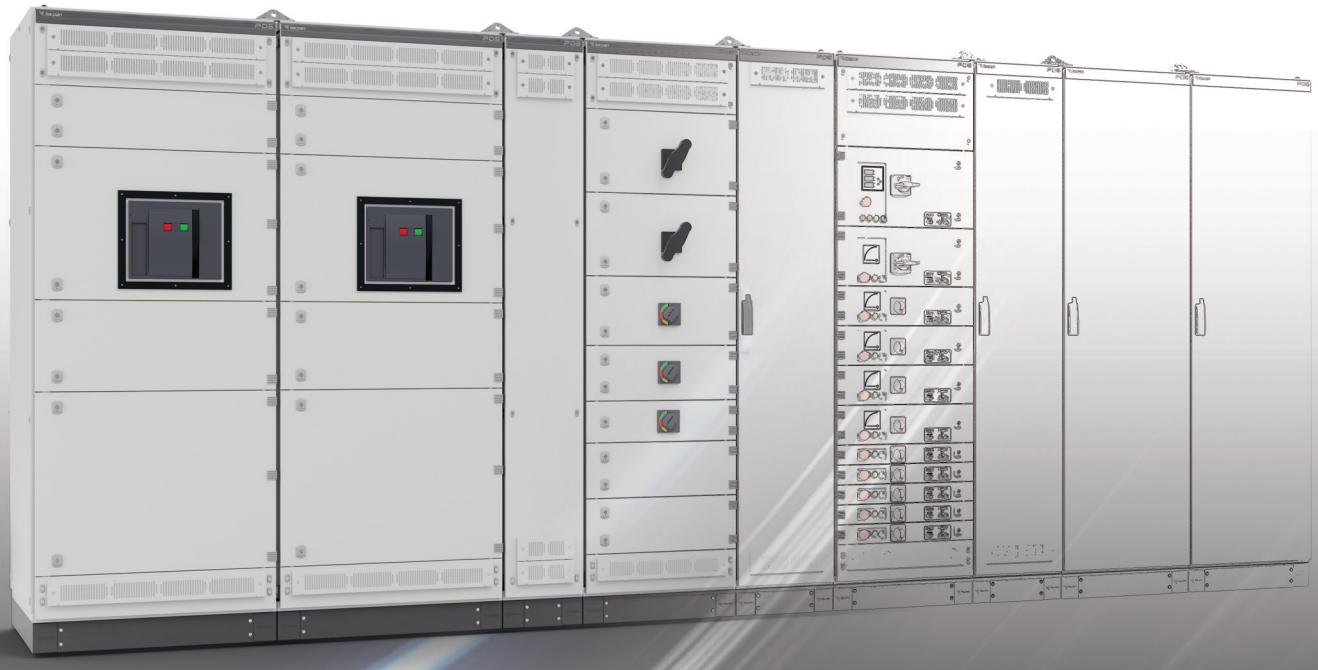
D

CONTROLS AT WORKSHOP

11/2021



UPGRADE THE POWER

1. GENERAL PERSPECTIVE

PDS developed to produce high quality equipment fully complying IEC 61439-1 and IEC 61439-2 standards worldwide. Guarantee of best quality and standards from all partners worldwide is one of the key statement of PDS for customers to ensure this documentation and certification process is defined both for partners and last consumers.

The quality inspection stage must be performed with care, rigour, in compliance both with customer specifications and with proper operating procedures. Quality is also the determination of all the staff, from manager to the line worker.

Responsibilities Of Each Entity

Original Manufacturer is the entity responsible for the original design and associated verification of an assembly in accordance with standard IEC 61439. Example: PDS

The original manufacturer produces or specifies the various components which make up the distribution panel. Protective devices, enclosures, main busbar, distribution busbar, incoming units, outgoing units, motor control drawers etc. all these components have product certificates of conformity. Representative configurations created based on these products undergo a series of tests which are called Type Tests.

Assembly Manufacturer assembles the electrical enclosure, installs the equipment and carries out the wiring in line with rules for the selection and installation of the products according to the methods defined by original manufacturer, the standards, the regulations and good practice.

The assembly manufacturer is responsible for certifying the finished assembly and providing the technical documentation. The individual tests and the final inspection are all recorded in a simplified individual report. Full compliance with this process can then be certified by a declaration of conformity.

CHARACTERISTICS TO BE CHECKED	ASSEMBLY MANUFACURER (Panel builder)
Degree of protection (IP)	Visual check 3.2
Clearance	Visual check 3.3
Creepage distance	Visual check 3.3
Protection against electric shock and integrity of protective circuits	Spot check 3.6
Integration of connection devices and components	Visual check 3.5
Internal electrical circuits and connections	Spot check 3.6
Terminals for external conductors	Visual check 3.7
Dielectric properties	Test to be performed 3.9 (time 1 s)
Mechanical operation	Visual check 3.8
Wiring, operational performance and function	Function test or visual check 3.10

2. ORIGINAL MANUFACTURER TESTS

Standard IEC 61439-2 requires verification of 13 characteristic points for certification of power switchgear and control gear assemblies. Verification can be carried out using three different methods, depending on the characteristics:

1-Testing carried out on a sample of an assembly or parts of assemblies

2-Structured comparison of a design proposal for an assembly or parts of an assembly with a reference design that has been verified by testing.

3-Verification on of compliance with design rules or strict calculations applied to a sample of an assembly or to parts of assemblies, including the use of appropriate safety margins.

These methods are considered to be equivalent and the choice of the appropriate method is the responsibility of the original manufacturer.

* If all the requirements and instructions given by PDS are complied with in full, the assembly manufacturer does not have to repeat these verifications on the finished assembly.

13 Design Verifications In Detail:

TEST 1. Strength Of Materials and Parts
The mechanical, electrical and thermal capacities of the construction materials and parts of the assemblies must be deemed to be proved by verification of the construction and performance characteristics. Tests are therefore carried out to check resistance against heat, ultra violet radiation, lifting and mechanical impact.

TEST 2. Verification Of the Degree of Protection (IP)
The IP defines the ability to protect people from dangerous parts and to prevent entry of solid objects and liquids. IP is represented by two numbers which first one represents solid object protection, second one liquid protection. There can be additional letter indicating protection against access to dangerous parts.

TEST 3. Clearance and Creepage Distances
The measurement methods for the clearances and creepage distances are covered in detail Annex F of IEC 61439-1 which is based on standard IEC 60664-1. The clearances and distances are measured between live parts with different polarities, and also between live parts and exposed conductive parts.

TEST 4. Assembling Devices and Equipment
PDS guarantees compliance with the clearances and distances for the insulation voltages of devices when they are installed in accordance with specified conditions.

TEST 5. Effectiveness Of the Protective Circuit
The continuity of the protective circuit isa decisive factor for safety. It is checked in accordance with IEC 61439-1 at a test current of 25A between the terminal connecting protective conductors and all exposed conductive parts and also in accordance with an additional PDS test, at high fault current that could occur following accidental detachment of a conductor.

TEST 6. Incorporation Of Connection and Devices and Components
These are rules concerning the installation of devices included in the assembly, whether they are fixed or removable parts and compliance with the customers wiring equipments. This also includes accessibility to adjustment and reset devices and all type of indications.

TEST 7. Internal Electrical Circuits and Connections
This set consists of checking conformity of the power and control circuits with design requirements. It includes correct sizing of the busbar and cables, earthing the control circuits etc. It also includes identification of the various circuits using different colours.

TEST 8. Terminals For External Conductors
This rule requires the terminal capacity and whether the terminals are suitable for aluminium or copper conductors to be specified to the end user. It also includes checking all types or terminal that can be used for the cable entries and outlets.

TEST 9. Dielectric Properties

The dielectric tests check the insulation performance levels for the maximum operating voltage. They are carried out at the power frequency of 50Hz and in the form of voltage waves simulating a lightning strike.

TEST 10. Temperature Rise Limits

Temperature rise test on assemblies checks that assemblies operate correctly under maximum operating conditions. Current level, number or devices and volume of enclosure etc are the main tested values regarding temperature rise in assemblies. It is used to define the heat balance data for an average temperature rise of the air in assemblies of less than 30 C and a temperature rise in the terminals less than 70 C .

TEST 11. Short Circuit Withstand Strength

The tests carried out to guarantee the withstand strength of busbars and their supports, the breaking devices, the protective devices and the enclosures in relation to the thermal and electrodynamic stresses. The tests are the most destructive and high expense tests through the standard.

TEST 12. Electromagnetic Compatibility

This test consists of checking the electromagnetic interference caused by the assembly when operating in this environment, the aim being for it to cause ne interference.

TEST 13. Verification Of The Mechanical Operation

In accordance with the provisions of the standard, tests are carried out on parts and devices that are not subject to any specific requirements. Correct mechanical operation is checked by carrying out 200 operating cycles on draw-out racks and faceplate fixings.

Design verifications are carried out on a sample of an assembly or on parts of assemblies to demonstrate that the design satisfies the requirements of the applicable assembly standard. These verifications are carried out officially by notified organisations on assemblies representative of the usual wiring configurations and device layouts.

