N/A
	- After the parts have dried in a heating cabinet at 100 ± 5°C for 10 min. and have been left at room temperature for 24 h		N/A
	After the test their surface are show no signs of iron oxidation		N/A
10.2.2.3	**Severity test B**		**P**
	This test is applies to:		P
	- metallic indoor enclosures		P
	- external metallic parts of indoor ASSEMBLIES		P
	Each 12 day period comprises:		P
	5 cycles of 24 h each to damp heat cycling test (Test Db) at 40 ± 3°C and relative humidity of 95% 7 cycles of 24 h each to salt mist test (Test Ka: Salt mist) at 35 ± 2°C		P
10.2.2.4	**Results to be obtained**		**P**
	After the test, samples washed, dried and stored under normal service conditions for 2 h. This does not apply to the alternative test		P
	Compliance is checked by visual inspection to determine that:		P
	– there is no evidence of iron oxide, cracking or other deterioration more than that allowed by ISO 4628-3;		P
	– the mechanical integrity is not impaired;		P
	– seals are not damaged;		P
	– doors, hinges, locks, and fastenings work without abnormal effort.		P

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Clause	Requirement + Test	Result - Remark	Verdict

10.2.3	**Properties of insulating materials**		**P**
10.2.3.1	**Verification of thermal stability of enclosures**		N/A
	Heating test 70 °C for h and recovery of 96 h.	See attachment Table 1	N/A
	No visible cracks		N/A
	Dry piece of rough cloth, pressed with 5 N. No traces of the cloth remains on the sample and the material of the enclosure or sample does not stick to the cloth.		N/A
10.2.3.2	**Verification of resistance of insulating materials to abnormal heat and fire due to internal electric effects**		**P**
	– 960 °C for parts necessary to retain current-carrying parts in position;	See attachment Table 2	P
	– 850 °C for enclosures intended for mounting in hollow walls;	See attachment Table 2	N/A
	– 650 °C for all other parts, including parts necessary to retain the protective conductor.	See attachment Table 2	N/A
	– flames and glowing extinguish within 30 s	no flame	N/A
	no burning of tissue paper		P
10.2.4	**Resistance to ultra-violet (UV) radiation**		**P**
	Representative samples of such parts subjected to the following test:		P
	UV test according to ISO 4892-2 method A; Cycle 1 of a total test period of 500 h.		P
	Insulating enclosures: Flexural strength (according to ISO 178) and Charpy impact (according to ISO 179) of insulating materials have 70 % minimum retention.		N/A
	For the test carried out in accordance with ISO 178, the surface of the sample exposed to UV is turned face down and the pressure applied to the non-exposed surface.		N/A
	For the test carried out in accordance with ISO 179 for materials whose impact bending strength cannot be determined prior to exposure because no rupture has occurred, not more than tree of the exposed test specimens break.		N/A
	enclosures constructed of metals entirely coated by synthetic material have a minimum retention of category 3 according to ISO 2409.		P
	Samples show no cracks or deterioration		P
10.2.5	**Lifting**		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	The maximum number of sections lifted together, equipped with components and/or weights to achieve a weight of 1,25 times its maximum shipping weight. ..... :		N/A
	During the test, with the test weights in place, the ASSEMBLY shows no deflections and after the test show no cracks or permanent distortions visible, which could impair any of its characteristics.		N/A
10.2.6	**Mechanical impact**		**P**
	Verification of the degrees of protection against mechanical impacts shall be carried out in accordance with IEC 62262.	See attachment Table 3	-
	Impact spring hammer test as described in IEC 60068-2-75.		-
	The test made after the samples has been for 2 h at a temperature of -5°C ± 1 K for indoor use and -25°C ± 1 K for outdoor use		P
	Compliance is checked on those exposed parts which may be subjected to mechanical impact		P
	Three blows applied on separate places of each of the accessible faces and door.		P
	The impacts evenly distributed on the faces of the enclosures under test.		P
	Blows not applied to knock-outs, built-in components , other fastening means which are to be subject to impact.		P
	Cable entries which are not provided with knock-outs left open. Two knock-outs opened.		P
	Before applying the blows, fixing screws of bases, covers and the like tightened with torque of table 102		P
	After the test, the specified IP code and dielectric properties maintain		P
	removable covers can still be removed and reinstalled, doors opened and closed		P
10.2.7	**Marking**		**P**
	The test is made by rubbing the marking by hand for 15 s with a piece of cloth soaked in water and then for 15 s with a piece of cloth soaked with petroleum spirit.		P
	After the test the marking is legible to normal or corrected vision without additional magnification.		P
10.3	**DEGREE OF PROTECTION OF ASSEMBLIES**		**P**

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Clause	Requirement + Test	Result - Remark	Verdict
	The degree of protection provided is verified in accordance with IEC 60529 ……..:	IP65	P
	Empty enclosure according IEC 62208 not influenced by external modification, further tests not required		N/A
	IP 5X tested according to category 2 in 13.4 of IEC 60529.		N/A
	No harmful ingress of dust.		N/A
	IP 6X are tested according to category 1 in 13.4 of IEC 60529.		P
	No ingress of dust.		P
	The test device for IP X3 and IP X4 as well as the type of support for the enclosure during the IP X4…:		-
	No or acceptable ingress of water after IP X1 to IP X6 tests		P
10.4	**CLEARANCES AND CREEPAGE DISTANCES**		**P**
	The clearances are sufficient to enable the declared rated impulse withstand voltage (Uimp) of a circuit to be achieved. Rated impulse withstands voltage. ……. :	See attachment Table 4	-
	Required clearances as specified in Table 1. …… :	see attached table	-
	Measured clearances …… :	see attached table	P
	For any given circuit the rated insulation voltage is not less than the rated operational voltage (Ue). Insulation voltage Ui…… :	500V	P
	Pollution degree. …… :	3	P
	Material group . …… :	IIIa	P
	Minimum creepage required…… :	see attached table	P
	The creepage distances measured…… :	see attached table	P
10.5	**PROTECTION AGAINST ELECTRIC SHOCK AND INTEGRITY OF PROTECTIVE CIRCUITS**		**P**
10.5.1	**Effectiveness of the protective circuit**		**P**
	The effectiveness of protective circuit is verified for the following functions:		-
	a) protection against the consequences of a fault within the ASSEMBLY as outlined in 10.5.2, and		P
	b) protection against the consequences of faults in external circuits supplied through the ASSEMBLY as outlined in 10.5.3		P

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Clause	Requirement + Test	Result - Remark	Verdict
10.5.2	**Effective earth continuity between the exposed conductive parts of the ASSEMBLY and the protective circuit**		**P**
	A current of 10 A a.c. or d.c. is passed between each exposed conductive part and the terminal for the external protective conductor.		P
	The resistance does not exceed 0,1 Ω		P
10.5.3	**Short-circuit withstand strength of the protective circuit**		**P**
10.5.3.2	**Protective circuits that are exempted from short-circuit withstand verification**		**P**
	Where a separate protective conductor is provided in accordance with 8.4.3.2.3, short-circuit testing is not required if one of the conditions of 10.11.2. is fulfilled.		P
10.5.3.3	**Verification by comparison with a reference design – Utilising a check list**		N/A
	Verification by design rules is achieved by verification with an already tested design utilising items 1 to 6 and 8 to 10 of the check list in Table 13 shows no deviations.		N/A
10.5.3.4	**Verification by comparison with a reference design – Utilising calculation**		N/A
	Verification by comparison with a reference design based on calculation is in accordance with 10.11.4		N/A
10.5.3.5	**Verification by test**		N/A
	Subclause 10.11.5.6 applies.		N/A
10.6	**INCORPORATION OF SWITCHING DEVICES AND COMPONENTS**		**P**
	Compliance with the design requirements of 8.5 for the incorporation of switching devices and components is confirmed by inspection and verified to the requirements of this standard.		P
10.6.2	**Electromagnetic compatibility**		N/A
	The performance requirements of J.9.4 for electromagnetic compatibility is confirmed by inspection or where necessary by test (see J.10.12).		N/A
10.7	**INTERNAL ELECTRICAL CIRCUITS AND CONNECTIONS**		**P**
	Compliance with the design requirements of 8.6 for internal electrical circuits and connections is confirmed by inspection and verified to this standard.		P
10.8	**TERMINALS FOR EXTERNAL CONDUCTORS**		**P**
	Compliance with the design requirements of 8.8 for terminals for external conductors is confirmed by inspection.		P
10.9	**DIELECTRIC PROPERTIES**		**P**

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Clause	Requirement + Test	Result - Remark	Verdict
10.9.1	**General**		**P**
10.9.2	**Power-frequency withstand voltage**		**P**
10.9.2.1	**Main, auxiliary and control circuits**		**P**
	Main, auxiliary and control circuits that are connected to the main circuit are subjected to the test voltage according to Table 8.	See attachment Table 5	P
	Auxiliary and control circuits, whether a.c. or d.c., that are not connected to the main circuit are subjected to the test voltage according to Table 9.		N/A
10.9.2.2	**Test voltage**		**P**
	The test voltage sinusoidal between 45 Hz and 65 Hz.		P
	The high-voltage transformer output current is at least 200 mA.		P
	The overcurrent relay does not trip when the output current is less than 100 mA.		P
	The value of the test voltage is that specified in Table 8 or 9 as appropriate with a permitted tolerance of ± 3 %.		P
10.9.2.3	**Application of the test voltage**		**P**
	The voltage at the moment of application does not exceed 50 % of the full test value. It is then be increased progressively to this full value and maintained for 5 s		-
	a) between all live parts of the main circuit connected together and exposed conductive parts		P
	b) between each live part of different potential of the main circuit and the other live parts of different potential and exposed conductive parts connected together		P
	c) between each control and auxiliary circuit not normally connected to the main circuit and the – main circuit; – other circuits; – exposed conductive parts including the earthed enclosure.		N/A
10.9.2.4	**Acceptance criteria**		**P**
	The overcurrent relay does not operate and there are no disruptive discharge (see 3.6.17) during the tests.		P
10.9.3	**Impulse withstand voltage**		**P**

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Clause	Requirement + Test	Result - Remark	Verdict

