

WHITE PAPER



CONSTRUCTION AND CERTIFICATION OF ASSEMBLIES

IEC 61439-2

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The document serves as a reminder of the tests, responsibilities, and roles of both the Original Manufacturer and the assembly builder.

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ROLE AND RESPONSIBILITY OF EACH PARTY



The IEC 61439-1 standard defines the general rules relating to assemblies for low-voltage installations. It provides definitions, specifies operating conditions, construction requirements, technical characteristics, and verification requirements.

The IEC 61439-2 standard, on the other hand, is a product standard that defines the specific requirements for power switchgear assemblies (PSC[1]).

The new IEC 61439 series clearly reiterates the responsibilities of the various stakeholders and continues to distinguish the role of the Original Manufacturer from that of the Assembly Manufacturer.

(1) PSC: Power Switchgear and Controlgear assemblies
A complete system of electrical and mechanical components (enclosures, busbars, functional units, etc.) as defined by the Original Manufacturer and intended to be assembled according to their instructions.

IEC 61439-2 Standard – Edition 3

In 4 key points, here are **the major changes** to consider for your future power switchgear assembly (PSC[1]) projects:

- **Group Rated Current of a Main Circuit (Ing):** A new characteristic applied to each main circuit.

It is the rated current that a main circuit can carry, taking into account the mutual thermal influences of the other circuits simultaneously loaded within the same column of the assembly (see IEC 61439-1:2020).
It ensures that a panel with a specific configuration and operating profile will meet the end user's expected usage.
Specifiers should strive to provide the operating current for each main circuit. The Original Manufacturer must be able to verify that the PSC can supply the required currents to the loads without excessive heating in accordance with the applicable standard and the characteristics of the products concerned.

- **Temperature Rise:** New provisions allow, under certain conditions, verification by calculation for naturally ventilated PSC, including circuits above 1600 A, or PSC equipped with forced ventilation up to 1600 A.

This makes it possible to reduce the number of actual laboratory tests.

- **Internal Arc:** The new standard acknowledges the possibility of an internal arc fault occurring in a PSC, even though the risk remains very low if design, construction, and inspection conditions are met. However, to enhance safety and operational performance, some users require additional technical solutions to cover these risks.

- **Definition Updates:**
  - clarification between a Class I or Class II PSC with appropriate protective measures.
  - distinction between the "macro" environment outside the assembly, for which the assembly must be suitable, and the "micro" environment inside the assembly, for which it must be perfectly adapted to the equipment housed within the PSC enclosure.

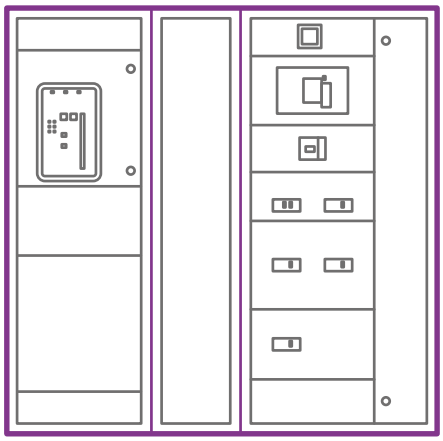
(1) PSC: Power Switchgear and Controlgear assemblies
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ROLE AND RESPONSIBILITY OF EACH PARTY

Original Manufacturer

Entity responsible for designing a PSC(1) in compliance with the construction and performance requirements of IEC 61439-2. It is accountable for the PSC design, which must be accompanied by a certificate or a declaration of conformity covering 11 points. The designation of the entity holding this role may vary depending on the project. All products making up the assembly must have certificates of conformity and be accompanied by technical documentation.

ORIGINAL MANUFACTURER



Standard configuration compliant with the construction and performance requirements of IEC 61439-2

11 design verifications



Certificate of conformity or declaration of conformity

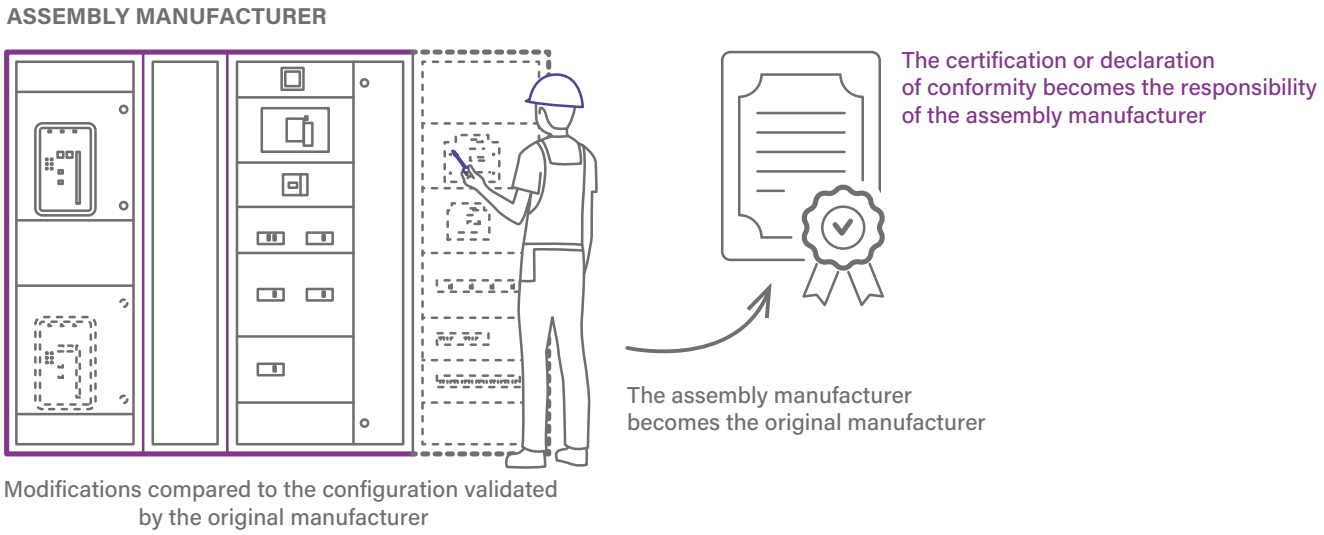
The Original Manufacturer undertakes to carry out the design verifications required by IEC 61439-2 on standard configurations and to issue the corresponding certificates.