TEST CERTIFICATE

Issued to: Tekpan Teknik Elektrik Kumanda Pano San. ve Turizm Tic. As, Kemalpasa O.S.B, Istiklal Mah.17 SK No. 8, Ulucak Kemalpasa Izmir Turkey

For the product: Low-voltage switchgear and controlgear assembly

Trade name: Tekpan / PDS

Type/Model: Teos Series (plus+/standard) 4000A -Fixed&Withdrawable MCC

Ratings: I_n 2970 A (at normal ambient), I_n 2500 A (at 50 °C ambient), U_i 415 V, U_r max. 1000 V, U_{imp} max. 12 kV, IP40, I_{cw} max. 80 kA - 1 s, I_{cc} max. 25 kA at 415 V. For more details see annex

Manufactured by: Tekpan Teknik Elektrik Kumanda Pano San. ve Turizm Tic. As, Kemalpasa O.S.B, Istiklal Mah.17 SK No. 8, Ulucak Kemalpasa Izmir Turkey

Subject: Design verification

Requirements: IEC 61439-2:2020 Clauses 10.2, 10.3, 10.4, 10.5.3, 10.6, 10.7, 10.8, 10.9, 10.10.2,3.5, 10.11, 10.12

Remarks: -

This Test Certificate is granted on account of an examination by DEKRA, the results of which are laid down in report no. 2220729.01-INC, dated 22 September 2020.

The examination has been carried out on one single specimen of the product, submitted by the manufacturer. The Attestation does not include an assessment of the manufacturer's production. Conformity of his production with the specimen tested by DEKRA is not the responsibility of DEKRA.

Arnhem, 22 September 2020 Number: 2220729.100

DEKRA Certification B.V.

F.S. Striwanda Certification Manager

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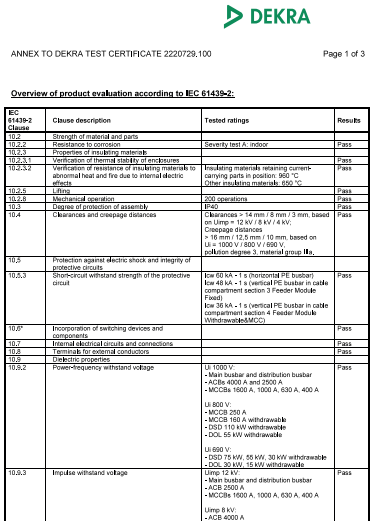
DEKRA Certification B.V. Meander 1051, 6825 MJ Arnhem P.O.Box 5185, 6802 ED Arnhem, The Netherlands T +31 88 96 83000 F +31 88 96 83100 www.dekra-certification.com Company registration 09098396



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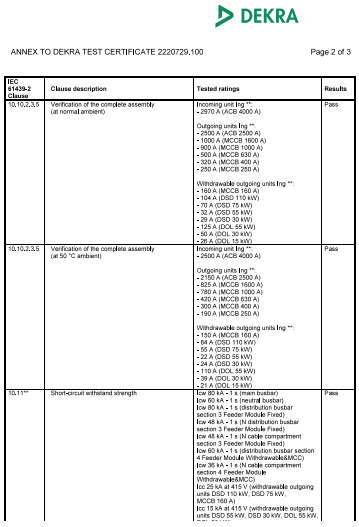
ANNEX TO DEKRA TEST CERTIFICATE 2220729.100 Page 1 of 3

Overview of product evaluation according to IEC 61439-2:

IEC 61439-2 Clause	Clause description	Tested ratings	Results
10.2	Strength of material and parts		-
10.2.2	Resistance to corrosion	Severity test A: indoor	Pass
10.2.3	Properties of insulating materials		-
10.2.3.1	Verification of thermal stability of enclosures		Pass
10.2.3.2	Verification of resistance of insulating materials to abnormal heat and fire due to internal electric effects	Insulating materials retaining current-carrying parts in position: 960 °C Other insulating materials: 650 °C	Pass
10.2.5	Lifting		Pass
10.2.6	Mechanical operation	200 operations	Pass
10.3	Degree of protection of assembly	IP40	Pass
10.4	Clearances and creepage distances	Clearances > 14 mm / 8 mm / 3 mm, based on Uimp = 12 kV / 8 kV / 4 kV; Creepage distances > 16 mm / 12,5 mm / 10 mm, based on Ui = 1000 V / 800 V / 690 V; pollution degree 3, material group IIIa,	Pass
10.5	Protection against electric shock and integrity of protective circuits		-
10.5.3	Short-circuit withstand strength of the protective circuit	Icw 60 kA - 1 s (horizontal PE busbar) Icw 48 kA - 1 s (vertical PE busbar in cable compartment section 3 Feeder Module Fixed) Icw 36 kA - 1 s (vertical PE busbar in cable compartment section 4 Feeder Module Withdrawable&MCC)	Pass
10.6*	Incorporation of switching devices and components		Pass
10.7	Internal electrical circuits and connections		Pass
10.8	Terminals for external conductors		Pass
10.9	Dielectric properties		-
10.9.2	Power-frequency withstand voltage	LI: 1000 V: - Main busbar and distribution busbar - ACBs 4000 A and 2500 A - MCCBs 1600 A, 1000 A, 630 A, 400 A LI: 800 V: - MCCB 250 A - MCCB 160 A withdrawable - DSD 110 kW withdrawable - DOL 55 kW withdrawable LI: 690 V: - DSD 75 kW, 55 kW, 30 kW withdrawable - DOL 30 kW, 15 kW withdrawable	Pass
10.9.3	Impulse withstand voltage	Uimp 12 kV: - Main busbar and distribution busbar - ACB 2500 A - MCCBs 1600 A, 1000 A, 630 A, 400 A Uimp 8 kV: - ACB 4000 A	Pass



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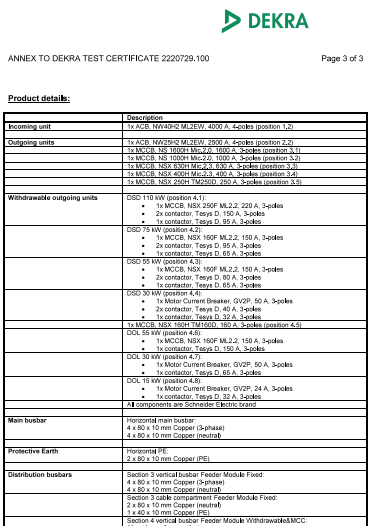
ANNEX TO DEKRA TEST CERTIFICATE 2220729.100 Page 2 of 3

IEC 61439-2 Clause	Clause description	Tested ratings	Results
10.10.2,3.5	Verification of the complete assembly (at normal ambient)	Incoming unit Ing **: - 2970 A (ACB 4000 A) Outgoing units Ing **: - 2500 A (ACB 2500 A) - 1000 A (MCCB 1600 A) - 800 A (MCCB 1000 A) - 500 A (MCCB 630 A) - 320 A (MCCB 400 A) - 250 A (MCCB 250 A) Withdrawable outgoing units Ing **: - 160 A (MCCB 160 A) - 104 A (DSD 110 kW) - 70 A (DSD 75 kW) - 52 A (DSD 55 kW) - 29 A (DSD 30 kW) - 125 A (DOL 55 kW) - 56 A (DOL 30 kW) - 28 A (DOL 15 kW)	Pass
10.10.2,3.5	Verification of the complete assembly (at 50 °C ambient)	Incoming unit Ing **: - 2500 A (ACB 4000 A) Outgoing units Ing **: - 2150 A (ACB 2500 A) - 825 A (MCCB 1600 A) - 780 A (MCCB 1000 A) - 400 A (MCCB 630 A) - 300 A (MCCB 400 A) - 160 A (MCCB 250 A) Withdrawable outgoing units Ing **: - 150 A (MCCB 160 A) - 84 A (DSD 110 kW) - 55 A (DSD 75 kW) - 22 A (DSD 55 kW) - 24 A (DSD 30 kW) - 110 A (DOL 55 kW) - 39 A (DOL 30 kW) - 21 A (DOL 15 kW)	Pass
10.11**	Short-circuit withstand strength	Icw 80 kA - 1 s (main busbar) Icw 80 kA - 1 s (neutral busbar) Icw 80 kA - 1 s (distribution busbar section 3 Feeder Module Fixed) Icw 48 kA - 1 s (N distribution busbar section 3 Feeder Module Fixed) Icw 48 kA - 1 s (N cable compartment section 3 Feeder Module Fixed) Icw 80 kA - 1 s (distribution busbar section 4 Feeder Module Withdrawable&MCC) Icw 36 kA - 1 s (N cable compartment section 4 Feeder Module Withdrawable&MCC) Icc 25 kA at 415 V (withdrawable outgoing units DSD 110 kW, DSD 75 kW, MCCB 160 A) Icc 15 kA at 415 V (withdrawable outgoing units DSD 55 kW, DSD 30 kW, DOL 55 kW,	Pass



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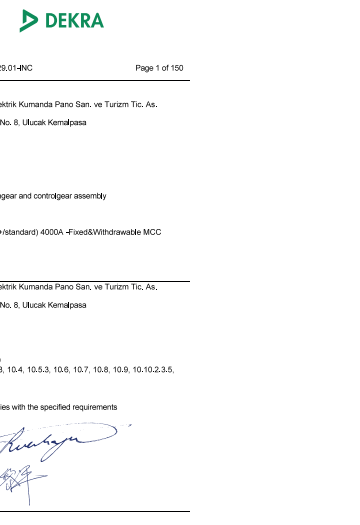
ANNEX TO DEKRA TEST CERTIFICATE 2220729.100 Page 3 of 3

Product details:

	Description
Incoming unit	1x ACB, NW40H2 ML2EW, 4000 A, 4-poles (position 1,2)
Outgoing units	1x ACB, NW25H2 ML2EW, 2500 A, 4-poles (position 2,2)
	1x MCCB, NS 1600H Mic2.2, 1600 A, 3-poles (position 3,1)
	1x MCCB, NS 1000H Mic2.2, 1000 A, 3-poles (position 3,2)
	1x MCCB, NSX 630H Mic2.3, 630 A, 3-poles (position 3,3)
	1x MCCB, NSX 400H Mic2.3, 400 A, 3-poles (position 3,4)
	1x MCCB, NSX 250H TM250D, 250 A, 3-poles (position 3,5)
Withdrawable outgoing units	DSD 110 kW (position 4,1): • 1x MCCB, NSX 250F ML2.2, 220 A, 3-poles • 2x contactor, Tesys D, 150 A, 3-poles • 1x contactor, Tesys D, 85 A, 3-poles
	DSD 75 kW (position 4,2): • 1x MCCB, NSX 160F ML2.2, 150 A, 3-poles • 2x contactor, Tesys D, 95 A, 3-poles • 1x contactor, Tesys D, 65 A, 3-poles
	DSD 55 kW (position 4,3): • 1x MCCB, NSX 160F ML2.2, 150 A, 3-poles • 2x contactor, Tesys D, 80 A, 3-poles • 1x contactor, Tesys D, 65 A, 3-poles
	DSD 30 kW (position 4,4): • 1x Motor Current Breaker, GV2P, 50 A, 3-poles • 2x contactor, Tesys D, 40 A, 3-poles • 1x contactor, Tesys D, 32 A, 3-poles
	1x MCCB, NSX 160H TM160D, 160 A, 3-poles (position 4,5)
	DOL 55 kW (position 4,6): • 1x MCCB, NSX 160F ML2.2, 150 A, 3-poles • 1x contactor, Tesys D, 150 A, 3-poles
	DOL 30 kW (position 4,7): • 1x Motor Current Breaker, GV2P, 50 A, 3-poles • 1x contactor, Tesys D, 65 A, 3-poles
	DOL 15 kW (position 4,8): • 1x Motor Current Breaker, GV2P, 24 A, 3-poles • 1x contactor, Tesys D, 32 A, 3-poles
	All components are Schneider Electric brand
Main busbar	Horizontal main busbar: 4 x 80 x 10 mm Copper (3-phase) 4 x 80 x 10 mm Copper (neutral)
Protective Earth	Horizontal PE: 2 x 80 x 10 mm Copper (PE)
Distribution busbars	Section 3 vertical busbar Feeder Module Fixed: 4 x 80 x 10 mm Copper (3-phase) 4 x 80 x 10 mm Copper (neutral) Section 3 cable compartment Feeder Module Fixed: 2 x 80 x 10 mm Copper (neutral) 1 x 40 x 10 mm Copper (PE) Section 4 vertical busbar Feeder Module Withdrawable&MCC:



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TEST REPORT 2220729.01-INC Page 1 of 150

Applicant : Tekpan Teknik Elektrik Kumanda Pano San. ve Turizm Tic. As. Kemalpasa O.S.B. Istiklal Mah.17 SK No. 8, Ulucak Kemalpasa Izmir Turkey

Application Date : 11 February 2020

Order Number : 2220729.00-INC

Product : Low-voltage switchgear and controlgear assembly

Trade name : Tekpan / PDS

Type/Model : Teos Series (plus+/standard) 4000A -Fixed&Withdrawable MCC

Arnhem, 22 September 2020

Manufacturer/ Production sites : Tekpan Teknik Elektrik Kumanda Pano San. ve Turizm Tic. As, Kemalpasa O.S.B, Istiklal Mah.17 SK No. 8, Ulucak Kemalpasa Izmir Turkey

Subject : Design verification

Requirements : IEC 61439-2:2020 Clauses 10.2, 10.3, 10.4, 10.5.3, 10.6, 10.7, 10.8, 10.9, 10.10.2,3.5, 10.11, 10.12

Conclusion : The product complies with the specified requirements

Tested by : R. Verhagen

Checked by : F. Fu

RVer

3. RESPONSIBILITY OF ASSEMBLY MANUFACTURER-PARTNER

* Assembly manufacturer -Partner must be make verifications after the assembly which the rules applied from instructions at Section C: Installation Instructions at Workshop.

3.1. GENERAL

Under the responsibility of the assembly manufacturer, all routine verification including testing, installation and commissioning shall be carried out or supervised by a competent person.

Routine verification is intended to detect faults in materials, workmanship and to proper functioning of the manufactured assembly. It is made on every assembly. The assembly manufacturer shall determine if routine verification is carried out during and or after manufacture. Routine verification shall confirm that the assembly manufacturing instructions have been adhered to.

Routine verification is not required to be carried out on devices and self-contained components incorporated in the assembly when they have been selected in accordance with 8.5.3 and installed in accordance with 8.5.4.

Verification shall comprise the following categories:

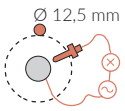
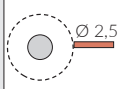
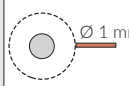
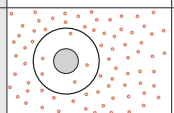
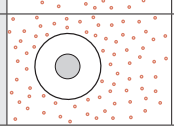
CHARACTERISTICS TO BE CHECKED		ASSEMBLY MANUFACTURER/PARTNER
A. Construction		
3.2	Degree of protection against with hazardous live parts, ingress of solid foreign bodies and water of enclosures;	Visual check
3.3	Clearances and creepage distances;	Visual check
3.4	Protection against electric shock and integrity of protective circuits;	Spot check
3.5	Incorporation of built-in components;	Visual check
3.6	Internal electrical circuits and connections;	Spot check
3.7	Terminals for external conductors;	Visual check
3.8	Mechanical operation.	Visual check
B. Performance		
3.9	Dielectric properties;	Test To Be Performed
3.10	Wiring, operational performance and function.	Function Test
C. Confirmation that documents that are intended to be supplied with the assembly are provided and include those required in 6.2.1.		**Documentation**

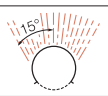
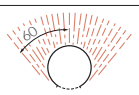
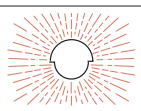
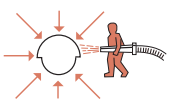
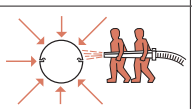
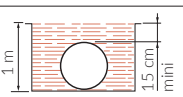
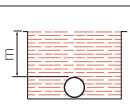
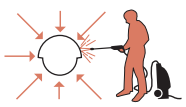
3.2. Degree of protection against contact with hazardous live parts, ingress of solid foreign bodies and water of enclosures (Item 11.2 IEC 61439 1-2)

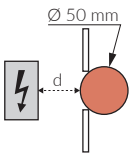
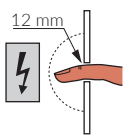
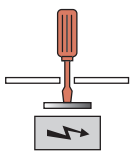
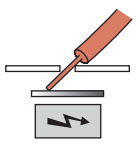
The degree of protection of an assembly defines its capacity to protect people from direct contact with live parts and to prevent the entry of solid objects or liquids. It is specified by the IP code in accordance with the tests described in standard IEC 60529 (see below). The IP code required for an assembly in an enclosure depends on its installation conditions and the external influences to which it is subjected. In all cases it must be at least IP 2X. The degree of protection of an open assembly must be at least IP XXB

A visual inspection is necessary to confirm that the assembly meets the prescribed measures to achieve the designated degree of protection are maintained.

- The assembly manufacturer must carry out a visual inspection, once all the components have been assembled, to check that the enclosure and its components comply with the stated degree of protection.
- For example, if control and signalling auxiliaries are installed on doors or panels, their own IP and their installation must comply with the stated IP value. In this case, no additional testing is required.

1st number: protection against the penetration of solid objects		
IP	tests	
0		No protection
1		Protected against solid objects larger than 50 mm
2		Protected against solid objects larger than 12.5 mm
3		Protected against solid objects larger than 2.5 mm
4		Protected against solid objects larger than 1 mm
5		Protected against dust (no harmful deposits)
6		Totally protected against dust

2nd number: protection against liquids		
IP	tests	
0		No protection
1		Protected against vertically falling drops of water (condensation)
2		Protected against dripping water up to 15° from the vertical
3		Protected against rainwater up to 60° from the vertical
4		Protected against water sprayed from all directions
5		Protected against water jets from all directions
6		Totally protected against powerful water jets similar to heavy seas
7		Protected against the effects of immersion
8		Protected against the effects of prolonged immersion under specified conditions
9		Protected against high-pressure and high-temperature water jets

Additional letter IP XX (ABCD): protection against direct contact by access to hazardous live parts		
IP	tests	protection
A		The back of the hand is kept away from hazardous parts
B		If a finger is inserted it cannot touch hazardous parts
C		If a tool is inserted (for example, a screwdriver) it cannot touch hazardous parts
D		If a wire is inserted it cannot touch hazardous parts

3.3. Clearances and creepage distances (Item 11.3 IEC 61439 1-2)

Clearances represent the shortest distance between two conductive parts with different voltages. If there is a breakdown that disrupts the air, the electric arc will follow this path. The minimum clearances are determined according to the impulse withstand voltage U_{imp} of the assembly.

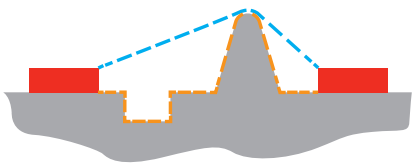
Creepage distances represent the shortest distance along the surface of the insulating materials. The minimum creepage distances are determined according to the stated insulation voltage U_i for the assembly and the degree of pollution of its installation environment. As a general rule, degree of pollution 2 can be applied for residential or commercial applications and degree of pollution 3 for industrial applications.