10.9.3.1	**General**		**P**
	Verification made by test or by assessment		P
10.9.3.2	**Impulse withstand voltage test**		**P**
	The impulse voltage generator is adjusted to the required impulse voltage with the ASSEMBLY connected. The value of the test voltage is that specified in 9.1.3. The accuracy of the applied peak voltage is ± 3 %.		-
	Impulse withstand voltage (Uimp) ..... :		-
	Auxiliary circuits not connected to main circuits are connected to earth. The 1,2/50 µs impulse voltage is applied to the ASSEMBLY five times for each polarity at intervals of 1 s		-
	a) between all live parts of the main circuit connected together and exposed conductive parts		P
	b) between each live part of different potential of the main circuit and the other live parts of different potential and exposed conductive parts connected together		P
	c) between each control and auxiliary circuit not normally connected to the main circuit and the – main circuit; – other circuits; – exposed conductive parts		N/A
	Overcurrent relay does not and no disruptive discharge occur during test.		P
10.9.3.3	**Alternative power-frequency voltage test**		N/A
	The test voltage sinusoidal between 45 Hz and 65 Hz.		N/A
	The high-voltage transformer output current is at least 200 mA.		N/A
	The overcurrent relay does not trip when the output current is less than 100 mA.		N/A
	The value of the test voltage is that specified in 9.1.3 and Table 10 as appropriate with a permitted tolerance of ± 3 %.		-
	Power-frequency ..... :		N/A
	The power-frequency voltage is applied once, at full value, for a duration sufficient for the magnitude to be ascertained, not less than 15 ms		N/A
	a) between all live parts of the main circuit connected together and exposed conductive parts		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	b) between each live part of different potential of the main circuit and the other live parts of different potential and exposed conductive parts connected together		N/A
	c) between each control and auxiliary circuit not normally connected to the main circuit and the – main circuit; – other circuits; – exposed conductive parts including the earthed enclosure.		N/A
	Overcurrent relay does not and no disruptive discharge occur during test.		N/A
10.9.3.4	**Alternative d.c. voltage test**		N/A
	The test voltage has negligible ripple.		N/A
	The high-voltage transformer output current is at least 200 mA.		N/A
	The overcurrent relay does not trip when the output current is less than 100 mA.		N/A
	The value of the test voltage is that specified in 9.1.3 and Table 10 as appropriate with a permitted tolerance of ± 3 %.		-
	Alternative d.c. voltage ..... :		N/A
	The d.c. voltage is applied once for each polarity for a duration sufficient for the magnitude to be ascertained, but it is not less than 15 ms or greater than 100 ms.		N/A
	a) between all live parts of the main circuit connected together and exposed conductive parts		N/A
	b) between each live part of different potential of the main circuit and the other live parts of different potential and exposed conductive parts connected together		N/A
	Overcurrent relay does not and no disruptive discharge occur during test.		N/A
10.9.3.5	**Verification assessment**		**P**
	Clearances are verified by measurement, or verification of measurements on design drawings, employing the measurement methods stated in Annex F.		P
	The clearances are at least 1,5 times the values specified in Table 1.		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	It is verified by assessment of the device manufacturer's data that all incorporated devices are suitable for the specified rated impulse withstand voltage (Uimp).		N/A
10.9.4	**Testing of enclosures made of insulating material**		N/A
	a.c. voltage applied between enclosure covered with metal foil and interconnected live and exposed conductive parts inside the enclosure. Test voltage 1,5 times of table 8.		N/A
	Overcurrent relay does not and no disruptive discharge occur during test.		N/A
10.9.5	**External operating handles of insulating material**		N/A
	A dielectric test is carried out on handles made of or covered by insulating material by applying a test voltage equal to 1,5 times the test voltage indicated in Table 8 between the live parts and a metal foil wrapped round the whole surface of the handle.		N/A
	During this test, the exposed conductive parts shall not be earthed or connected to any other circuit.		N/A
10.10	**VERIFICATION OF TEMPERATURE RISE**		**P**
10.10.2	**Verification by testing**		**P**
10.10.2.1	**General**		**P**
	a) most onerous arrangement(s) selected		P
	b) The ASSEMBLY is verified by one of the following methods:		P
	1) considering individual functional units, the main and distribution busbars and the ASSEMBLY collectively according to 10.10.2.3.5;		P
	2) considering individual functional units separately and the complete ASSEMBLY including the main and distribution busbars according to 10.10.2.3.6;		N/A
	3) considering individual functional units and the main and distribution busbars separately as well as the complete ASSEMBLY according to 10.10.2.3.7.		N/A
	c) test results used to establish the ratings of similar variants without further testing according rules of 10.10.3		N/A
10.10.2.2	**Selection of the representative arrangement**		N/A
	Selection of representative arrangements according 10.10.2.2.2 and 10.10.2.2.3		N/A
10.10.2.2.2	**Busbars**		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	variants of which differ only in the reduction of height, or reduction of thickness or quantity of bars per conductor, but which have the same arrangement of bars, the same conductor spacing, the same enclosure and busbar compartment (if any), as a minimum for the test, the busbars with the greatest cross-sectional area is selected as the representative arrangement.		N/A
	For ratings of smaller busbar size variants or other materials see 10.10.3.3.		N/A
10.10.2.2.3	**Functional units**		N/A
	a) Selection of comparable functional unit groups		N/A
	Functional units intended to be used at different rated currents can be considered to have a similar thermal behaviour and form a comparable range of units, if they fulfil the following conditions:		-
	1) the function and basic wiring diagram of the main circuit is the same (e.g. incoming unit, reversing starter, cable feeder);		N/A
	2) the devices are of the same frame size and belong to the same series;		N/A
	3) the mounting structure is of the same type;		N/A
	4) the mutual arrangement of the devices is the same;		N/A
	5) the type and arrangement of conductors is the same;		N/A
	6) the cross-section of the main circuit conductors within a functional unit has a rating at least equal to that of the lowest rated device in the circuit. Selection of conductors are as tested or in accordance with IEC 60364-5-52.		N/A
	b) Selection of a critical variant out of each comparable group as a specimen for test		N/A
	For the critical variant the most onerous compartment (where applicable) and enclosure conditions (with respect to shape, size, design of partitions and enclosure ventilation) is tested.		N/A
	The maximum possible current rating for each variant of functional unit is established.		N/A
	For functional units containing only one device this is the rated current of the device.		N/A
	For functional units with several devices, it is that of the device with the lowest rated current.		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	If a combination of devices connected in series is intended to be used at a lower current (e.g. motor starter combination), this lower current is used.		N/A
	For each functional unit the power loss is calculated at the maximum possible current using the data given by the device manufacturer for each device together with the power losses of the associated conductors.		N/A
	For functional units with currents up to and including 630 A, the critical unit in each range is the functional unit with the highest total power loss.		N/A
	For functional units with currents above 630 A the critical unit in each range is that which has the highest rated current. This ensures that additional thermal effects relating to eddy currents and current displacement are taken into consideration.		N/A
	The critical functional unit is at least tested inside the smallest compartment (if any) which is intended for this functional unit; and with the worst variant of internal separation (if any) with respect to size of ventilation openings; and the enclosure with the highest installed power loss per volume; and the worst variant of ventilation of the enclosure with respect to kind of ventilation (natural or forced convection) and size of ventilation openings.		N/A
	If the functional unit can be arranged in different orientations (horizontal, vertical), then the most onerous arrangement is tested.		N/A
10.10.2.3	**Methods of test**		**P**
	The temperature-rise test on the individual circuits is made with the type of current for which they are intended, and at the design frequency.		P
	Coils of relays, contactors, releases, etc., are supplied with rated operational voltage		P
	mounted as in normal use, with all covers including bottom cover plates, etc., in place.		P
	tightening torque applied to terminals in accordance with those specified for the temperature rise test in the relevant device product standard.		P
	fuses fitted for the test with fuse-links as specified by the manufacturer.		N/A
	The power losses of the fuse-links used for the test are stated		P

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Clause	Requirement + Test	Result - Remark	Verdict
	The size and the disposition of external conductors used for the test are stated in the test report.		P
	The average value of the actual incoming test currents between -0 % and + 3% of intended value. Each phase within ± 5% of the intended value.		P
	undue cooling prevented		P
	adjacent functional units replaced by heating resistors		P
	where there is a possibility that additional control circuits or devices may be incorporated, heating resistors simulate the power dissipation of these additional items.		P
10.10.2.3.2	**Test conductors**		**P**
	the cross-section of the external test conductors are in accordance with the following:		P
	a) **For values of rated current up to and including 400 A:**		**P**
	1) the conductors are single-core, copper cables or insulated wires with cross-sectional areas as given in Table 11		P
	2) as far as practicable, the conductors are in free air		P
	3) the minimum length of each temporary connection from terminal to terminal is: – 1 m for cross-sections up to and including 35 mm² – 2 m for cross-sections larger than 35 mm².		P
	b) **For values of rated current higher than 400 A but not exceeding 800 A:**		N/A
	1) The conductors are single-core copper cables with cross-sectional areas as given in Table 12, or the equivalent copper bars given in Table 12 as specified by the original manufacturer.		N/A
	2) Cables or copper bars are spaced at approximately the distance between terminals. Multiple parallel cables per terminal are bunched together and arranged with approximately 10 mm air space between each other. Multiple copper bars per terminal are spaced at a distance approximately equal to the bar thickness. If the sizes stated for the bars are not suitable for the terminals or are not available, it is allowed to use other bars having the same cross-sectional dimensions ± 10 % and the same or smaller cooling surfaces. Cables or copper bars are not interleaved.		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	3) For single-phase or multi-phase tests, the minimum length of any temporary connection to the test supply is 2 m. The minimum length to a star point may be reduced to 1,2 m where agreed by the original manufacturer.		N/A
	c) **For values of rated current higher than 800 A but not exceeding 4000 A:**		N/A
	1) The conductors are copper bars of the sizes stated in Table 12 unless the ASSEMBLY is designed only for cable connection. In this case, the size and arrangement of the cables are as specified by the original manufacturer.		N/A
	2) Copper bars are spaced at approximately the distance between terminals. Multiple copper bars per terminal are spaced at a distance approximately equal to the bar thickness. If the sizes stated for the bars are not suitable for the terminals or are not available, it is allowed to use other bars having the same cross-sectional dimensions ± 10 % and the same or smaller cooling surfaces. Copper bars are not interleaved.		N/A
	3) For single-phase or multi-phase tests, the minimum length of any temporary connection to the test supply is 3 m, but this can be reduced to 2 m provided that the temperature rise at the supply end of the connection is not more than 5 K below the temperature rise in the middle of the connection length. The minimum length to a star point is 2 m.		N/A
	d) **For values of rated current higher than 4 000 A:**		N/A
	The original manufacturer determines all relevant items of the test, such as type of supply, number of phases and frequency (where applicable), cross-sections of test conductors, etc. This information is part of the test report.		N/A
10.10.2.3.3	**Measurement of temperatures**		**P**
	Thermocouples or thermometers are used for temperature measurements.		P
	For windings, the method of measuring the temperature by resistance variation is used.		P
	The thermometers or thermocouples is protected against air currents and heat radiation.		P
	The temperature is measured at all points where a temperature-rise limit (see 9.2) must be observed.		P
	Particular attention is given to joints in conductors and terminals within the main circuits.		P

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Clause	Requirement + Test	Result - Remark	Verdict
	For measurement of the temperature of air inside an ASSEMBLY, several measuring devices are arranged in convenient places.		P
10.10.2.3.4	**Ambient air temperature**		**P**
	The thermometers or thermocouples are protected against air currents and heat radiation.		P
	The ambient temperature during the test is between +10 °C and +40 °C.		P
10.10.2.3.5	**Verification of the complete ASSEMBLY**		**P**
	Incoming and outgoing circuits of the ASSEMBLY are loaded with their rated currents that result in the rated diversity factor being equal to 1.		P
	If the rated current of the incoming circuit or distribution busbar system is less than the sum of the rated currents of all outgoing circuits, then the outgoing circuits shall be split into groups corresponding to the rated current of the incoming circuit or distribution busbar system.		P
	The groups are formed in a manner so that the highest possible temperature rise is obtained.		P
	Sufficient groups are formed and tests undertaken so as to include all different variants of functional units in at least one group.		P
	Where the fully loaded circuits do not distribute exactly the total incoming current, the remaining current is distributed via any other appropriate circuit.		P
	This test is repeated until all types of outgoing circuit have been verified at their rated current.		P
	Change in the arrangement of functional units within a verified ASSEMBLY, or section of an ASSEMBLY may necessitate additional tests as the thermal influence of the adjacent units may differ significantly.		P
10.10.2.3.6	**Verification considering individual functional units separately and the complete ASSEMBLY**		N/A
	The rated currents of the circuits according to 5.3.2 and the rated diversity factor according to 5.3.3 are verified in two stages.		N/A
	The rated current of each critical variant functional unit (10.10.2.2.3.b)) shall be verified separately in accordance with 10.10.2.3.7 c).		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	The ASSEMBLY is verified by loading the incoming circuit to its rated current and all outgoing functional units collectively to their rated current multiplied by the diversity factor.		N/A
	If the rated current of the incoming circuit or distribution busbar system is less than the sum of the test currents of all outgoing circuits (i.e. the rated currents multiplied by the diversity factor), then the outgoing circuits shall be split into groups corresponding to the rated current of the incoming circuit or distribution busbar system.		N/A
	The groups as defined by the original manufacturer are formed in a manner so that the highest possible temperature rise is obtained.		N/A
	Sufficient groups are formed and tests undertaken so as to include all different variants of functional units in at least one group.		N/A
	One method to determine the most onerous group, is for the rated current of the DBO (I_{nA}), to be distributed amongst the smallest possible number of outgoing circuits, so that each of these circuits is loaded with its rated current multiplied by the assumed loading factor shown in table 101 of this standard or a diversity factor stated by the manufacturer.		N/A
	Where the fully loaded circuits do not distribute exactly the total incoming current, the remaining current is distributed via any other appropriate circuit.		N/A
	This test is repeated until all types of outgoing circuit have been verified at their rated current.		N/A
	Change in the arrangement of functional units within a verified ASSEMBLY, or section of an ASSEMBLY may necessitate additional tests as the thermal influence of the adjacent units may differ significantly.		N/A
10.10.2.3.7	**Verification considering individual functional units and the main and distribution busbars separately as well as the complete ASSEMBLY**		N/A
	ASSEMBLIES are verified by separate verification of standard elements a) to c) as selected in accordance with 10.10.2.2.2 and 10.10.2.2.3, and verification of a complete ASSEMBLY d) under worst case conditions as detailed below:		-
	a) Main busbars are tested separately.		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	b) Distribution busbars are tested separately from the outgoing units.		N/A
	c) Functional units are tested individually.		N/A
	d) The complete ASSEMBLY verified by temperature rise testing of the most onerous arrangement(s) possible in service and as defined by the original manufacturer.		N/A
	One method to determine the most onerous group, is for the rated current of the DBO (I_{nA}), to be distributed amongst the smallest possible number of outgoing circuits, so that each of these circuits is loaded with its rated current multiplied by the rated diversity factor shown in table 101 of this standard or a diversity factor stated by the manufacturer.		N/A
10.10.2.3.8	**Results to be obtained**		P
	At the end of the test, the temperature rise does not exceed the values specified in Table 6.		P
	The apparatus operates satisfactorily within the voltage limits specified for them at the temperature inside the ASSEMBLY.		P
10.10.3	**Derivation of ratings for similar variants**		N/A
10.10.3.2	**ASSEMBLIES**		N/A
	The ASSEMBLY that incorporates non-tested variants are verified by derivation from similar tested arrangements.		N/A
	ASSEMBLIES verified in this manner comply with the following:		-
	a) the functional units belong to the same group as the functional unit selected for test (see 10.10.2.2.3);		N/A
	b) the same type of construction as used for the test;		N/A
	c) the same or increased overall dimensions as used for the test;		N/A
	d) the same or increased cooling conditions as used for the test (forced or natural convection, same or larger ventilation openings);		N/A
	e) the same or reduced internal separation as used for the test (if any);		N/A
	f) the same or reduced power losses in the same section as used for the test;		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	g) the same or reduced number of outgoing circuits for every section		N/A
	The ASSEMBLY being verified may comprise all or only part of the electrical circuits of the ASSEMBLY previously verified.		N/A
	Alternative arrangement(s) of functional units within the ASSEMBLY or section compared to the tested variant is allowed as long as the thermal influences of the adjacent units are not more severe.		N/A
	Thermal tests performed on 3-phase, 3-wire ASSEMBLIES are considered as representing 3-phase, 4-wire and single-phase, 2-wire or 3-wire ASSEMBLIES, provided that the neutral conductor is sized equal to or greater than the phase conductors arranged in the same manner.		N/A
	DBO´s with synthetic enclosures are considered representative of DBOs with metallic enclosures, if the highest air temperature rise on the inside surfaces of the synthetic enclosure does not exceed the maximum surface temperature rise for the accessible external metal surface according to Table 6 of Part 1.		N/A
10.10.3.3	**Busbars**		N/A
	Ratings established for aluminium busbars are valid for copper busbars with the same cross sectional dimensions and configuration.		N/A
	The ratings of variants not selected for test according to 10.10.2.2.2 are determined by multiplying their cross-section with the current density of a larger cross-section busbar that has been verified by test.		N/A
	If additionally a smaller cross-section than the one to be derived has been tested, which also fulfils the conditions of 10.10.2.2.2, then the rating of the intermediate variants may be established by interpolation.		N/A
10.10.3.4	**Functional units**		N/A
	After the critical variants of a group of comparable functional units (see 10.10.2.2.3 a)) have been subjected to a test for verification of temperature rise limits, the actual rated currents of all other functional units in the group are calculated using the results of these tests.		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	For each functional unit tested a de-rating factor (rated current, resulting from the test divided by the maximum possible current of this functional unit, see 10.10.2.2.3 b)) is calculated.		N/A
	The rated current of each non-tested functional unit in the range is the maximum possible current of the functional unit multiplied by the lowest de-rating factor established for the variants tested in the range.		N/A
10.10.3.5	**Functional units – Device substitution**		N/A
	A device may be substituted with a similar device from another series to that used in the original verification, provided that the power loss and terminal temperature rise of the device, when tested in accordance with its product standard, is the same or lower.		N/A
	In addition, the physical arrangement within the functional unit and the rating of the functional unit is maintained.		N/A
10.10.4	**Verification by calculation**		N/A
	Determine the approximate air temperature rise inside the enclosure, which is caused by the power losses of all circuits, and compare this temperature with the limits for the installed equipment.		N/A
	Because the actual local temperatures of the current-carrying parts cannot be calculated by these methods, some limits and safety margins are necessary and are included.		N/A
10.10.4.2	**Single compartment assembly with rated current not exceeding 630 A**		N/A
	Verification of the temperature rise of a single compartment ASSEMBLY with the total supply current not exceeding 630 A and for rated frequencies up to and including 60 Hz may be made by calculation if all the following conditions are fulfilled:		-
	a) the power loss data for all built-in components is available from the component manufacturer;		N/A
	b) there is an approximately even distribution of power losses inside the enclosure;		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	c) the rated current of the circuits of the ASSEMBLY as verified (see 10.10.1) does not exceed 80 % of the rated conventional free air thermal current (Ith) if any, or the rated current (In) of the switching devices and electrical components included in the circuit. Circuit protection devices shall be selected to ensure adequate protection to outgoing circuits, e.g. thermal motor protection devices at the calculated temperature in the ASSEMBLY;		N/A
	d) the mechanical parts and the installed equipment are so arranged that air circulation is not significantly impeded;		N/A
	e) conductors carrying currents in excess of 200 A, and the adjacent structural parts are so arranged that eddy-current and hysteresis losses are minimised;		N/A
	f) all conductors have a minimum cross-sectional area based on the current rating of the functional unit according to IEC 60364-5-52. Examples on how to adapt this standard for conditions inside an ASSEMBLY are given in the tables included in Annex H. Where the device manufacturer specifies a conductor with a larger cross sectional area this is used;		N/A
	g) the temperature rise depending on the power loss installed in the enclosure for the different installation methods (e.g. flush mounting, surface mounting), is: – available from the enclosure manufacturer; – determined in accordance with 10.10.4.2.2; or – in accordance with performance and installation criteria from the cooling equipment manufacturer when active cooling (e.g. forced cooling, internal air conditioning, heat exchanger etc.) is incorporated.		N/A
	The effective power losses of all circuits including interconnecting conductors are calculated based on maximum load currents of the circuits.		N/A
	The total power loss of the ASSEMBLY is calculated by adding the power losses of the circuits taking additionally into account that the total load current is limited to the rated current of the ASSEMBLY.		N/A
	The power losses of the conductors are determined by calculation (see Annex H).		N/A
10.10.4.2.2	**Determination of the power loss capability of an enclosure by test**		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	The power loss is simulated by means of heating resistors that produce heat equivalent to the intended power loss capability of the enclosure.		N/A
	The heating resistors are distributed evenly over the height of the enclosure and installed in suitable places inside the enclosure.		N/A
	The cross-section of the leads to these resistors are such that no appreciable amount of heat is conducted away from the enclosure.		N/A
	The test is carried out in accordance with 10.10.2.3.1 to 10.10.2.3.4 and the air temperature rise is measured in the top of the enclosure.		N/A
	Enclosure temperatures do not exceed the values given in Table 6.		N/A
10.10.4.2.3	**Results to be obtained**		N/A
	The ASSEMBLY is verified if the air temperature determined from the calculated power loss does not exceed the permissible operating air temperature as declared by the device manufacturer.		N/A
	This means for switching devices or electrical components in the main circuits that the continuous load does not exceed its permissible load at the calculated air temperature and not more than 80 % of its rated current (see 10.10.4.2.1 c).		N/A
10.10.4.3	**ASSEMBLY with rated current not exceeding 1 600 A**		N/A
10.10.4.3.1	**Verification method**		N/A
	Verification of the temperature-rise of a multiple compartment ASSEMBLY with the total supply current not exceeding 1 600 A and for rated frequencies up to and including 60 Hz, may be made by calculation in accordance with the method of IEC 60890 if all the following conditions are fulfilled:		-
	a) the power loss data for all built-in components is available from the component manufacturer;		N/A
	b) there is an approximately even distribution of power losses inside the enclosure;		N/A
	c) the rated current of the circuits of the ASSEMBLY as verified (see 10.10.1) do not exceed 80 % of the rated conventional free air thermal current (Ith) if any, or the rated current (In) of the switching devices and electrical components included in the circuit.		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	d) the mechanical parts and the installed equipment are so arranged that air circulation is not significantly impeded;		N/A
	e) conductors carrying currents in excess of 200 A, and the adjacent structural parts are so arranged that eddy-current and hysteresis losses are minimised;		N/A
	f) all conductors have a minimum cross-sectional area based on the current rating of the functional unit according to IEC 60364-5-52. Examples on how to adapt this standard for conditions inside an ASSEMBLY are given in the tables included in Annex H.		N/A
	Where the device manufacturer specifies a conductor with a larger cross sectional area this conductor is used;		N/A
	g) for enclosures with natural ventilation, the cross section of the air outlet openings is at least 1,1 times the cross section of the air inlet openings;		N/A
	h) there are no more than three horizontal partitions in the ASSEMBLY or a section of an ASSEMBLY;		N/A
	i) for enclosures with compartments and natural ventilation the cross section of the ventilating openings in each horizontal partition is at least 50 % of the horizontal cross section of the compartment.		N/A
	The effective power losses of all circuits including interconnecting conductors are calculated based on maximum load currents of the circuits.		N/A
	The total power loss of the ASSEMBLY is calculated by adding the power losses of the circuits taking additionally into account that the total load current is limited to the rated current of the ASSEMBLY.		N/A
	The power losses of the conductors are determined by calculation (see Annex H).		N/A
	The temperature rise within the ASSEMBLY is then determined from the total power loss using the method of IEC 60890.		N/A
10.10.4.3.2	**Results to be obtained**		N/A
	The ASSEMBLY is verified if the calculated air temperature at the mounting height of any device does not exceed the permissible ambient air temperature as declared by the device manufacturer.		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	Switching devices or electrical components in the main circuits that the continuous load do not exceed its permissible load at the calculated local air temperature and not more than 80 % of its rated current (see 10.10.4.3.1 c).		N/A
10.11	**SHORT-CIRCUIT WITHSTAND STRENGTH**		P
	Short-circuit current ratings declared shall be verified except where exempt, see 10.11.2.		-
	Verification may be, by comparison with a reference design (10.11.3 and 10.11.4) or by test (10.11.5). For verification the following applies:		-
	a) If the ASSEMBLY system to be verified comprises a number of variants, most onerous arrangement(s) of the ASSEMBLY shall be selected, taking into account the rules in 10.11.3.		N/A
	b) the ASSEMBLY variants selected for test shall be verified according to 10.11.5.		N/A
	c) when the ASSEMBLIES tested are the most onerous variants of the larger product range of an ASSEMBLY system then the test results can be used to establish the ratings of similar variants without further testing. Rules for such derivations are given in 10.11.3 and 10.11.4.		N/A
10.11.2	**Circuits of ASSEMBLIES which are exempted from the verification of the short-circuit withstand strength**		P
	Verification of the short-circuit withstand strength is not required for the following:		-
	a) ASSEMBLIES having a rated short-time withstand current or rated conditional short-circuit current not exceeding 10 kA r.m.s;		P
	b) ASSEMBLIES, or circuits of ASSEMBLIES, protected by current-limiting devices having a cut-off current not exceeding 17 kA with the maximum allowable prospective short-circuit current at the terminals of the incoming circuit of the ASSEMBLY;		P
	c) Auxiliary circuits of ASSEMBLIES intended to be connected to transformers whose rated power does not exceed 10 kVA for a rated secondary voltage of not less than 110 V, or 1,6 kVA for a rated secondary voltage less than 110 V, and whose short-circuit impedance is not less than 4 %.		N/A
	All other circuits shall be verified.		N/A
10.11.3	**Verification by comparison with a reference design – Utilising a check list**		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	Verification by the application of design rules is undertaken by comparison of the assembly to be verified with an already tested design using the check list provided in Table 13.	See attachment Table 7	N/A
	Should any elements identified in the check list not comply with the requirements of the check list and be marked “NO”, one of the following means of verification shall be used (see 10.11.4 and 10.11.5).		N/A
10.11.4	**Verification by comparison with a reference design – Utilising calculation**		N/A
	Assessment of the rated short-time withstand current of an ASSEMBLY and its circuits, by calculation and the application of design rules, is undertaken by a comparison of the ASSEMBLY to be assessed with an ASSEMBLY or an ASSEMBLY module, already verified by test.		N/A
	In addition each of the circuits of the ASSEMBLY to be assessed meets the requirements of items 6, 8, 9 and 10 in Table 13.		N/A
	The data used, calculations made and comparison undertaken are recorded.		N/A
	If the assessment in accordance with Annex P is not passed or any of the items listed above are not fulfilled then the ASSEMBLY and its circuits shall be verified by test in accordance with 10.11.5.		N/A
10.11.5	**Verification by test**		N/A
	The ASSEMBLY or its parts as necessary to complete the test are mounted as in normal use.	See attachment Table 7 and 8	N/A
	It is sufficient to test a single functional unit if the remaining functional units are of the same construction.		N/A
	Similarly it is sufficient to test a single busbar configuration if the remaining busbar configurations are of the same construction.		N/A
10.11.5.2	**Performance of the test – General**		N/A
	If the test circuit incorporates fuses, fuse-links with the maximum let-through current and, if required, of the type indicated by the original manufacturer as being acceptable, they are used.		N/A
	The supply conductors and the short-circuit connections required for testing the ASSEMBLY have sufficient strength to withstand short-circuits and be so arranged that they do not introduce any additional stresses on the ASSEMBLY.		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	Unless otherwise agreed, the test circuit is connected to the input terminals of the ASSEMBLY. Three-phase ASSEMBLIES are connected on a three-phase basis.		N/A
	All parts of the equipment intended to be connected to the protective conductor in service, including the enclosure, are connected as follows:		-
	a) for ASSEMBLIES suitable for use on three-phase four-wire systems (see also IEC 60038) with an earthed star point and marked accordingly, to the neutral point of supply or to a substantially inductive artificial neutral permitting a prospective fault current of at least 1500 A;		N/A
	b) for ASSEMBLIES also suitable for use in three-phase three-wire as well as on three-phase four-wire systems and marked accordingly, to the phase conductor least likely to arc to earth.		N/A
	The connection mentioned in a) and b) include a fusible element consisting of a copper wire of 0,8 mm diameter and at least 50 mm long, or of an equivalent fusible element for the detection of a fault current.		N/A
	The prospective fault current in the fusible element circuit shall be 1 500 A $\pm$ 10 %.		N/A
10.11.5.3	**Testing of main circuits**		N/A
	Circuits are tested with the highest thermal and dynamic stresses that may result from short circuit currents up to the rated values for one or more of the following conditions as declared by the original manufacturer.		N/A
	a) Not dependent upon a SCPD. The ASSEMBLY is tested with the rated peak withstand current and the rated short-time withstand current for the specified duration		N/A
	b) Dependent upon an incoming SCPD included within the ASSEMBLY. The assembly is tested with an incoming prospective short-circuit current for a period time that is limited by the incoming SCPD.		N/A
	c) Dependent upon an upstream SCPD. The ASSEMBLY is tested to the let through values permitted by the upstream SCPD as defined by the original manufacturer.		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	Where an incoming or outgoing circuit includes a SCPD that reduces the peak and/or duration of the fault current, then the circuit is tested allowing the SCPD to operate and interrupt the fault current		N/A
	If the SCPD contains an adjustable short-circuit release, then this is set to the maximum allowed value		N/A
	One of each type of circuit is subject to a short-circuit test		N/A
10.11.5.3.2	**Outgoing circuits**		N/A
	The outgoing terminals of outgoing circuits are provided with a bolted short-circuit connection.		N/A
	When the protective device in the outgoing circuit is a circuit-breaker, the test circuit may include a shunting resistor in accordance with 8.3.4.1.2 b) of IEC 60947-1 in parallel with the reactor used to adjust the short-circuit current.		N/A
	For circuit-breakers having a rated current up to and including 630 A, a conductor 0,75 m in length having a cross-sectional area corresponding to the rated current (see Tables 11 and 12) is included in the test circuit.		N/A
	The switching device is closed and held closed in the manner normally used in service. The test voltage is then applied once and,		N/A
	a) for a time sufficiently long to enable the short-circuit protective device in the outgoing unit to operate to clear the fault and, in any case, for not less than 10 cycles (test voltage duration), or		N/A
	b) in cases where the outgoing circuit does not include a SCPD, for a magnitude and duration as specified for the busbars by the original manufacturer. Testing of outgoing circuits may also result in the operation of the incoming circuit SCPD.		N/A
10.11.5.3.3	**Incoming circuit and main busbars**		N/A
	ASSEMBLIES containing main busbars are tested to prove the short-circuit withstand strength of the main busbars and the incoming circuit including at least one joint where the busbars are intended to be extendable.		N/A
	The short-circuit is placed such that the length of main busbar included in the test is (2 ± 0,4) m.		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	For the verification of rated short-time withstand current (see 5.3.5) and rated peak withstand current (see 5.3.4), this distance may be increased and the test conducted at any convenient voltage providing the test current is the rated value		N/A
	Where the design of the ASSEMBLY is such that the length of the busbars to be tested is less than 1,6 m and the ASSEMBLY is not intended to be extended, then the complete length of busbar is tested, the short-circuit being established at the end of these busbars.		N/A
	If a set of busbars consists of different sections (as regards cross-sections, distance between adjacent busbars, type and number of supports per metre), each section is tested separately or concurrently, provided that the above conditions are met.		N/A
	A rated conditional short-circuit current can be assigned where the distance of the main and distribution busbar between the load terminals of the incoming device connected to the main busbar and the supply terminals of the outgoing functional unit does not exceed 3 m.		N/A
	The main busbar, distribution busbar and incoming device may be tested and rated on the basis of the reduced short-circuit stresses occurring on the load side of the respective short-circuit protective device within each unit. Provided that these conductors are arranged so that an internal short-circuit between phases and/or between phases and earth is not to be expected.		N/A
10.11.5.3.4	**Connections to the supply side of outgoing units**		N/A
	Where an ASSEMBLY contains conductors between a main busbar and the supply side of outgoing functional units that do not fulfil the requirements of 8.6.4 one circuit of each type is subject to an additional test.		N/A
	A short-circuit is obtained by bolted connections on the conductors connecting the busbars to a single outgoing unit, as near as practicable to the terminals on the busbar side of the outgoing unit. The value of the short-circuit current is the same as that for the main busbars.		N/A
10.11.5.3.5	**Neutral conductor**		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	If a neutral conductor exists within a circuit it is subjected to one test to prove its short-circuit withstand strength in relation to the nearest phase conductor of the circuit under test including any joints.		N/A
	Unless otherwise agreed between the original manufacturer and the User, the value of the test current in the neutral is at least 60 % of the phase current during the three-phase test.		N/A
	The test need not be executed if the test is intended to be made with a current of 60 % of the phase current and if the neutral conductor is:		-
	– the same shape and cross- section as the phase conductors		N/A
	– supported in an identical manner as the phase conductors and with support centres along the length of the conductor not greater than that of the phases;		N/A
	– spaced at a distance from the nearest phase(s) not less than that between phases;		N/A
	– spaced at a distance from earthed metalwork not less than the phase conductors.		N/A
10.11.5.4	**Value and duration of the short-circuit current**		N/A
	For all short-circuit withstand ratings, the dynamic and thermal stresses shall be verified with a prospective current, at the supply side of the specified protective device, if any, equal to the value of the rated short-time withstand current, rated peak withstand current or rated conditional short-circuit current assigned.		N/A
	For the verification of all the short-circuit withstand ratings, the value of prospective short-circuit current at a test voltage equal to 1,05 times the rated operational voltage shall be determined from a calibration oscillogram which is taken with the supply conductors to the ASSEMBLY short-circuited by a connection of negligible impedance placed as near as possible to the input supply of the ASSEMBLY.		N/A
	The oscillogram shall show that there is a constant flow of current such that it is measurable at a time equivalent to the operation of the protective device incorporated in the ASSEMBLY or for the specified duration (see 9.3.2. a)).		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	The value of current during the calibration is the average of the r.m.s. values of the a.c. component in all phases. When making the tests at maximum operational voltage, the calibration current in each phase is equal to the rated short-circuit current within a +5 % tolerance and the power factor is within a -0,05 tolerance.		N/A
	All tests shall be made at the rated frequency of the ASSEMBLY with a tolerance of ± 25 %, and at the power factor appropriate to the short-circuit current in accordance with Table 7.		N/A
	a) For a test at rated conditional short circuit current Icc, whether the protective devices are in the incoming circuit of the ASSEMBLY or elsewhere, the test voltage shall be applied for a time sufficiently long to enable the short-circuit protective devices to operate to clear the fault and, in any case, for not less than 10 cycles. The test shall be conducted at 1,05 times the rated operational voltage with prospective short circuit currents, at the supply side of the specified protective device, equal to the value of the rated conditional short-circuit current. Tests at lower voltages are not permitted.		N/A
	b) For a test at rated short-time withstand current and rated peak withstand current, the dynamic and thermal stresses shall be verified with a prospective current equal to the value of rated short-time withstand current and rated peak withstand current declared. The current shall be applied for the specified time during which the r.m.s. value of its a.c. component shall remain constant.		N/A
	In the case of test station difficulty of making the short-time or peak withstand tests at the maximum operational voltage, the tests according to 10.11.5.3.3, 10.11.5.3.4 and 10.11.5.3.5 are made at any convenient voltage, with the original manufacturer's agreement, the actual test current being, in this case, equal to the rated short-time current or peak withstand current. This shall be stated in the test report.		N/A
	The peak current withstand test and the short-time current test may be separated. In this case, the time during which the short-circuit is applied for the peak current withstand test shall be such that the value I^2t is not larger than the equivalent value for the short-time current test, but it shall be not less than three cycles.		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	Where the required test current in each phase cannot be achieved the positive tolerance may be exceeded with the agreement of the original manufacturer.		N/A
10.11.5.5	**Results to be obtained**		N/A
	After the test deformation of busbars and conductors is acceptable provided that the clearances and creepage distances specified in 8.3 are still complied with.		N/A
	The characteristics of the insulation remains such that the mechanical and dielectric properties of the equipment satisfy the requirements of the relevant ASSEMBLY standard.		N/A
	A busbar insulator or support or cable restraint has not separated into two or more pieces.		N/A
	There are no cracks appearing on opposite sides of a support and no cracks, including surface cracks, running the full length or width of the support.		N/A
	There are no loosening of parts used for the connection of conductors and the conductors are not separated from the outgoing terminals.		N/A
	Distortion of the busbars or structure of the ASSEMBLY that impairs its normal use are a failure.		N/A
	Any distortion of the busbars or structure of the ASSEMBLY that impairs normal insertion or removal of the removable parts is a failure.		N/A
	Deformation of the enclosure or of the internal partitions, barriers and obstacles due to short-circuit is permissible to the extent that the degree of protection is not impaired and the clearances or creepage distances are not reduced to values, which are less than those specified		N/A
	Additionally after the tests incorporating short-circuit protective devices, the tested equipment is capable of withstanding the dielectric test at a value of voltage for the “after test” condition prescribed in the relevant short-circuit protective device standard for the appropriate short-circuit test, as follows:		-
	a) between all live parts and the exposed conductive parts of the ASSEMBLY, and		N/A
	b) between each pole and all other poles connected to the exposed conductive parts of the ASSEMBLY.		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	If tests a) and b) above are conducted, they are carried out with any fuses replaced and with any switching device closed.		N/A
	The fusible element (see 10.11.5.2.), if any, does not indicate a fault current.		N/A
	In case of any doubt, it shall be checked that the apparatus incorporated in the ASSEMBLY are in a condition as prescribed in the relevant specifications.		N/A
10.11.5.6	**Testing of the protective circuit**		N/A
	A single-phase test supply is connected to the incoming terminal of one phase and to the terminal for the incoming protective conductor.		N/A
	When the ASSEMBLY is provided with a separate protective conductor, the nearest phase conductor is used.		N/A
	For each representative outgoing unit, a separate test is made with a bolted short-circuit connection between the corresponding outgoing phase terminal of the unit and the terminal for the relevant outgoing protective conductor.		N/A
	Each outgoing unit on test is fitted with its intended protective device. Where alternative protective devices can be incorporated in the outgoing unit, the protective device which lets through the maximum values of peak current and I^2t is used.		N/A
	For this test, the frame of the ASSEMBLY is insulated from earth. The test voltage is equal to 1,05 times the single-phase value of the rated operational voltage.		N/A
	Unless otherwise agreed between the original manufacturer and the user, the value of the test current in the protective conductor is at least 60 % of the phase current during the three-phase test of the ASSEMBLY.		N/A
	All other conditions of this test are analogous to 10.11.5.2 to 10.11.5.4 inclusive.		N/A
10.11.5.6.2	**Results to be obtained**		N/A
	The continuity and the short-circuit withstand strength of the protective circuit, whether it consists of a separate conductor or the frame, are not significantly impaired.		N/A
	Besides visual inspection, this may be verified by measurements with a current in the order of the rated current of the relevant outgoing unit.		N/A