Where the clearances are:

- Less than the values given in Table 1, an impulse voltage withstand test in accordance with 10.9.3 shall be carried out;
- Not evident by visual inspection to be larger than the values given in Table 1 (see 10.9.3.5), verification shall be by physical measurement or by an impulse voltage withstand test in accordance with 10.9.3;
- Evidently larger by visual inspection than the values given in Table 1, verification may be carried out only by visual inspection. The prescribed measures with regard to creepage distances (see 8.3.3) shall be subject to a visual inspection. Where it is not evident by visual inspection, verification shall be by physical measurement. No reduction on the values given in Table 2 is acceptable.

Rated impulse withstand voltage, U_{imp} kV	Minimum clearance [a] mm
≤ 2.5	1,5
4,0	3,0
6.0	5,5
8.0	8,0
12.0	14,0

[a] Based on inhomogeneous field conditions and pollution degree 3.



Clearance
Creepage distance
Conductive part
Solid insulated part

Rated insulation voltage U_i V[b]	Minimum Creepage Distance mm							
	Pollution Degree							
	1	2			3			
	Material Group[c]	Material Group[c]			Material Group[c]			
	All Material Groups	I	II	IIIa and IIIb	I	II	IIIa	IIIb
32	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
40	1.5	1.5	1.5	1.5	1.5	1.6	1.8	1.8
50	1.5	1.5	1.5	1.5	1.5	1.7	1.9	1.9
63	1.5	1.5	1.5	1.5	1.6	1.8	2	2
80	1.5	1.5	1.5	1.5	1.7	1.9	2.1	2.1
100	1.5	1.5	1.5	1.5	1.8	2	2.2	2.2
125	1.5	1.5	1.5	1.5	1.9	2.1	2.4	2.4
160	1.5	1.5	1.5	1.6	2	2.2	2.5	2.5
200	1.5	1.5	1.5	2	2.5	2.8	3.2	3.2
250	1.5	1.5	1.8	2.5	3.2	3.6	4	4
320	1.5	1.6	2.2	3.2	4	4.5	5	5
400	1.5	2	2.8	4	5	5.6	6.3	6.3
500	1.5	2.5	3.6	5	6.3	7.1	8.0	8.0
630	1.8	3.2	4.5	6.3	8	9	10	10
800	2.4	4	5.6	8	10	11	12.5	a
1000	3.2	5	7.1	10	12.5	14	16	
1250	4.2	6.3	9	12.5	16	18	20	
1600	5.6	8	11	16	20	22	25	

NOTE 1 The CTI values in footnote c refer to the values obtained in accordance with IEC 60112:2003, and IEC 60112:2003/AMD1:2009, test solution A, for the insulating material used.

NOTE 2 Values taken from IEC 60664-1:2007, but maintaining a minimum value of 1.5 mm

[a] Insulation of material group IIIb is not recommended for use in pollution degree 3 above 630 V.

[b] As an exception, for rated insulation voltages of 127 V, 208 V, 415 V, 440 V,660 V, 690 V and 830 V. creepage distances corresponding to the lower values 125 V, 200 V, 400 V, 630 V and 800 V may be used.

[c] Material groups are classified as follows, according to the range of values of the comparative tracking index (CTI) (see 3.6.16):
- Material Group I 600 ≤ CTI
- Material Group II 400 ≤ CTI < 600
- Material Group IIIa 175 ≤ CTI < 400
- Material Group IIIb 100 ≤ CTI <175

Compliance with the clearances and creepage distances depends largely on compliance with the specifications and the care taken with mounting the components of the assembly. It is therefore the responsibility of the assembly manufacturer to check the finished assembly by means of a visual inspection or a physical measurement if visual inspection is not adequate.

The clearances and distances are measured between the live parts with different polarities, and also between the live parts and the exposed conductive parts. The measurement methods are described in standard IEC 61439-1 Annex F.

Experience has shown that the greatest risk is in the wiring. Unsuitable connectors, bolted connections, joints and metal supports can reduce the clearances.

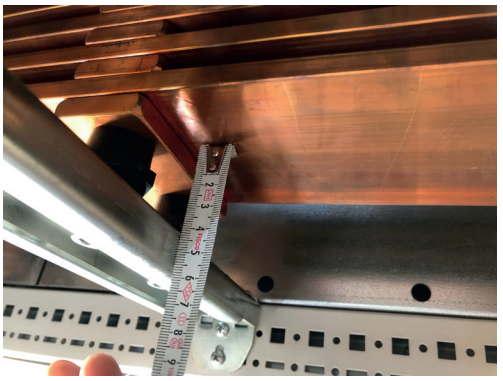
Particular attention must be paid to:

- The distances between the connections of devices (lugs, terminals for cable lugs, etc.) and nearby exposed conductive parts (chassis, plates, etc.)
- The distances between connections
- Bolted connections and connections on bars (distances from other bars and the exposed conductive part)

Partitions or insulated screens can be used to increase the distances in air. If the clearances are below the values in the table 2, an impulse withstand test must be carried out.

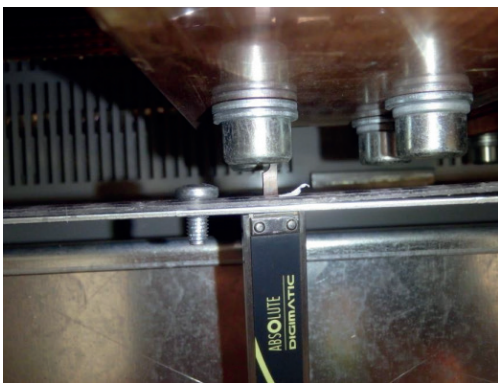
Support Profile-Busbar

Breaker Connection Bolts

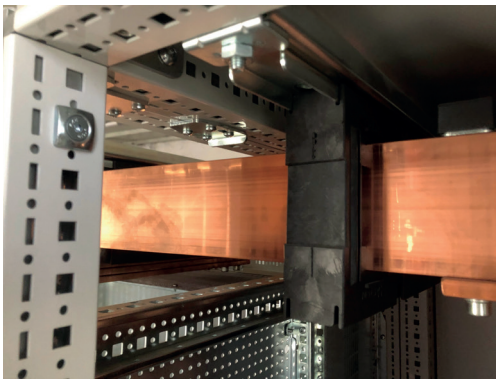


Support Profiles-Busbars

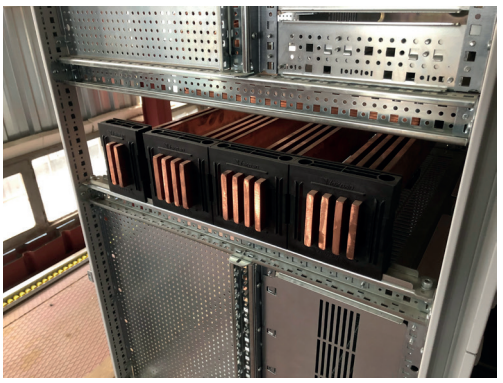
Support Profiles-Busbars



Main Busbar Connections - Forming Seperators Main



Main Busbar End – Side Cover

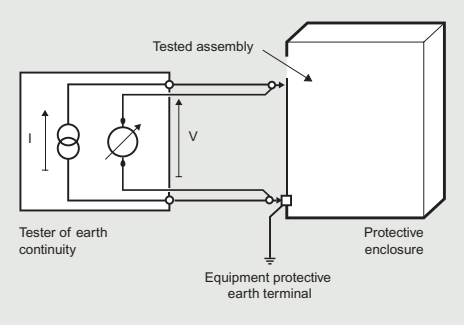


Busbars – Panel Joint Brackets

3.4. Protection against electric shock and integrity of protective circuits (Item 11.4 IEC 61439 1-2)

The main protection of enclosed distribution assemblies against electric shocks is provided by a metal or insulated casing (cabinets or enclosures).

In addition, each assembly must have a protective conductor for easy automatic cut-off off the power supply if a fault occurs inside the assembly or on the external circuits supplied via the assembly. This protective conductor must be able to withstand the short-circuit stresses which may occur where the assembly is installed.



- The prescribed protective measures with regard to basic protection and fault protection (see 8.4.2 and 8.4.3) shall be subject to a visual inspection.
- The protective circuits shall be checked by visual inspection to ascertain that the measures prescribed in 8.4.3 the manufacturer's instructions are adhered to and verified. When it is not obvious by inspection that the earth continuity of the protective circuits meets the requirement of 8.4.3.2, a continuity test according to 10.5.2 shall be made.
- Screwed and bolted connections shall be checked for the correct tightness on a random basis.
- A check must be carried out to ensure that the various exposed conductive parts of the assembly are connected to the terminal of the incoming external protective conductor.
- The check must be carried out using a resistance measurement instrument which is capable of carrying a current of at least 10 A (AC or DC).
- This current is injected between each exposed conductive part and the terminal for the external protective conductor. The resistance is measured and must not exceed 0.1 Ω.
- Random spot checks of the tightening of screwed and bolted assemblies must be carried out. Details of the tightening torques are available in assembling guides.

! It is recommended that the duration of the test is limited when low power equipment may be affected by the test.

3.5. Incorporation of built-in components (Item 11.5 IEC 61439 1-2-2)

All the components incorporated in an assembly must be suitable for their use and must comply with the corresponding IEC standards. The values of the electrical characteristics of the devices (voltage, current, rated frequencies, breaking and making capacity, short-circuit resistance, insulation voltage, rated impulse withstand voltage, etc.) must comply with the specifications and installation conditions of the assembly.

For example for a main LV distribution board specified for an operating voltage U_e of 400 V, and therefore suitable for use on a 400 V system, no product in this assembly must have an insulation voltage U_i of less than 400 V. Likewise, its main switch must, amongst other requirements, be sized for the short-circuit current.

All information on any protection to be associated with it must be detailed on the nameplate and in the technical documentation. The adjustment and reset devices and also the terminals for connecting devices must be easily accessible.