IEC 61439-2			
Clause	Requirement + Test	Result - Remark	Verdict
	Deformation of the enclosure or of the internal partitions, barriers and obstacles due to short-circuit is permissible to the extent that the degree of protection is not apparently impaired and the clearances or creepage distances are not reduced to values, which are less than those specified in 8.3.		N/A
10.12	**ELECTROMAGNETIC COMPATIBILITY (EMC)**		N/A
	For EMC tests, see J.10.12.		N/A
10.13	**MECHANICAL OPERATION**		N/A
	For parts, which need verification by test, satisfactory mechanical operation is verified after installation in the DBO. The number of operating cycles is 50.		N/A
	At the same time, the operation of the mechanical interlocks associated with these movements is checked.		N/A
	The test is passed if the operating conditions of the apparatus, interlocks, specified degree of protection etc., have not been impaired and if the effort required for operation is practically the same as before the test.		N/A

IEC 61439-2			
Clause	Requirement + Test	Result - Remark	Verdict

	ANNEX J: ELECTROMAGNETIC COMPATIBILITY (EMC)		N/A
J.9.4	**Performance requirements**		N/A
J.9.4.1	**General**		N/A
	environmental condition A and/or B		N/A
J.9.4.2	**Requirement for testing**		N/A
	a) devices and components are in compliance stated environment (see J.9.4.1)		N/A
	b) The internal installation and wiring is carried out in accordance with the devices and Components Manufacturers' instructions (arrangement with regard to mutual influences, cable, screening, earthing etc.)		N/A
	In all other cases the EMC requirements are to be verified by tests as per J.10.12.		N/A
J.9.4.3	**Immunity**		N/A
J.9.4.3.1	**ASSEMBLIES not incorporating electronic circuits**		N/A
	ASSEMBLIES not incorporating electronic circuits are not sensitive to electromagnetic disturbances and therefore no immunity tests are required.		N/A
J.9.4.3.2	**ASSEMBLIES incorporating electronic circuits**		N/A
	Electronic equipment incorporated in ASSEMBLIES comply with the immunity requirements of the relevant product or generic EMC standard and are suitable for the specified EMC environment stated by the ASSEMBLY manufacturer.		N/A
	In all other cases the EMC requirements are to be verified by tests as per J.10.12.		N/A
	Equipment utilizing electronic circuits in which all components are passive (for example diodes, resistors, varistors, capacitors, surge suppressors, inductors) are not required to be tested.		N/A
	The ASSEMBLY manufacturer obtains from the device and or component manufacturer the specific performance criteria of the product based on the acceptance criteria given in the relevant product standard.		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
J.9.4.4	**Emission**		N/A
J.9.4.4.1	**ASSEMBLIES not incorporating electronic circuits**		N/A
	For ASSEMBLIES not incorporating electronic circuits, electromagnetic disturbances can only be generated by equipment during occasional switching operations. The duration of the disturbances is of the order of milliseconds. The frequency, the level and the consequences of these emissions are considered as part of the normal electromagnetic environment of lowvoltage installations. Therefore, the requirements for electromagnetic emission are deemed to be satisfied, and no verification is necessary.		N/A
J.9.4.4.2	**ASSEMBLIES incorporating electronic circuits**		N/A
	Electronic equipment incorporated in the ASSEMBLY comply with the emission requirements of the relevant product or generic EMC standard and are suitable for the specific EMC environment stated by the ASSEMBLY manufacturer.		N/A
J.9.4.4.2.1	**Frequencies of 9 kHz or higher**		N/A
	ASSEMBLIES incorporating electronic circuits (such as switched mode power supplies, circuits incorporating microprocessors with high-frequency clocks) may generate continuous electromagnetic disturbances.		N/A
	For such emissions, these do not exceed the limits specified in the relevant product standard, or the requirements of Table J.1 for environment A and/or Table J.2 for environment B applies. These tests are only required when the main and/or auxiliary circuits contain components with fundamental switching frequencies equal or greater than 9 kHz.		N/A
	Tests are to be carried out as detailed in the relevant product standard, if any, otherwise according to J.10.12.		N/A
J.9.4.4.2.2	**Frequencies lower than 9 kHz**		N/A
	ASSEMBLIES incorporating electronic circuits, which generate low frequency harmonics on the mains supply, comply with the requirements of IEC 61000-3-2 where applicable.		N/A

IEC 61439-2			
Clause	Requirement + Test	Result - Remark	Verdict

J.10.12	**Tests for EMC**		N/A
	The emission and immunity tests are carried out in accordance with the relevant EMC standard (see Tables J.1, J.2, J.3 and J.4); however, the ASSEMBLY manufacturer specifies any additional measures necessary to verify the criteria of performance for the ASSEMBLIES if necessary (e.g. application of dwell times).		N/A
J.10.12.1	**Immunity tests**		N/A
J.10.12.1.1	**ASSEMBLIES not incorporating electronic circuits**		N/A
	No tests are necessary.		N/A
J.10.12.1.2	**ASSEMBLIES incorporating electronic circuits**		N/A
	Tests are made according to the relevant environment: A or B		N/A
	The values used are given in Tables J.3 and/or J.4 except where a different test level is given in the relevant specific product standard and justified by the electronic components manufacturer.		N/A
	Electrostatic discharge immunity test IEC 61000-4-2	Performance criterion A/B/C	N/A
	Radiated radio-frequency electromagnetic field immunity test IEC 61000-4-3 at 80 MHz to 1 GHz and 1,4 GHz to 2 GHz	Performance criterion A/B/C	N/A
	Electrical fast transient/burst immunity test IEC 61000-4-4	Performance criterion A/B/C	N/A
	1,2/50 µs and 8/20 µs surge immunity test IEC 61000-4-5	Performance criterion A/B/C	N/A
	Conducted radio-frequency immunity test IEC 61000-4-6 at 150 kHz to 80 MHz	Performance criterion A/B/C	N/A
	Immunity to power-frequency magnetic fields IEC 61000-4-8	Performance criterion A/B/C	N/A
	Immunity to voltage dips and interruptions IEC 61000-4-11	Performance criterion A/B/C	N/A
	Immunity to harmonics in the supply IEC 61000-4-13	Performance criterion A/B/C	N/A
J.10.12.2	**Emission tests**		N/A
J.10.12.2.1	**ASSEMBLIES not incorporating electronic circuits**		N/A
	No tests are necessary		N/A
J.10.12.2.2	**ASSEMBLIES incorporating electronic circuits**		N/A

IEC 61439-2			
Clause	Requirement + Test	Result - Remark	Verdict
	Tests are made according to the relevant environment: A or B		N/A
	The test methods used; see J.9.4.4.2.		N/A
	If the ASSEMBLY incorporates telecommunication ports, the emission requirements of CISPR 22, relevant to that port and to the selected environment, applies.		N/A

IEC 61439-2			
Clause	Requirement + Test	Result - Remark	Verdict

	ANNEX K: PROTECTION BY ELECTRICAL SEPARATION		N/A
K.2	**Electrical separation**		N/A
K.2.2	**Supply source**		N/A
	The circuit is supplied through a source that provides separation i.e.		-
	• an isolating transformer, or		N/A
	• a source of current providing a degree of safety equivalent to that of the isolating transformer specified above, for example a motor generator with windings providing equivalent isolation.		N/A
	Mobile sources of supply connected to a supply system are selected in accordance with Clause K.3 (class II equipment or equivalent insulation).		N/A
	Fixed sources of supply are either:		-
	• selected in accordance with Clause K.3, or		N/A
	• such that the output is separated from the input and from the enclosure by an insulation satisfying the conditions of Clause K.3; if such a source supplies several items of equipment, the exposed conductive parts of that equipment are not connected to the metallic enclosure of the source.		N/A
K.2.3	**Selection and installation of supply source**		N/A
K.2.3.1	**Voltage**		N/A
	The voltage of the electrically separated circuit does not exceed 500 V.		N/A
K.2.3.2	**Installation**		N/A
K.2.3.2.1	Live parts of the separated circuit are not connected at any point to another circuit or to earth.		N/A
	To avoid the risk of a fault to earth, particular attention is given to the insulation of such parts from earth, especially for flexible cables and cords.		N/A
	Arrangements ensure electrical separation not less than that between the input and output of an isolating transformer.		N/A
K.2.3.2.2	Flexible cables and cords are visible throughout any part of their length liable to mechanical damage.		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
K.2.3.2.3	For separated circuits, the use of separate wiring systems is necessary. If the use of conductors of the same wiring system for the separated circuits and other circuits is unavoidable, multi-conductor cables without metallic covering, or insulated conductors in insulating conduit, ducting or trunking is used, provided that their rated voltage is not less than the highest voltage likely to occur, and that each circuit is protected against overcurrent.		N/A
K.2.4	**Supply of a single item of apparatus**		N/A
	Where a single item of apparatus is supplied, the exposed conductive parts of the separated circuit is not connected either to the protective conductor or exposed conductive parts of other circuits.		N/A
K.2.5	**Supply of more than one item of apparatus**		N/A
	If precautions are taken to protect the separated circuit from damage and insulation failure, a source of supply, complying with K.2.1, may supply more than one item of apparatus provided that all the following requirements are fulfilled.		-
	a) The exposed-conductive-parts of the separated circuit is connected together by insulated non-earthed equipotential bonding conductors. Such conductors are not connected to the protective conductors or exposed-conductive-parts of other circuits or to any extraneous conductive parts.		N/A
	b) All socket-outlets are provided with protective contacts which are connected to the equipotential bonding system provided in accordance with item a).		N/A
	c) Except where supplying class II equipment, all flexible cables embody a protective conductor for use as an equipotential bonding conductor.		N/A
	It is ensured that if two faults affecting two exposed conductive parts occur and these are fed by conductors of different polarity, a protective device disconnects the supply in a disconnecting time conforming to Table K.1.		N/A
	For voltages which are within the tolerance band stated in IEC 60038, the disconnecting time appropriate to the nominal voltage applies.		N/A
	For intermediate values of voltage, the next higher value in table K.1 is to be used.		N/A
K.3	**Class II equipment or equivalent insulation**		N/A

IEC 61439-2			
Clause	Requirement + Test	Result - Remark	Verdict
	Protection is provided by electrical equipment of the following types:		-
	• Electrical equipment having double or reinforced insulation (class II equipment)		N/A
	• ASSEMBLIES having total insulation see 8.4.3.4.		N/A
	This equipment is marked with the symbol 		N/A

IEC 61439-2			
Clause	Requirement + Test	Result - Remark	Verdict

10.10.4.2	**TABLE: Heating Test**		**P**
	Test Current (A)	**230V AC, 22.7A**	**—**
	Ambient (°C).....	**25℃**	**—**

Thermocouple Locations		**max. temperature measured, (°C)**		**max. temperature limit, (°C)**
		L	**N**	
1.	Incoming terminal block X2 (IN)	39	40	70 K
2.	Incoming terminal block X2 (OUT)	42	40	70 K
3.	Contactor KM1 terminal (IN)	46	44	70 K
4.	Contactor KM1 terminal (OUT)	47	45	70 K
5.	Contactor KM2 terminal (IN)	47	44	70 K
6.	Contactor KM2 terminal (OUT)	48	45	70 K
7.	Circuit breaker QF terminal (IN)	52	51	70 K
8.	Circuit breaker QF terminal (OUT)	55	52	70 K
9.	Load terminal block (IN)	41	40	70K
10.	Load terminal block (OUT)	43	41	70 K
11.	Enclosure	19		30K
12.	handle (MCB)	18		25K
13.	Ambient Temp. near main busbar			

10.9	**TABLE: Dielectric Strength**		**P**
Test voltage applied between:		**Test potential applied (V)**	**Breakdown / flashover (Yes/No)**
r.m.s			
Live parts – external conductive parts		1890	No
different potentials		1890	No
Impulse :			
Live parts – external conductive parts		4920	No
different potentials		4920	No
Supplementary information:			

IEC 61439-2			
Clause	Requirement + Test	Result - Remark	Verdict

10.10.4.2	**TABLE: Heating Test**		**P**
	Test Current (A)	**400V AC, 15.2A**	**—**
	Ambient (°C).....	**25℃**	**—**

Thermocouple Locations		**max. temperature measured, (°C)**			**max. temperature limit, (°C)**
		L1		**N**	
1.	Incoming terminal block X2 (IN)	42	/	40	70 K
2.	Incoming terminal block X2 (OUT)	43	/	41	70 K
3.	Contactor KM1 terminal (IN)	46	/	44	70 K
4.	Contactor KM1 terminal (OUT)	47	/	45	70 K
5.	Contactor KM2 terminal (IN)	47	/	44	70 K
6.	Contactor KM2 terminal (OUT)	49	/	45	70 K
7.	Circuit breaker QF terminal (IN)	53	/	51	70 K
8.	Circuit breaker QF terminal (OUT)	55	/	52	70 K
9.	Load terminal block (IN)	42	/	40	70 K
10.	Load terminal block (OUT)	43	/	41	70 K
11.	Enclosure	18			30K
12.	handle (MCB)	19			25K
13.	Ambient Temp. near main busbar	28.9			

10.9	**TABLE: Dielectric Strength**	**P**
Test voltage applied between:	**Test potential applied (V)**	**Breakdown / flashover (Yes/No)**
r.m.s		
Live parts – external conductive parts	1890	No
different potentials	1890	No
Impulse :		
Live parts – external conductive parts	4920	No
different potentials	4920	No
Supplementary information:		

IEC 61439-2			
Clause	Requirement + Test	Result - Remark	Verdict

TABLE: Clearance And Creepage Distance Measurements						P
clearance cl and creepage distance dcr at/of:	**Up (V)**	**U r.m.s. (V)**	**Required cl (mm)**	**cl (mm)**	**required dcr (mm)**	**dcr (mm)**
Backup-						
Phase - phase	4kV	500V	8	13.9	10	13.9
live part – exposed conductive part	4kV	500V	8	21.9	10	25.0
Phase - phase	4kV	500V	8	13.9	10	13.9
live part – exposed conductive part	4kV	500V	8	21.9	10	25.0
Supplementary information:						

TABLE: Critical components information					P
Object / part No.	**Manufacturer/ trademark**	**Type / model**	**Technical data**	**Standard**	**Mark(s) of conformity[1)]**
Enclosure	Shenzhen Zhong Yuan Tong Power Supply Technology Co., Ltd.	Backup Box	Steel, Min. Thk 1.2mm	--	Test in appliance
Circuit breaker (MCB)	Shanghai Liangxin Electrical Co., Ltd	NDB2LM-63	40A, 2P, Icn 10kA	AS 61009-1 EN 61009-2-1, EN 61009-1	TUV SUD CE N8A180583574332 TUV RH AZ 69024805
Contactor	Shanghai Liangxin Electrical Co., Ltd	NDC1-2540	AC 230V, 40A,	EN 60947-4-1	TUV SUD CE N8A170983574277
Contactor	Shanghai Liangxin Electrical Co., Ltd	NDC1-2501	AC 230V, 40A,	EN 60947-4-1	TUV SUD CE N8A170983574277
Time Relay	OMRON Corporation	H3DT-A	AC/DC 24-240V, 0.1s to1200h	EN 61812-1	DOC:OMSQ-Y05151901A
		H3DT-H	AC200-240V, 0.1to12s		
Terminal Block	PHOENIX CONTACT GmbH & Co. KG	UT2.5	M4, -60℃ to 110℃	EN 60947-7-1	VDE 40013658

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Clause	Requirement + Test	Result - Remark	Verdict

Terminal Block	PHOENIX CONTACT GmbH & Co. KG	UT 6	M4, -60℃ to 110℃	EN 60947-7-1	VDE 40013658
Terminal Block	PHOENIX CONTACT GmbH & Co. KG	UT 6-PE	M4, -60℃ to 110℃	EN 60947-7-2	VDE 40013715
Internal Wiring	3F ELECTRONICS INDUSTRY CORP	UL1015	L/N/PE:10AWG, Signal: 18AWG, 105℃	UL 758	UL:E211048
- Alt.	Guangzhou panyu cable Group co., LTD	UL1015	L/N/PE:10AWG, Signal: 18AWG, 105℃	UL 758	UL E216775
Cable gland	SHANGHAI FOUND AUTOMATIC EQUIPMENT CO LTD	FCS-K-M12 FCS-K-M32	IP68, -20℃ to 105℃	UL 514B	UL E325535
Supplementary information: [1)] Provided evidence ensures the agreed level of compliance. See OD-CB2039.					