The busbars must be designed and sized to withstand the short-circuit stresses. The conductors must be sized according to the rules in IEC 60364-5-5, suitable for the conditions inside the assemblies.

All products must be used in accordance with manufacturer's instructions. The first part of this guide gives essential recommendations and precautions for constructing assemblies.

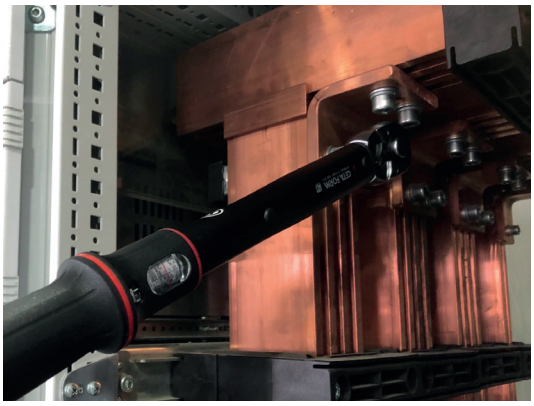
The assembly manufacturer must check that the products and their identification comply with the specifications of the assembly and that their installation complies with the original manufacturer's instructions. This check is carried out by means of a visual inspection.

The assembly manufacturer must ensure that the technical documentation is compiled with the manuals and other instructions provided by the original manufacturer.

3.6. Internal electrical circuits and connections (Item 11.6 IEC 61439 1-2)

The connections, especially screwed and bolted connections, shall be checked for the correct tightness on a random basis.

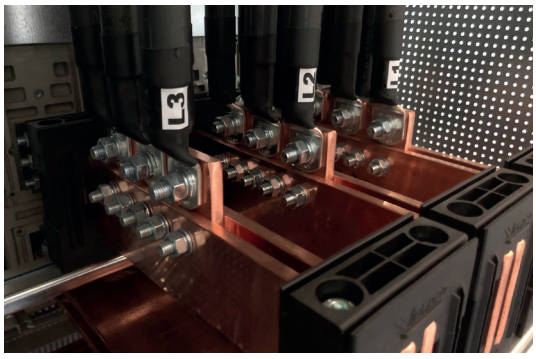
- Conductors shall be checked in accordance with the assembly's manufacturing instructions.
- Busbars and power circuit conductors must be sized and installed according to the prospective short-circuit current which could occur at the assembly installation point.
- For the selection and sizing of busbars, refer to the PDS specifications or the PDS Line software. The choice of conductors must comply with the requirements of Section C.2: "Conductor sizing, rigidity and insulation"
- The auxiliary circuits must be protected against the effects of short-circuits or must be set up in such a way that there is no chance of a short-circuit.
- The finished assembly must be checked by means of a visual inspection. Compliance with the conductor identification diagram is the responsibility of the assembly manufacturer.

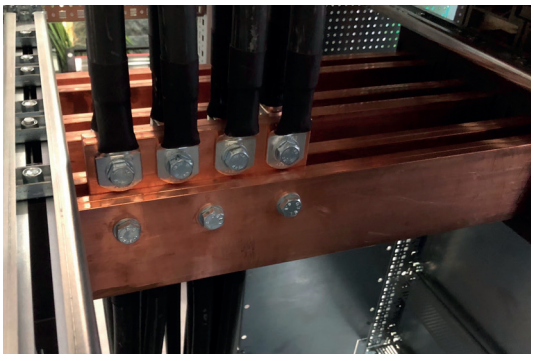


3.7. Terminals for external conductors (Item 11.7 IEC 61439 1-2)

The number, type and identification of terminals shall be checked in accordance with the assembly's manufacturing instructions. See at Section C.13: "Labelling"

- The conductors must not be subjected to stresses which could reduce their normal life expectancy. The assembly manufacturer must indicate whether the terminals are suitable for copper or aluminium conductors, or for both.
- The terminals must be such that the external conductors can be connected by a means (screws, connectors, etc.) which provides the necessary contact pressure corresponding to the rated current value and the short-circuit resistance of the device and that the circuit is maintained.
- The terminals of the external conductors must be marked in accordance with IEC 60445.
- The assembly manufacturer must check all the types of terminal which can be used for the cable entries and outlets (neutral, PEN, etc.) and check that they are suitable for copper or aluminium conductors, or both.
- The terminals for the external conductors must be identified. The finished assembly must be checked by means of a visual inspection.





3.8. Mechanical operation (Item 11.8 IEC 61439 1-2)

The effectiveness of mechanical actuating elements, interlocks and locks, including those associated with removable parts, shall be checked.

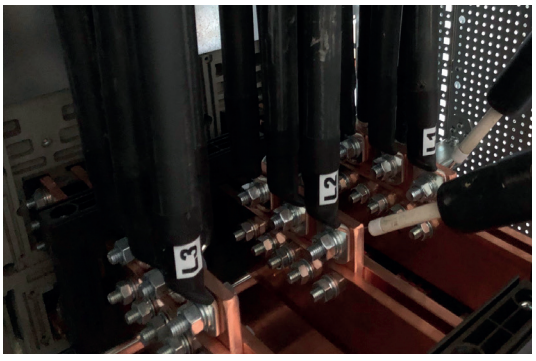
- Where a device's operating handle is used to indicate the switching position of the device, and it detaches from the device when the door is open, it shall be confirmed that, when the door is closed, the handle provides positive and unambiguous indication of the device's open and closed positions.
- This verification test does not have to be carried out on the devices (for example draw-out circuit breaker) of an ASSEMBLY that has previously undergone type tests in accordance with their applicable product standard unless their mechanical operation has been modified by their mounting.
- For devices which require verification by a test, the satisfactory mechanical operation must be checked after installation in the assembly. 200 operating cycles must be carried out. The operation of the mechanical interlocks associated with these movements must be checked at the same time.
- The correct mechanical operation of the doors and faceplates mounted on hinges must be checked, as well as the mechanical control components, interlocks and locking devices, including those associated with removable parts. 200 operating cycles must be carried out.

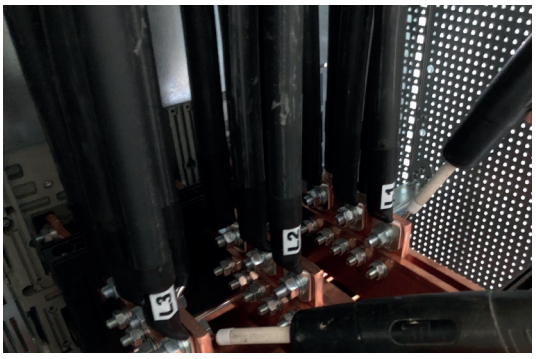
! The test is considered to be satisfactory if the devices and interlocks remain in good working order, if the specified degree of protection is unaffected and if the effort required for operation is virtually the same as before the test.

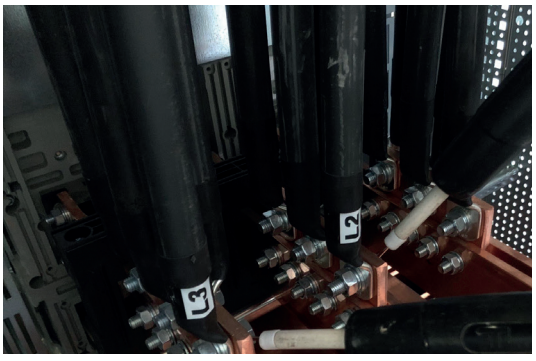
3.9. Dielectric properties (Item 11.9 IEC 61439 1-2)

A power-frequency withstand test shall be performed on all circuits in accordance with 10.9.2 and 10.9.3 but for a duration of 1 s and with a tripping current not less than 3,5 mA.

- This test need not be made on auxiliary circuits:
  - that are protected by a short-circuit protective device with a rating not exceeding 16 A;
  - if an electrical function test has been made previously at the rated operational voltage for which the auxiliary circuits are designed.
- As an alternative for assemblies with incoming protection rated up to 630 A and a rated voltage Un not exceeding 500 V, the verification of insulation resistance may be by measurement using an insulation measuring device at a voltage of at least 500 V DC.
- In this case, the test is satisfactory if the insulation resistance between circuits and exposed conductive parts is at least 1 MΩ.
- The dielectric tests check the insulation performance levels for the maximum operating voltage. They are carried out at the power frequency of 50 Hz and in the form of voltage waves simulating a lightning strike.
- The dielectric test must be carried out in accordance with the instructions or specifications for the assembly.
  - Test at power frequency for a given insulation value U_i
  - Impulse voltage test (1.2/50 µs wave) for a given U_{imp} value
- The assembly being tested must be de-energised and there must be no receiver devices connected.
- All the breaking devices must be in position I (ON).
- The test voltage must be applied according to the following sequence:
  -Between each pole of each circuit (power, control, auxiliaries) and the exposed conductive part of the assembly,
  - Between each pole of the main circuit and the other poles (between each phase and between each phase and neutral),
  - Between each circuit if they are not electrically connected (for example, SELV or separate control circuit and main circuit),
  - Between the protective circuit and exposed conductive part for class II assemblies,
  - Between drawn-out or separate parts for the isolation function.