IEC 61439-3			
Clause	Requirement + Test	Result - Remark	Verdict

ATTACHMENT TO TEST REPORT IEC 61439-3
(AUSTRALIA / NEW ZEALAND) NATIONAL DIFFERENCES
(LOW VOLTAGE SWITCHGEAR AND CONTROLGEAR ASSEMBLIES)
(PART 3: DISTRIBUTION BOARDS INTENDED TO BE OPERATED BY ORDINARY PERSONS (DBO))

Differences according to..... :	AS/NZS 61439.3:2016
Attachment Form No. ..... :	AU_NZ_ND_IEC61439_3B
Attachment Originator..... :	TUV Rheinland
Master Attachment..... :	2017-05

	National Differences		
Appendix ZA	Variations to IEC 61439-1 Ed 2.0 (2011) Normative		–
ZA1 Introduction	This Appendix sets out variations to IEC 61439-1, Ed. 2.0 (2011) for Australia and New Zealand, including additional requirements to cover issues not addressed by the International Standard (AS/NZS 61439.1:2016)		–
ZA2	Variations		--
Appendix ZZ1	This Appendix sets out variations to IEC 61439-3, Ed. 1.0 (2012) for Australia and New Zealand, including additional requirements to cover issues not addressed by the International Standard (AS/NZS61439.3:2016)		--
2	**NORMATIVE REFERENCES**		--
	Add the following new normative references: IEC TR 61641, Enclosed low-voltage switchgear and controlgear assemblies—Guide for testing under conditions of arcing due to internal fault AS 2467, Maintenance of electrical switchgear AS/NZS 3000, Electrical installations (known as the Australian/New Zealand Wiring Rules) AS/NZS 3008, Electrical installations—Selection of cables—Cables for alternating voltages up to and including 0.6/1 kV (series) AS/NZS 3493, Low-voltage switchgear and controlgear assemblies (series) AS/NZS 5000, Electric cables—Polymeric insulated (series) AS/NZS 5112, *Neutral links with tunnel terminals for the connection of copper conductors—Requirements for brass neutral links with ratings up to and including 125 A* (AS/NZS 61439.1:2016)		--
	Add the following new normative reference: *IEC 61032, Protection of persons and equipment by enclosures—Probes for verification* (AS/NZS61439.3:2016)		--
3	**TERMS AND DEFINITIONS**		--
3.7.1	Variation **Live part** refer to AS/NZS 3000 for the definition of a live part (AS/NZS 61439.1:2016)		--
3.7.2	Addition At the end of Clause 3.7.2, add the following Notes: NOTE 1 As a guide to hazardous live voltages the PELV values in AS/NZS 3000:2007 are:		--

IEC 61439-3			
Clause	Requirement + Test	Result - Remark	Verdict
	–25 V a.c. or 60 V ripple-free d.c., when electrical equipment is normally used in a dry location only and large-area contact with the human body is not to be expected; or		--
	–6 V a.c. or 15 V ripple-free d.c., in all other cases. NOTE 2 For internal separation for protection against contact with hazardous parts (subject to agreement) refer to AS/NZS 61439.2 Clause 8.101. (AS/NZS 61439.1:2016)		--
5	**INTERFACE CHARACTERISTICS**		P
5.3.1	Variation *Delete* Note 1 and *replace* with the following: NOTE 1 The rated current of an incoming circuit may be lower than the rated current of the incoming device (according to the respective device standard) installed in the assembly, which is the value determined from the markings on the device. (AS/NZS 61439.1:2016)		P
5.3.2	Replacement *Delete* Note 1 and *replace* with the following: NOTE 1 The rated current of a circuit may be lower than the rated currents of the devices (according to the respective device standard) installed in this circuit, which is the value determined from the markings on the device. (AS/NZS 61439.1:2016)		P
5.6	After Item q), add new Items r), s) and t), as follows: r) The rating of loose busbars. (e.g. 80 A) s) The maximum size of the overcurrent protection t) The rating of the neutral link (e.g. 125 A) (AS/NZS61439.3:2016)		P
6	**INFORMATION**		P
6.1	After Item e), add the following text: Addition: NOTE AS/NZS 5112 has requirements for tunnel type terminal neutral bars (AS/NZS61439.3:2016)		P
	Addition *Add* after the Note for the last paragraph the following: Where access to live parts is required, the following symbolic electric shock risk sign shall be displayed in locations where additional attention is required to be given to the removal of covers and the like. 		P
	In addition, a DANGER sign as illustrated below, with an additional message of appropriate wording, should be conspicuously displayed on the enclosure of the ASSEMBLY to alert persons to the hazard. 		P

IEC 61439-3			
Clause	Requirement + Test	Result - Remark	Verdict
	Where an item of equipment or enclosure contains live parts connected to more than one supply, a notice shall be placed in such a position that any person gaining access to live parts will be warned of the need to isolate those parts from the various supplies. (AS/NZS 61439.1:2016)		P
6.2	Addition *Add* after the last paragraph the following: It is the responsibility of the owner of the ASSEMBLY to institute a system of maintenance. Are the manufacturer's recommendations included, together with the recommendations of AS 2467, in a planned preventative maintenance programme. This will minimize the risk of injury or breakdown and the consequences thereof. (AS/NZS 61439.1:2016)		P
8	**CONSTRUCTIONAL REQUIREMENTS**		P
8.1.1	Addition *Add* after the last paragraph the following: NOTE The construction of an ASSEMBLY to this Standard is considered to be adequate for most applications. However, for applications where an increased degree of protection against internal arcing or its effects is essential, guidance may be obtained from Appendix ZC and internal arcing fault tests are specified in Appendix ZD. (AS/NZS 61439.1:2016)		N/A
8.5.5	Variation *Replace* the last list item with the following: Actuators for emergency switching devices (see 536.4.2 of IEC 60364-5-53:2001) shall be readily accessible. (AS/NZS 61439.1:2016)		N/A
8.6.1	Variation 1. Replace Paragraph 3 beginning 'Unless otherwise agreed' with the following text: The current rating of the neutral supplied with the assembly shall be: – For a type A DBO (single pole devices only), at least 100% of InA. – For a type B DBO (multi pole and single pole devices), at least 50 % of InA. – AS/NZS 3000 has requirements which consider harmonics and phase balance. If a larger neutral than the above is required then this shall be subject to agreement between the ASSEMBLY manufacturer and the user. NOTE AS/NZS 5112 has requirements for tunnel type terminal neutral bars. (AS/NZS61439.3:2016)		P

IEC 61439-3			
Clause	Requirement + Test	Result - Remark	Verdict
8.8	Variation 1. First paragraph, delete the last sentence of the first addition paragraph. 2. Delete the second paragraph. (AS/NZS61439.3:2016)		–
	Addition 1. Add new Note 1 as follows: NOTE 1 AS/NZS 5112 has requirements for tunnel type terminal neutral bars for connecting copper neutral conductors from 1 mm2 up to and including 50 mm2.		N/A
	2. Renumber the existing Notes 1, 2, 3, 4 and 5 as 2, 3, 4, 5 and 6.		--
	3 Replace the first sentence of the seventh paragraph with the following: AS/NZS 3000 has requirements for the size of the neutral conductor on three-phase and neutral circuits. Terminals for the neutral conductors shall allow the connection of copper conductors satisfying these requirements and unless otherwise agreed between the ASSEMBLY manufacturer and the user, shall be not less than the following:		P
	4 Replace the third last paragraph with the following: Unless otherwise agreed between the ASSEMBLY manufacturer and the user, terminals for protective conductors shall allow the connection of copper conductors having a cross-section according to AS/NZS 3000. (AS/NZS 61439.1:2016)		P
10	**DESIGN VERIFICATION**		P
10.1	Variation *Delete* the second paragraph and *replace* with the following: Where tests on the ASSEMBLY have been conducted in accordance with the IEC 60439, IEC 61439 or AS/NZS 3439 series, and the test results fulfil the requirements of the relevant part of AS/NZS 61439, the verification of these requirements need not be repeated. (AS/NZS 61439.1:2016)		N/A
10.9.2.1	Addition *Add* the following after the first paragraph: NOTE Refer to Clause 8.5.3 for the value of the test voltage of the equipment, which may be specified to its own standard at a lower value than shown in Table 8. (AS/NZS 61439.1:2016)		N/A

IEC 61439-3			
Clause	Requirement + Test	Result - Remark	Verdict
10.9.6	Addition *Add* new Clause 10.9.6 as follows: **Testing of insulation to comply with Clause 8.101** Insulation required for forms of internal separation to Clause 8.101 shall comply with the power frequency withstand tests of Clause 10.9.3.2 at a voltage of 1.5 times the value applicable to the rated Ui in Table 8 of Part 1. e.g. for Ui >300V to ≤690V the test voltage is 1.5×1890=2835V		N/A
	The voltage shall be applied between hazardous live parts and metal foil laid on the outer surface of relevant insulating surfaces and over any joints and openings in the insulation which are accessible after opening of a compartment and are contactable by the standard jointed test finger (STF).		N/A
	NOTE 1 The test may be limited to places where the insulation is likely to be weak, for example where there are openings or sharp metal edges under the insulation		N/A
	NOTE 2 Care should be taken that the metal foil is placed so that no flashover occurs at the edges of the insulation and to ensure no edges of the foil enter openings in the insulation.		N/A
	NOTE 3 The foil may be pushed into corners and the like by means of the STF but it is not pressed into openings.		N/A
	NOTE 4 For similar tests refer to Clause 10.9.4 for testing of assemblies with enclosures made of insulating material (contactable in normal service) and to IEC TR 61641 Clause 6.2 for tests relating to arc ignition protected fault zones (AS/NZS 61439.2:2016)		N/A
10.10.3.5	Variation *Replace* the existing text with the following: A device may be substituted with a similar device to that used in the original verification, provided that—		N/A
	a) if the device is not from the same manufacturer, the device rating does not exceed 3150A;		N/A
	b) the power loss and terminal temperature rise of the device are the same or lower when tested in accordance with the relevant product standard; and		N/A
	c) the physical arrangement within the functional unit and the rating of the functional unit are maintained or bettered with respect to thermal considerations. NOTE The physical arrangements include terminal shields, conductor type, material, and connection sizes, mounting orientation, clearances to other parts, ventilation arrangements and terminal arrangement. (AS/NZS 61439.1:2016)		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
10.10.4.3.1	Addition At the end of the Clause, *add* new Note 4 as follows: NOTE 4 Annex N of AS 60890 provides guidance on calculating operating current and power loss for copper busbars of size 5 mm, 6.3 mm and 10 mm. (AS/NZS 61439.1:2016)		N/A
Table 5	Variation Delete Table 5 (AS/NZS 61439.1:2016)		--
Table 6	Variation Replace Table 6		P

Parts of ASSEMBLIES	Temperature Rise K
Built-in components [a, h]	In accordance with the relevant product standard requirements for the individual components or, in accordance with the component manufacturer's instructions [f], taking into consideration the temperature in the ASSEMBLY
Terminals for external insulated conductors	70 [b] (see Note 3)
Busbars and conductors [h]	Limited by [f]: – mechanical strength of conducting material [g]; – possible effect on adjacent equipment; – permissible temperature limit of the insulating materials in contact with the conductor; – effect of the temperature of the conductor on the apparatus connected to it; – for plug-in contacts, nature and surface treatment of the contact material
Manual operating means: – of metal – of insulating material	 15 [c] 25 [c]
Accessible external enclosures and covers: – metal surfaces – insulating surfaces	 30 [d] 40 [d]
Discrete arrangements of plug and socket-type connections	Determined by the limit for those components of the related equipment of which they form part [e]

IEC 61439-3			
Clause	Requirement + Test	Result - Remark	Verdict

NOTE 1 The 105 K relates to the temperature above which annealing of copper is likely to occur. Other materials may have a different maximum temperature rise.

NOTE 2 The temperature rise limits given in this table apply for a mean ambient air temperature up to 35 °C under service conditions (see 7.1). During verification a different ambient air temperature is permissible (see 10.10.2.3.4).

NOTE 3 The temperature rise allowed for terminals for external insulated conductors is 70 K V75 cables are deemed to be acceptable because there is a temperature drop to the point where insulation is relied upon and the load current is generally not more than 80 % of the calculated maximum demand.

If the temperature rise of the terminals, determined when the ASSEMBLY is tested at maximum rating as described in Clause 10.10, is within 25 K of the rating of the cable and if a circuit of the ASSEMBLY is to be loaded above 80 % of its rated current, one of the following actions should be taken:

– separate the cable cores to provide electrical clearance for a minimum distance of 100 mm back from the terminals;

– apply high temperature covering over the cores for 100 mm back from the terminals;

– use a higher temperature grade cable of the same conductor cross-section as selected for V75 grade cable; or

– use a larger conductor.

a) The term 'built-in components' means:

– conventional switchgear and controlgear;

– electronic sub-assemblies (e.g. rectifier bridge, printed circuit); and

– parts of the equipment (e.g. regulator, stabilized power supply unit, operational amplifier).

b) The temperature-rise limit of 70 K is a value based on the conventional test of 10.10. An ASSEMBLY used or tested under installation conditions may have connections, the type, nature and disposition of which will not be the same as those adopted for the test, and a different temperature rise of terminals may result and may be required or accepted. Where the terminals of the built-in component are also the terminals for external insulated conductors, the lower of the corresponding temperature-rise limits shall be applied. The temperature rise limit is the lower of the maximum temperature rise specified by the component manufacturer and 70 K. In the absence of manufacturer's instructions it is the limit specified by the built-in component product standard but not exceeding 70 K.

c) Manual operating means within ASSEMBLIES which are only accessible after the ASSEMBLY has been opened, for example draw-out handles which are operated infrequently, are allowed to assume a 25 K increase on these temperature-rise limits.

d) Unless otherwise specified, in the case of covers and enclosures, which are accessible but need not be touched during normal operation, a 10 K increase on these temperature-rise limits is permissible. External surfaces and parts over 2 m from the base of the ASSEMBLY are considered inaccessible.

e) This allows a degree of flexibility in respect of equipment

IEC 61439-3			
Clause	Requirement + Test	Result - Remark	Verdict
	(e.g. electronic devices) which is subject to temperature-rise limits different from those normally associated with switchgear and controlgear. f) For temperature-rise tests according to 10.10, the temperature-rise limits have to be specified by the original manufacturer taking into account any additional measuring points and limits imposed by the component manufacturer. g) Assuming all other criteria listed are met a maximum temperature rise of 105 K for bare copper busbars and conductors shall not be exceeded. h) A temperature rise of not more than 70 K for H.C. copper busbars and 55 K for H.C. aluminium busbars is applicable unless supported by additional original component manufacturer's instructions and is deemed to comply for: – The terminals of individual component parts, including terminals for other than external insulated conductors. – Bare copper or aluminium busbars. The component manufacturers instructions and the original manufacturers temperature rise limits as per Note f) may not be required for these specific items. A temperature rise of more than 70 K for H.C. copper busbars and 55 K for H.C. aluminium busbars may be acceptable if supported by component manufacturer's declaration. Greater temperature than these values are allowed as long as the mechanical strength of the conducting material is not affected. (AS/NZS 61439.1:2016)		
Table 13	Addition 1 *Add* a new Item 6 as follows Does the short-circuit protective devices of each circuit of the ASSEMBLY to be assessed— – have a breaking capacity not less than the short-circuit rating of the assembly at the rated operational voltage of the assembly? – in case of a current limiting protective device: Have a peak let through current and let through energy at the short-circuit rating and the rated operational voltage of the assembly equal to or smaller than the reference design? – in case of a non-current limiting device: Have a rated short-time withstand current (*I*cw) equal to or higher than the reference design? – fulfil the requirements of co-ordination with upstream and downstream devices (see 9.3.4). – have equal or smaller critical distances (safety perimeter) to the reference design. – maintain identical mechanical orientation, including the direction and position of venting of the arc chutes		P

IEC 61439-3			
Clause	Requirement + Test	Result - Remark	Verdict
	Variation 2 Renumber items 6 to 10 as 7		--
	Addition 3 *Replace* Note[a] in Table 13 with the following: [a] Short-circuit protective devices of the same manufacturer but of a different series, or devices from a different manufacturer, may be considered equivalent and be substituted for the original device if the requirements of the device manufacturer are complied with and the assembly manufacturer declares the performance characteristics to be the same or better in all relevant respects to the series used for verification, e.g. breaking capacity, limitation characteristics (I^2t, I_{pk}), and the critical distances (safety perimeters) (AS/NZS 61439.1:2016)		--
Table C1	Addition 1 *Add* after the second paragraph the following: NOTE:Appendix ZB sets out the various standard IEC types of system earthing referred to in this Standard.	(see appended table)	--

IEC 61439-3			
Clause	Requirement + Test	Result - Remark	Verdict

Addition

the following at the end of the rows of characteristics for short-circuit withstand capability

Internal arcing faults				
Protection against internal arcing fault currents Applies to switchboards rated ≥800 A	AS/NZS 3000	Mandatory	None	
Guidelines for assemblies intended to provide increased security against the occurrence or the effects of internal arcing fault	ZC	Informative only	Refer ZC6 and ZD	
Internal arcing fault tests	ZD	Subject to agreement	Standard or special tests to ZD or IEC TR 61641	
Selection of components	ZE	Manufacturers standard	None	

(AS/NZS 61439.1:2016) --

Paragraph E2

Addition
The rated current of a device according to its product standard (for example, *I*n of a circuit breaker according to AS 60947.2) is its free air rating: *I*n = 630 A --

The rated current of the functional unit (the circuit) in a specific switchboard, as tested according to 10.10.2.3.7 c), may yield, for example, a lower rating of *I*nc = 534 A --

When conducting a complete ASSEMBLY test according to 10.10.2.3.7 d) or 10.10.2.3.6 (stage two) the test current used on the circuit is the rated current of the circuit (*I*nc) multiplied by rated diversity factor (RDF) of the assembly. If the RDF of the assembly is 0.9 for example, the test current would therefore be 0.9 × *I*nc = 0.9 × 534 A = 481 A --

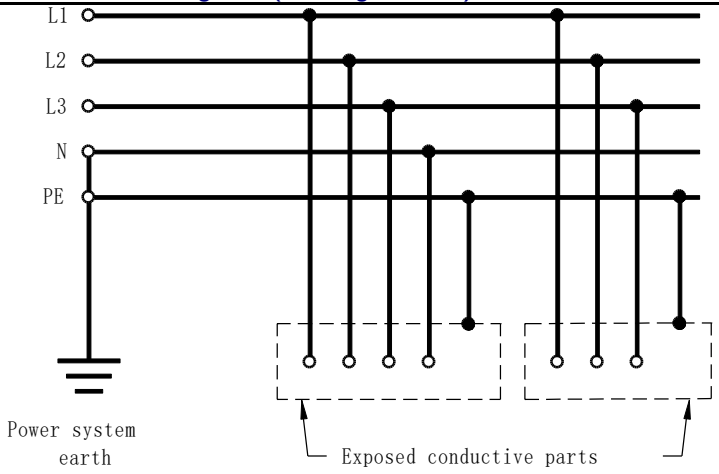
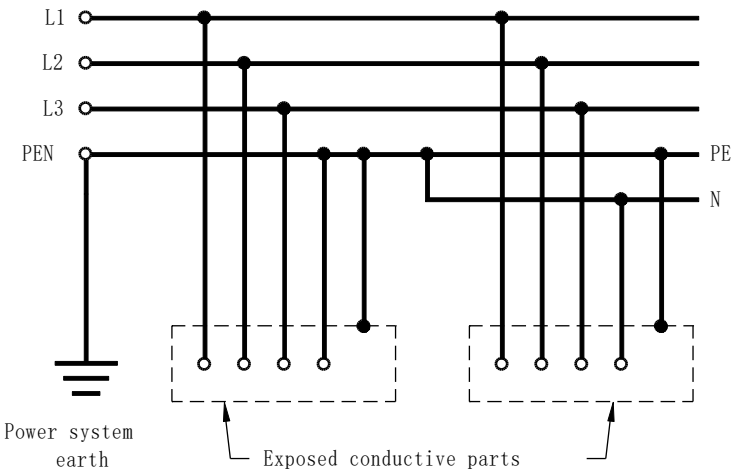
In addition for the tests of 10.10.2.3.5 I_{nc} becomes 481 A and the diversity factor is 1
(AS/NZS 61439.1:2016). --

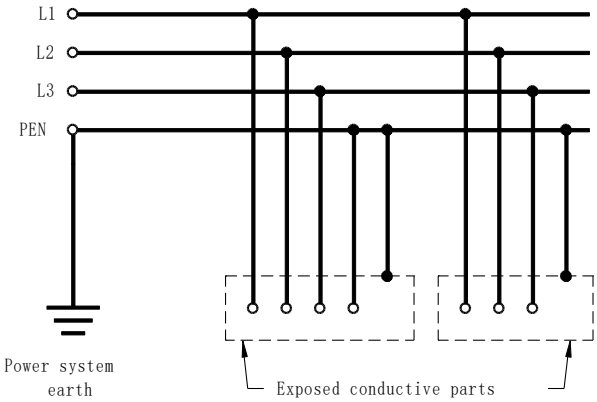
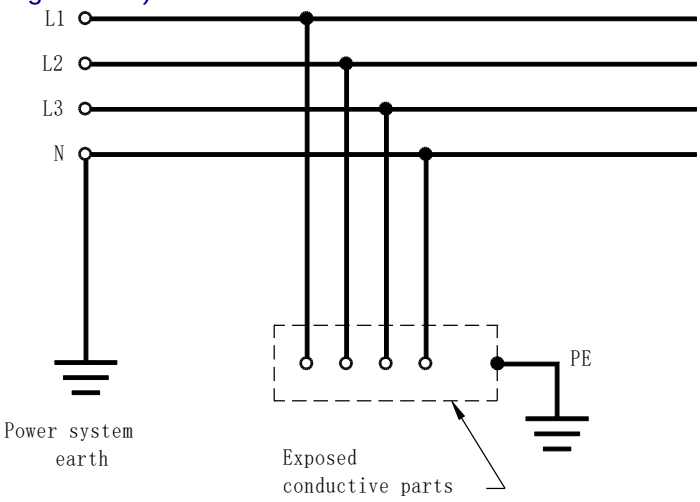
Table E2

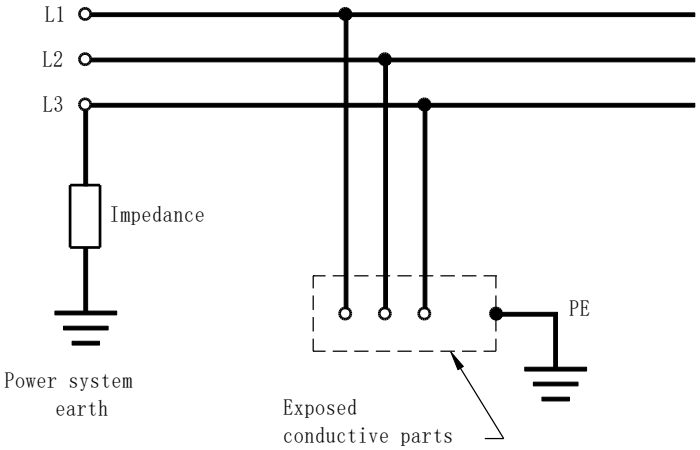
Variation
Third row, first column, *delete* '(*I*n)' and *replace* with '(*I*nc)'
(AS/NZS 61439.1:2016) --

IEC 61439-3			
Clause	Requirement + Test	Result - Remark	Verdict
Table E3	Variation Third row, first column, *delete* '(*I*n)' and *replace* with '(*I*nc)'. (AS/NZS 61439.1:2016)		--
Annex H	Addition Reference may also be made to AS/NZS 3008. (AS/NZS 61439.1:2016)		--
	Special national conditions (if any)		
10.101	Addition Verification of mechanical strength of fastening means of enclosures This test is applied only to items which are not an integral part of other components covered by their own product standards, and to components removed for installation or maintenance.	internal barrier	P
	The screws or nuts shall be tightened and loosened: - 10 times when in engagement with a thread of insulating material; or – 5 times in all other cases.	5 times	P
	The test shall be made by means of a suitable screwdriver or spanner applying a torque as given in Table 102.		P
	Where a screw has a hexagonal head with a slot for tightening with a screwdriver, and the values in columns II[c] and III[d] of Table 102 are different, the test shall be made twice: – first applying to the hexagonal head the torque specified in column III[d] by means of the spanner; – then, on a new sample, applying the torque specified in column II[c] by means of the screwdriver. If the values in columns II[c] and III[d] are the same, only the test with the screwdriver shall be made.		N/A
	During the test, the screwed connections shall not work loose and there shall be no damage, such as breakage of screws or damage to the head slots, threads, washers or stirrups, or damage to enclosures and covers, that will impair the further use of the equipment.		P
	After the test, the samples shall show no damage within the meaning of this Standard.		P
	In particular, the following items shall not show such damage: – covers which, when broken, make live parts accessible or impair the further use of the equipment; – operating means; and – linings and barriers of insulation material and the like.	no damage	P
10.102	Verification of fixing in position of pole fillers to comply with IP2XC of 8.2.2		N/A
	Pole fillers that protect against access to live parts shall be fixed in a reliable manner and withstand the mechanical stress occurring during normal use. The fixing properties of snap-in devices used in parts that are likely to be removed during installation or servicing shall be reliable.		N/A