Rated Insulation Voltage, U_i (Line to Line AC or DC)	Dielectric Test Voltage AC RMS	Dielectric Test Voltage [a] DC
V	V	V
$U_i \leq 60$	1000	1415
$60 < U_i \leq 300$	1500	2120
$300 < U_i \leq 690$	1890	2670
$690 < U_i \leq 800$	2000	2830
$800 < U_i \leq 1000$	2200	3110
$1000 < U_i \leq 1500$	2700	3820
[a] For DC Only		

Rated Insulation Voltage, U_i (Line to Line)	Dielectric Test Voltage AC RMS	Dielectric Test Voltage DC
V	V	V
$U_i \leq 12$	250	355
$12 < U_i \leq 60$	500	710
$60 < U_i$	See Table 8	See Table 8

Rated Impulse Withstand Voltage, U_{imp}	Test Voltages and Corresponding Altitudes During Test									
	$U_{1.2/50}$ **** AC peak and DC kV					AC RMS kV				
kV	See Level	200m	500m	1000m	2000m	See Level	200m	500m	1000m	2000m
2.5	2.95	2.8	2.8	2.7	2.5	2.1	2.0	2.0	1.9	1.8
4.0	4.8	4.8	4.7	4.4	4.0	3.4	3.4	3.3	3.1	2.8
6.0	7.3	7.2	7.0	6.7	6.0	5.1	5.1	5.0	4.7	4.2
8.0	9.8	9.6	9.3	9.0	8.0	6.9	6.8	6.6	6.4	5.7
12.0	14.8	14.5	14.0	13.3	12.0	10.5	10.3	9.9	9.4	8.5

3.10 Wiring, operational performance and function (Item 11.10 IEC 61439 1-2)

Depending on the complexity of the ASSEMBLY, it may be necessary to examine the wiring and carry out an electrical operating test. The test procedure and the number of tests depend on whether or not there are interlocks, complicated control sequences, etc. in the ASSEMBLY.

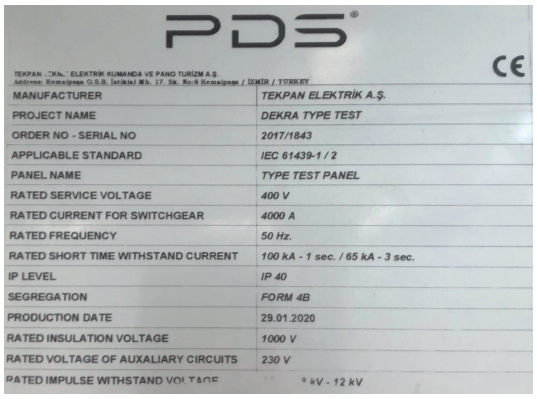
- By agreement between the user and the assembly manufacturer, communicating devices that are included and connected in a system within the assembly may need to be checked for basic operation and functionality.
- In some cases, it may be necessary to make or repeat this test on site before putting the installation into operation.

Marking

The ASSEMBLY manufacturer must provide every ASSEMBLY with a PDS nameplate, with durable marking and placed in a location where it is visible and legible when the ASSEMBLY is installed and operating.

The following information must be marked on the nameplate:

- Name or trademark of the assembly manufacturer (partner)
- Type designation or an identification number,
- Identifying the date of manufacture, e.g. 2021 or 2021-05 Standard IEC 61439-2


PDS®

CE

TEKPAN ...Kn.: ELEKTRİK KUMANDA VE PANO TURİZM A.Ş.
Address: Kemalpaşa O.S.B. Tetikler Mh. 17. Sk. No:5 Kemalpaşa / İZMİR / TURKEY

MANUFACTURER	TEKPAN ELEKTRİK A.Ş.
PROJECT NAME	DEKRA TYPE TEST
ORDER NO - SERIAL NO	2017/1843
APPLICABLE STANDARD	IEC 61439-1 / 2
PANEL NAME	TYPE TEST PANEL
RATED SERVICE VOLTAGE	400 V
RATED CURRENT FOR SWITCHGEAR	4000 A
RATED FREQUENCY	50 Hz.
RATED SHORT TIME WITHSTAND CURRENT	100 kA - 1 sec. / 65 kA - 3 sec.
IP LEVEL	IP 40
SEGREGATION	FORM 4B
PRODUCTION DATE	29.01.2020
RATED INSULATION VOLTAGE	1000 V
RATED VOLTAGE OF AUXALIARY CIRCUITS	230 V
RATED IMPULSE WITHSTAND VOLTAGE	° kV - 12 kV

The following additional information must be included in the technical documentation supplied with the assembly (documentation or technical specifications):

- Rated voltage of the assembly (*U*n), e.g. *U*n = 400 V
- Rated operating voltage of a circuit (*U*e), e.g. *U*e = 230 V (if different from *U*n)
- Rated impulse withstand voltage (*U*imp), e.g. *U*imp = 6 kV
- Rated insulation voltage (*U*i), e.g. *U*i = 800 V
- Rated current of the assembly (*I*na), e.g. *I*na = 3100 A
- Permissible rated peak current (*I*pk), e.g. *I*pk = 140 kA
- Permissible rated short-time withstand current (*I*cw), e.g. *I*cw = 50 kA 1 s
- Conditional rated short-circuit current (*I*sc), e.g. *I*sc = 70 kA
- Rated frequency (*f*n), e.g. *f*n = 50 Hz
- Rated diversity factor (RDF), e.g. RDF = 0.7

Inside the assembly, it shall be possible to identify individual circuits and their protective devices. Identification tags shall be legible, permanent and appropriate for the physical environment. Any designations used shall be in compliance with IEC 81346-1:2009 and IEC 81346-2:2019 and identical to those used in the wiring diagrams, which shall be in accordance with IEC 61082-1:2014.

- All interface characteristics according to Item 5, where applicable, shall be provided in the assembly manufacturer's technical documentation supplied with the assembly.

- The assembly manufacturer shall provide in documents or catalogues the conditions, if any, for the handling, installation, operation and maintenance of the assembly and the equipment contained therein. Where appropriate, instructions shall state that the assembly manufacturer is to be consulted when repair of an assembly is required.
- If necessary, the instructions shall indicate the measures that are of particular importance for the safe, proper and correct transport, handling, installation and operation of the assembly. The provision of weight details is of particular importance in connection with the transport and handling of transport units. In addition, installation instructions shall provide sufficient details for the installer to adequately secure the assembly in service.
- The correct location and installation of lifting means and the thread size of lifting attachments, if applicable, shall be given in the assembly manufacturer's documentation or the instructions on how the transport unit has to be handled.
- The measures to be taken, if any, with regard to EMC associated with the installation, operation and maintenance of the assembly shall be specified (see Annex J).
- If an assembly specifically intended for environment A is to be used in environment B, a warning shall be included in the operating instructions, in accordance with the following:

> **CAUTION:** This product has been designed for environment A. Use of this product in environment B can cause unwanted electromagnetic disturbances, in which case the user may be required to take adequate mitigation measures.

- Where necessary, the above-mentioned documents shall indicate the recommended extent and frequency of maintenance.
- If the circuitry within the assembly is not obvious, for example, there are connections from several incoming power-supplies such as photovoltaic supplies, generators, batteries, information detailing the circuit arrangements shall be supplied.
- When fuses are installed, the assembly manufacturer shall state the type and rating of the fuse-links to be used.

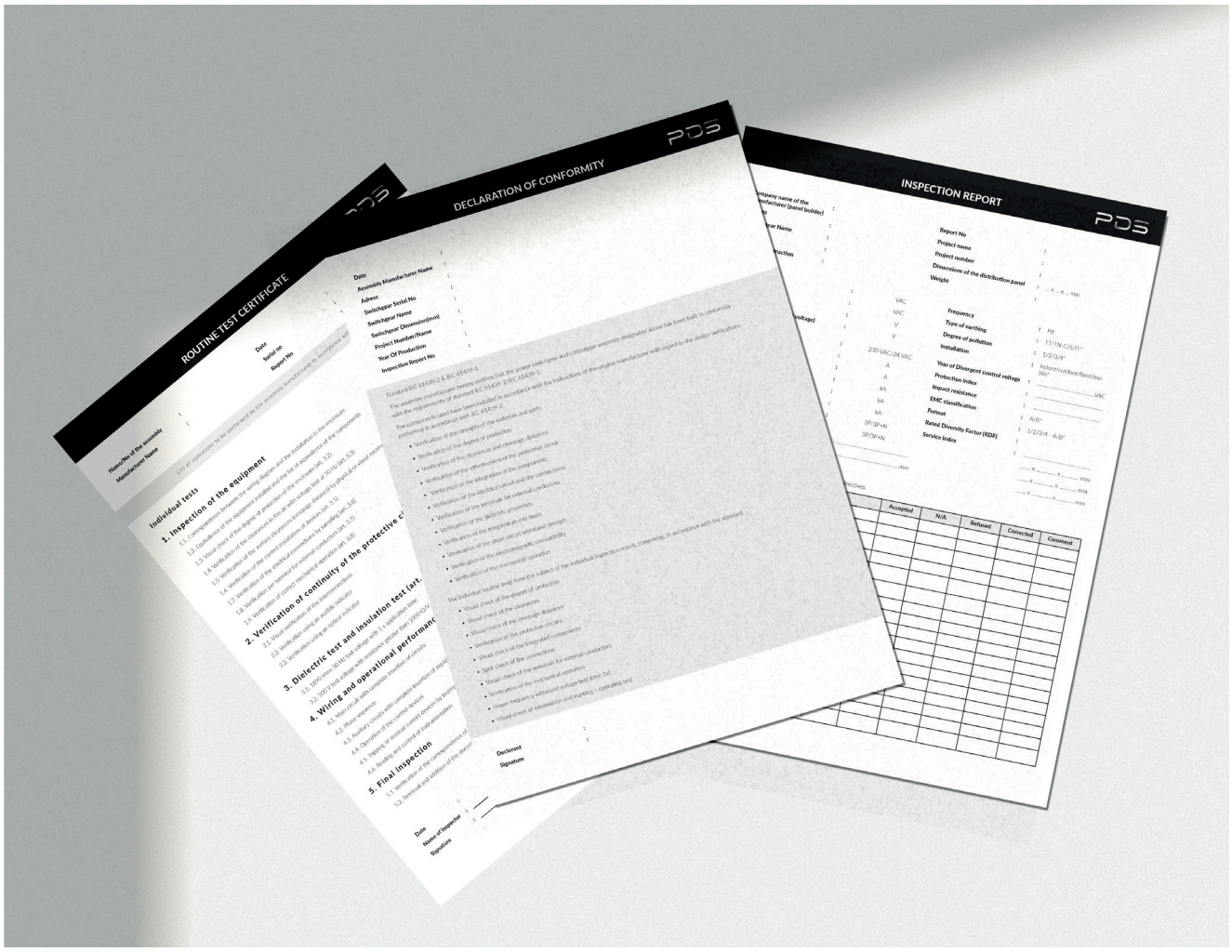
Documentation

The assembly manufacturer, must perform and fill in needed test reports and conformity according to standard. These are:

- Routine Test Report
- Declaration Of Conformity
- Inspection Report

These documents and photos of completed panel must be stored in digital archive for ten years period time with related serial no identification for future after sales support.