IEC 61439-3			
Clause	Requirement + Test	Result - Remark	Verdict
	Compliance is checked by the following tests. The tests are applied to all pole fillers that are likely to be detachable whether or not they are fixed by clips, moulded projections, screws, rivets or similar parts.		N/A
	Pole fillers are disassembled and assembled 10 times before the test is carried out.		N/A
	The test is carried out at room temperature. Test forces— – push force, 50 N; applied by test probe 11 of IEC 61032 (rigid test finger) for 10 s without jerks in the most unfavourable direction. – pull force, 30 N for 10 s without jerks, applied as in Test a) or b) in the direction of removal.		N/A
	Test a) if the test fingernail (see Figure 102) tip can be inserted in any aperture or joint with a force of 10 N. The test fingernail tip is inserted with a force of 10 N in the most unfavourable position. The test fingernail is then pulled for 10 s without jerks, by means of the loop, with a force of 30 N in the direction of removal.		N/A
	Test b) if the test fingernail cannot be inserted in any aperture or joint with a force of 10 N. The pull force of 30 N is applied for 10 s without jerks in the direction of removal by a suitable means, so that the test results are not affected, such as with a suction cup.		N/A
	If the test fingernail tip can be inserted with a force of 10 N, in an aperture or joint which appears while the 30 N force is being applied, then the test fingernail is inserted and then slid sideways with a force of 10 N but is not twisted or used as a lever.		N/A
	During and after the tests the pole fillers shall remain in position and not become detached.		N/A
	Any apertures which are present around the pole fillers after the test shall pass a test of IP2XC.		N/A
Appendix ZB	TYPES OF SYSTEM EARTHING (Informative)		--
ZB1 SCOPE	This Appendix sets out the various standard IEC types of system earthing referred to in this Standard		--

IEC 61439-3			
Clause	Requirement + Test	Result - Remark	Verdict
ZB2 TN SYSTEMS	TN power systems have one point directly earthed, the exposed conductive parts of the installation being connected to that point by protective conductors. Three types of TN systems are recognized, according to the arrangement of neutral and protective conductors, as follows: (a) TN-S system A system having separate neutral and protective conductors throughout (see Figure ZB1). (b) TN-C-S system A system in which neutral and protective functions are combined in a single conductor in a part of the system (see Figure ZB2). (c) TN-C system A system in which neutral and protective functions are combined in a single conductor throughout (see Figure ZB3).		--
	 FIGURE ZB1 TN-S SYSTEM		--
	 NOTE: The TN-C-S system is similar to the MEN system except that the— (a) PEN is earthed multiple times; (b) PEN is connected directly to N (neutral) not the PE (protective earth);		--

IEC 61439-3			
Clause	Requirement + Test	Result - Remark	Verdict
	(c) neutral is connected via a MEN connection to the earth bar; (d) installation PE conductors are connected to the earth bar; and (e) earth bar is connected to an earth electrode. For details refer to AS/NZS 3000, Figure 5.1. FIGURE ZB2 TN-C-S SYSTEM		
	 FIGURE ZB3 TN-C SYSTEM		--
ZB3 TT SYSTEM	The TT power system has one point directly earthed, and the exposed conductive parts of the installation being connected to earth electrodes are electrically independent of the earth electrodes of the power system (see Figure ZB4).  FIGURE ZB4 TT SYSTEM		--

IEC 61439-3			
Clause	Requirement + Test	Result - Remark	Verdict
ZB4 IT SYSTEM	The IT power system has no direct connection between live parts and earth, and the exposed conductive parts of the electrical installation being earthed (see Figure ZB5).  FIGURE ZB5 IT SYSTEM		--
APPENDIX ZC	GUIDELINES FOR ASSEMBLIES INTENDED TO PROVIDE INCREASED SECURITY AGAINST THE OCCURRENCE OR THE EFFECTS OF INTERNAL ARCING FAULTS (Informative)		--
ZC1	**INTRODUCTION**		--
	Many factors may influence the ability of an ASSEMBLY to satisfactorily limit the effects of an internal arc. This Appendix, the application of which is subject to agreement between the purchaser and the manufacturer, describes the problem of internal arcing which may occur in an ASSEMBLY during service, and covers the design principles that should be considered to reduce the risk of its occurrence or to limit its effects. The tests set out in Appendix ZD are intended to verify the degree of security provided by the design. This Standard does not define requirements for arc flash protection.		
ZC2	**OBJECT**		--
	The object of this Appendix is to give guidance to manufacturers with regard to design objectives and to give guidance to purchasers for the selection of an ASSEMBLY which will provide increased security by the prevention or control of arcing faults within ASSEMBLIES under normal operating conditions, with all doors closed and all covers and internal barriers in place. Specific objectives cover one or more of the following: (d) To provide means to reduce the probability of the initiation of an internal arcing fault. (e) To protect personnel from injury in the event of a fault under the normal		--

IEC 61439-3			
Clause	Requirement + Test	Result - Remark	Verdict
	operating conditions of the ASSEMBLY. (f) To limit as far as possible the extent of damage to equipment in the event of a fault. It should be appreciated that while some design features may give increased protection during maintenance, the tests set out in Appendix ZD are not intended to apply to a maintenance situation where work is being carried out within the ASSEMBLY		
ZC3	**POSSIBLE CAUSES OF FAILURE**		--
	Examples of possible causes of failure of the ASSEMBLY due to the initiation of internal arcing are as follows: (a) Failure of a component, the connections to it or the busbar system during commissioning. (b) Failure due to incorrect selection or application of components or faulty maintenance, such as— (i) the omission of barriers or shrouds; (ii) damaged insulation; (iii) incorrect installation of a protective device; (iv) replacement of a protective device by an inappropriate one; (v) the presence of a foreign object; (vi) the substitution of a component by an inappropriate one; (vii) loose connections; (viii) the incorrect adjustment of a component; and (ix) plug in contacts. (c) Failure in service due to one or more of the following: (i) Ingress of pollution. (ii) Ageing of insulation. (iii) Damage caused by rodents and vermin. (iv) Corrosion. (v) Component fatigue or breakage. (vi) Overheating due to, for example — (A) loose connections; (B) contact wear; (C) pollution; (D) overloading; or (E) lack of ventilation.		--

IEC 61439-3			
Clause	Requirement + Test	Result - Remark	Verdict
ZC4	**ARC FAULT CONDITIONS**		--
	When an arcing fault occurs between phases or to earth, the current flowing at any given instant is determined by the applied voltage, the source impedance and the arc voltage. The effect of the arc voltage is to reduce the current to a value below that which would flow under bolted fault conditions. Because of the dynamic nature of the arc it is difficult to predict the value of arc voltage, which varies as the arc moves under the effect of the thermal and magnetic forces acting on it. Depending upon the electrode configuration, at any time the instantaneous value of arc current could assume a relatively high value approaching the bolted fault current or a much lower value possibly approximating load current. Generally, an arc will continue until it becomes unstable and self-extinguishes, or until it is extinguished as a result of the operation of a circuit breaker or fuse interrupting the current, or by other means designed into the ASSEMBLY. Some such methods are described in Paragraph ZC5. The arc should not be relied on to become unstable and self-extinguishing		--
ZC5	**MINIMIZATION OF ARCING**		--
	It is recognized that the increased security against personal injury and damage to equipment may be obtained by a number of means, such as the following: (a) Taking precautions in the design, construction, insulation or arrangement of the ASSEMBLY which would make the occurrence of an arcing fault extremely unlikely (see Paragraph ZC6(a)). (b) Mitigation of the arcing fault (see Paragraph ZC6(b)). (c) Provision of adequate means for detection or limitation, or both, of a fault (see Items (c), (d) and (e) of Paragraph ZC6).		--
ZC6	**MEANS OF ACHEIVEMENT**		--
	Typical means of reducing the probability of initiation of internal arcing or minimizing its magnitude or duration, or both, and limiting its effects, as outlined in Paragraph ZC5, are as follows: (d) By the provision of one or more insulation systems providing IPXXB degree of protection. NOTE: For example, completely surrounding live conductors to include substantial insulation which alone is capable of withstanding the dielectric test voltage of the ASSEMBLY. Such provision is able to resist without damage all likely mechanical forces and temperatures that may occur in service and during maintenance by resin encapsulation or other insulation, in addition to clearance in air or other insulating media. (e) By the arrangement of the busbars and functional units of the ASSEMBLY in vented compartments designed to promote rapid extinction of the arc and to prevent the arc or arc products affecting other parts of the ASSEMBLY (refer to Paragraph ZC5(b)).		--

IEC 61439-3			
Clause	Requirement + Test	Result - Remark	Verdict
	(f) By the use of devices (e.g. fuses or circuit breakers), designed to limit the magnitude and duration of the arcing current by interruption thereof, so as to limit the risk of injury to personnel or damage to the ASSEMBLY. (g) By the use of devices sensitive to the energy radiated from an arc which are designed to reliably initiate the interruption of the arcing current (e.g. by means of a circuit breaker). (h) By the use of earth current detection devices (e.g. earth current relays) designed to initiate the interruption of the arcing current (e.g. by means of a circuit breaker). (i) Combinations of Items (a) to (e) above, or other methods designed to either prevent the initiation of an arc, or to reduce the damage or risk of injury resulting from an arc by sensing of the fault followed by interruption. (AS/NZS 61439.1:2016)		

Figure 1

Figure 2

Figure 3

Figure 4

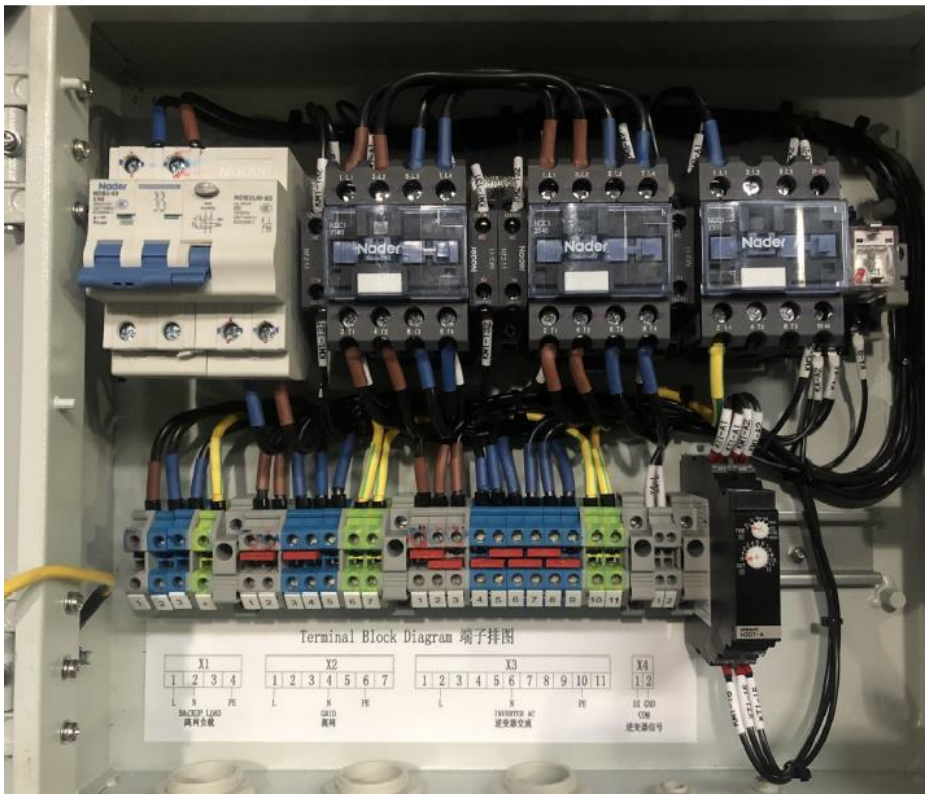


Figure 5 Backup Box-B0

Figure 6 Backup Box-B1

Figure 7

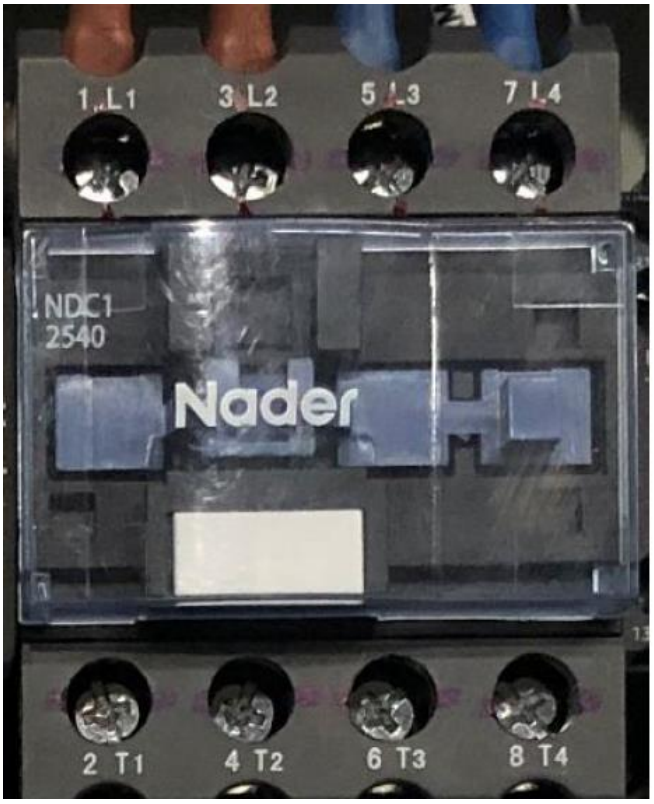


Figure 8