On behalf of these documents, as build project, missing part list (if exists) , delivery slip, site installation documentation, maintenance documentation, device and switchboard technical documentation must be delivered to end user and site installation teams.



4. PERFORMING FINAL INSPECTION

Inspection Zone

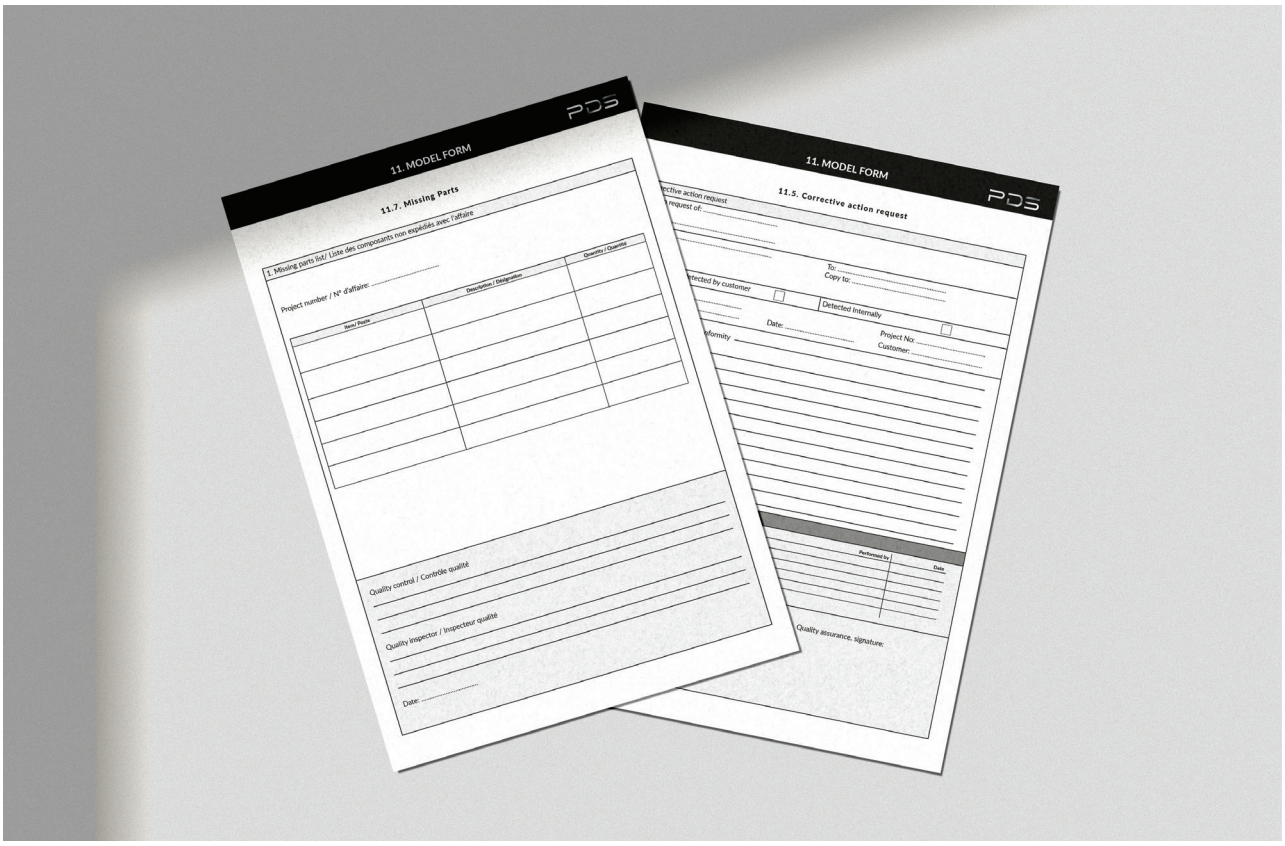
- Independent from production
- Must be physically separated from other departments against hazards of electric current and for protection of people and equipment
- Clearly marked out by tapes or partitions and clearly indicated by warning beacon, sign etc.
- Should be equipped in compliance with applicable legislation and local regulations

Inspection Equipments

- The switchboard fitter tools (screwdriver, wrenches, key etc.)
- HSE equipments
- Multi-Tester device to perform earth continuity and dielectric test
- Compass to measure clearance and creepage distances
- Roll meter to verify rough and mechanical sizes
- Multi-Meter to check voltage, current, ohm
- Torque Wrench to verify bolt and nut torques randomly
- 380VAC - 220VAC -110VAC serial lamp and 24VDC/AC indication lamp to check terminals
- Drawer test equipment
- Test cords and variety of plugs, supply cords and other connection systems
- Paint Thickness Device to measure thickness of paint between 80 and 130m
- IP Control Probe to verify the assembly has rated solid ingress protection
- RAL Colour Code Scala to verify paint colour
- 4-20mA/0-10V Generator to test low current automation input and outputs
- Steps, pallet-mover or other transport equipments
- Digital Camera

Necessary Documents

- IEC 61439-1 Standard
- Complete updated production file of the project (Single Line, Physical View, Terminal Plan etc.)
- Routine test Report template
- Calibration Reports related to test equipments
- Declaration Of Conformity template
- Device and switchboard technical documentation
- Corrective Action form template
- Missing parts list template
- Inspection Report Template



A. Conformity Check

- Take delivery of the switchboards to be inspected in the dedicated zone
- Become acquainted with the production file
- Check the observations and information given in the assembly follow up sheet
- Perform final inspection using the inspection Report Template or follow the steps below

A.1 Composition, dimensions and identification label

- Use the drawing of project front face to ensure that the number and order of cubicles respected
- Check the information on name plate match with the project file
- Check the presence of a product identification marker on each cubicle
- Check the presence of product identifications on protective devices and circuits according to electrical diagrams
- On completion of final inspection, the quality inspector must place his sign and indicate the date of inspection

A.2 Homogeneity - Finish

- Perform a visual inspection to check the homogeneity of the colours on surface of switchboard
- Check external appearance by a visual check; no scratches, deformations etc.
- Visually check the front face of the switchboard matches that shown in product drawing

A.3 Framework ground fixing, handling devices, keys

- Check the product design drawing to check the ground fixing points
- Check handling devices fastening and layout according to documentation
- Check keys matching of lock references and key numbers with references given in production file

A.4 Connection facilities, space and equipment

- Check the special facilities provided for cable routing (top or bottom) and bus way connections
- Check fixing of mounting plates, protection screens and partitioning or cowling parts as all screws present and properly secured

A.5 Conformity of Devices

- Use the layout diagrams in the production file to ensure that the devices are properly located and identified (QF1, QF2, etc.)
- Check presence and technical data of circuit breaker's associated devices (Residual, fault signal switch, trip unit, etc.)
- Check the power supply voltages for motor mechanisms, coils (contactor, relays, undervoltage and shunt coils etc.) indication lights, all electronic devices, soft starter, capacitors, etc.
- Check compatibility of the toroid with customer connection cables
- Check the technical data of the current transformers together with the installation direction, correspondence between associated measuring device due to secondary circuit, clearance between current transformer screws and live parts-metals, secure fastening of the transformer on conductors
- Visual checking for presence of accessories like crank handles, door stops, lights, clamps for extraction etc.

A.6 Mechanical Check on Safety and Locking System

- All mechanisms making the various operations to be checked
- Check that during plug-in or plug-out operation of the functional units (withdrawable, dismountable, plug-in on base or chassis version is impossible when the device is closed
- Check pre-tripping devices, on plug-in and plug-out operations
- Check devices on chassis, drawers, contactors etc.
- Check fuse blowing mechanical operation
- Check the fault trip and position indicators
- Check position of mechanical indicators after operation, a fault trip, drawer manoeuvring
- Check that the circuit breaker is reset after an electrical fault trip or after pressing trip test button
- Make sure of the correct resetting of the devices and drawers after a fault trip or switching operation
- Check interlocking that closing of one device prevents closing of the other associated one
- Check interlocking rods mechanical fasteners and adjustment
- Check interlocking cables radius and ensure they do not run near exposed live parts
- Check interlocking keys type and references and make sure that the key prevents the device from operating
- Check that the code of polarising slots matches the specifications (drawers and devices on chassis)
- Check padlocking operation

A.7 Clearances

- Check the shortest distance in the air between two live conductors or between live conductor and exposed conductive parts
  - 14mm for12kV impulse voltage (Main busbar -ACB)
  - 8mm for 8kV impulse voltage (MCCB)
  - 5.5mm for 6kV impulse voltage (MCB)
  - The attitude up to 2000m above sea level and pollution degree 3

A.8 Creepage Distances

- Check the shortest distance along an insulated material surface between two live conductors or between live conductor and exposed conductive parts:
  - 16mm for rated insulation voltage 1000VAC and DC (Main busbar -ACB)
  - 12.5mm for rated insulation voltage 750VAC and DC (MCCB)
  - 8mm for rated insulation voltage 500VAC and DC (MCB)
  - The material group 3a and pollution degree 3

A.9 Manual Equipment Operation

- Operate devices manual mechanisms to ensure their proper operation
- Check the operation of the functional units based on drawers, plug-in or chassis versions
- Check the operating safety margin of the drawers and their ease of operation; inserting and withdrawal of drawers should be performed without damaging the internal component wiring
- Check installation and operation of position contact, door, drawer position, extended rotary handle etc.

A.10 Installation and Maintenance Access

- Check accessibility of joint, cubicle coupling accessories, settings, fuses, contactor coils, interlock mechanisms, etc.
- Check the ease removing of auxiliary terminal blocks , with regard to screwdriver access for modifications and maintenance
- The associated bundles should be long enough to have access to the screws without difficulties
- Check jaw lubrication and mechanical parts lubrication

A.11 Electrical Operations Check

- Prepare equipments for test by connecting circuit and be sure of the earth link between sections
- Before energising, open the auxiliary control devices (relays, measuring devices, coils etc.)
- Power the switchboard, ensuring that voltage and phase rotation direction is complied
- Check power circuits by carrying out operations, opening all devices, verifying the order of phases, verifying correspondence of circuit and conductor identifications, verifying correspondence of phases on each device by closing them one by one from line side to load side.,
- When devices are connected to terminals or pads perform tests on them
- Check control circuits starting from power supply of auxiliary circuits by examining phase order on other an associated control devices. Special attention must be paid on non-protected circuits.
- Check operation of indicator lights, command and control buttons with associate devices.
- Check remote and local operating mechanisms
- Check systematically electronic supply circuits and the DC circuits using multi-meter
- Check the information supplied on the connection terminals such as contact status or voltage etc.
- Check motor mechanisms by activating devices according to the command and control diagram; local, remote, automatic etc.
- Check that it is impossible to close a device equipped with a locking contact
- Check metering circuits, winding direction, input-output characteristics of current transformers
- Check the test functions of circuit breaker by a variety of tests depending on the device type:
  - Earth Leakage Module Test by pushing test button of leakage relay to trip MCCB.
  - Trip MCCB by pushing trip test button.
  - Trip by remote controls if shunt or undervoltage coils inserted in MCCB.
- For voltage relays check that the contacts are in the status defined in electric design.
- For time relays, check correct operation.
- If mentioned check settings comply with product design file.
- For fault tracking devices, create a fault and check that the device detects and indicates its presence.

B. Protective Measures & Protective Circuit

Protective measures and electrical continuity of protection circuits performed according to IEC 61439-1 standard. The inspection is either visual and/or electrical as required by the customer.

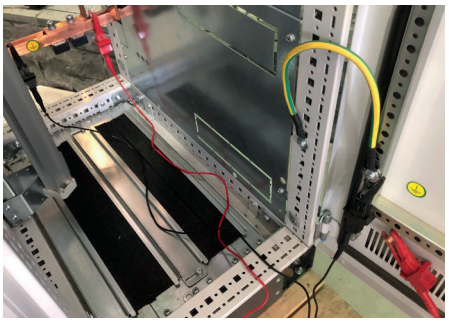
B.1 Mechanical Inspection (Visual) Of Protective Elements

- PE and/or PEN protection bars
- Check the presence of all the constituent elements of the assembly which ensure electrical continuity between the metal part and the earth bar
- Cross section in accordance with electrical characteristics
- Presence and cross-section of the joints between cubicles; they should be at least equal to the cross section of the PE/PEN bar to be connected
- Depending of earth/neutral connection systems, check presence of the PEN/PE disconnecting link and Access
- Ensure that its cross-section is the same as that of the earth bar
- Check that the protective conductors are identified by the two colours green/yellow marking plus PE or PEN lozenges
- Check the accessibility of external conductors to PE or PEN
- Check if , fr maintenance reasons , a part of the equipment is removed from the assembly , the protective circuit of other parts should not be interrupted

B.2 Electrical Inspection of Protective Elements

- A check must be carried out to ensure that the various exposed conductive parts of the assembly are connected to the terminal of the incoming external protective conductor.
- The check must be carried out using a resistance measurement instrument which is capable of carrying a current of at least 10 A (AC or DC). This current is injected between each exposed conductive part and the terminal for the external protective conductor. The resistance is measured and must not exceed 0.1 Ω.
- Random spot checks of the tightening of screwed and bolted assemblies must be carried out. Details of the tightening torques are available in assembling guides.

! It is recommended that the duration of the test is limited when low power equipment may be affected by the test.



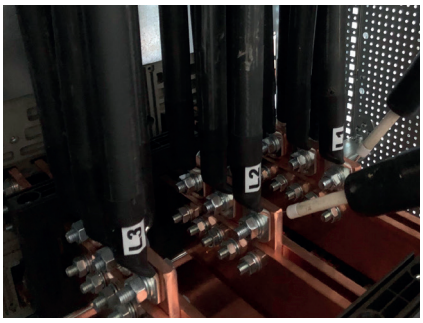
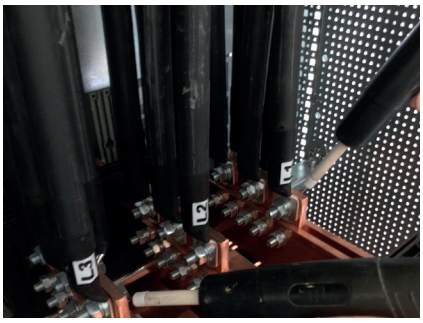
Record the values measured by test device and register the result on Inspection report.

C. Dielectrical Test

- Before performing the test, make sure that you disconnect; surge absorbers, electrical control motors and any other device not withstanding the applied voltage such as contactor coils, indicator lights, miniature relays, horn, measuring units, electronic instruments etc.
- The interference suppression capacitors installed between the live parts and the frames must not be disconnected, but be able to withstand test voltage
- This test does not need to be performed on auxiliary circuits which are connected to the main busbar if it:
  - is protected by a device of rating < 16A
  - has previously undergone operating tests
- Check that no unprotected connections are left
- Perform this test using Multi meter device designed to deliver a voltage 1900V
- Voltage to be applied:

Rated Insulation Voltage, U_i (Line to Line AC or DC)	Dielectric Test Voltage AC RMS	Dielectric Test Voltage [a] DC
V	V	V
$U_i \leq 60$	1000	1415
$60 < U_i \leq 300$	1500	2120
$300 < U_i \leq 690$	1890	2670
$690 < U_i \leq 800$	2000	2830
$800 < U_i \leq 1000$	2200	3110
$1000 < U_i \leq 1500$	2700	3820

[a] For DC Only

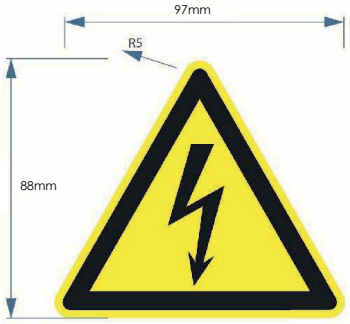




- Apply voltage on each phase in turn and on the other phases which are inter connected and led back to the switchboard frame
- All switching devices shall be closed-interconnect the exposed conductive parts and earth them
- Interconnect the live parts to one another and then to the assembly conductive parts
- Connect the measuring instrument earthing wire to the assembly frame
- Connect the injection cable to the circuit to be monitor and apply test voltage for 1 sec.
- Once this check is complete, repeat it for other live circuits
- The tests are satisfactory if there is no puncture or flashover
- Register the result on the final inspection list

D. Operator Safety, Protection of Persons

Check that during normal operations of device adjustment, operating handle access, drawer operation, pre-tripping devices of plug in devices, mechanical locking mechanisms do not cause danger for operators

- Check that during maintenance and safety operations (emergency stop, padlocking etc.) presence of warning labels such as '' do not step'' , "Danger'', ''Danger Supply Side'', 'Electric Shock Hazard''.
- Check that there is no any live part near the operating handles or adjustment screw, etc.
- Check the presence of plug-in flap, chassis etc.
- Check the insulation screens / phase barriers / terminal shields are fitted, firmly fixed and connected to earth for metallic ones
- Check the presence of all partitions and form screens and protection covers for devices located on doors
- Check the presence of picot washers, earthing braids for doors, covers, chassis, barriers, cover plates etc.
- Check earth braids strength by exerting a slight pressure on their connections



E. Pre-dispatching Checks

- Prior to packing, check that the equipment is clean; no dust, no foreign body forgotten in the assembly
- Using a detailed check list established by the design office perform inspection of all the equipment to be delivered separately, spare parts, devices dismantled for transport etc.
- Check the roof, coupling screws and busbar joints for site installation
- Check the presence of name plate and as built Project
- Check necessary documentation:
  - Routine test Report
  - Declaration Of Conformity
  - Inspection Report
  - Internal and external photos of each cubical from several angles to save in database
  - Missing parts list
  - Delivery Slip
  - Device and switchboard technical documentation
  - Maintenance Documentation
  - Site Installation Documentation
- Be sure that all internal devices and other parts are well secured, inserted or locked in the switchboard
- Check the packing details such as type of transport, the destination, storage conditions, climatic conditions
- Check the lock keys of panel doors to be shipped together with panel

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