The verifications performed by the Original Manufacturer during test campaigns correspond to critical configurations to assess product reliability and system robustness.
They do not correspond to an actual assembly configuration, but these verifications serve as a basis for comparison or evaluation (see p.10).

(1) PSC: Power Switchgear and Controlgear assemblies
A complete system of electrical and mechanical components (enclosures, busbars, functional units, etc.) as defined by the Original Manufacturer and intended to be assembled according to their instructions.

Assembly Manufacturer

Entity responsible for assembling, wiring, and taking responsibility for the finished PSC(1).
The Assembly Manufacturer builds the electrical cabinet in compliance with the assembly rules and/or the Original Manufacturer's instructions.
They perform 9 individual series verifications on each manufactured assembly, which allow them to issue the declaration of conformity for their assembly.
Compliance with the IEC 61439-2 standard also allows the CE marking to be applied if required.



The Assembly Manufacturer becomes the Original Manufacturer as soon as any design element of the PSC differs from the configurations previously verified by the Original Manufacturer.

(1) PSC: Power Switchgear and Controlgear assemblies
A complete system of electrical and mechanical components (enclosures, busbars, functional units, etc.) as defined by the Original Manufacturer and intended to be assembled according to their instructions.

THE ORIGINAL MANUFACTURER VERIFIES THESE POINTS



THE 11 VERIFICATIONS TO BE CARRIED OUT BY THE ORIGINAL MANUFACTURER

The IEC 61439-2 standard requires the verification of 11 points for the certification of PSC(1).
These verifications must be carried out on the finished assembly. They do not replace product compliance with their own standards.

Depending on the verification to be carried out, 3 different methods are possible:

- By **testing** performed on a sample assembly or on parts of an assembly.
- By structural **comparison** of a proposed assembly design, or parts of an assembly, with a reference design tested and proven.
- By **evaluation** of compliance with design rules applied to a PSC, including safety margins.

If all the requirements and instructions provided by the Original Manufacturer are fully respected, the Assembly Manufacturer does not need to repeat these verifications on the finished assembly.

When the Assembly Manufacturer incorporates its own devices not included in the Original Manufacturer's certification, it is considered responsible as the designer regarding these provisions and must provide the corresponding evidence.

**The Original Manufacturer provides certificates of conformity issued on a PSC guaranteeing its design in accordance with the requirements of the IEC 61439-2 standard.
These verifications are carried out by independent organizations.**

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A complete system of electrical and mechanical components (enclosures, busbars, functional units, etc.) as defined by the Original Manufacturer and intended to be assembled according to their instructions.

THE 11 DESIGN VERIFICATIONS ACCORDING TO IEC 61439-2:2020

1 Strength of materials and parts

The mechanical, electrical, and thermal robustness of construction materials and assembly parts must be proven by verifying construction and performance characteristics.

Tests are carried out to check resistance to:
- corrosion;
- heat;
- ultraviolet (UV) exposure;
- lifting;
- mechanical impacts (IK);
- marking durability;
- mechanical movements (200 cycles).

2 Verification of degree of protection (IP)

The IP rating defines the level of protection of an enclosure against the ingress of solid objects (first digit) and liquids (second digit).
The additional letter indicates protection against access to hazardous parts only.

3 Clearances and creepage distances

The measurement methods for creepage distances and clearances are precisely specified in Annex F of IEC 61439-1:2020. Distances are measured between live parts of different potentials, as well as between live parts and exposed conductive parts.

4 Effectiveness of the protective circuit

The continuity of the protective circuit is a key safety element. It is verified: according to IEC 61439-2 under a test current of 10 A minimum between the protective conductor terminal and all exposed conductive parts; and by an additional test under a fault current that may occur following an internal short circuit.

5 Integration of connection devices and components

These are the rules concerning the installation of devices compliant with their own product standards within the assembly, whether fixed or removable parts, as well as compliance with wiring according to customer requirements. This also includes accessibility to adjustment and resetting devices, and all types of indicators (lights, dials, etc.).

6 Internal electrical circuits and connections

This test consists of verifying compliance with design requirements for power and control circuits.
It includes correct sizing of the busbar system and cables, grounding of control circuits, color coding of different circuits, etc.

7 Terminals for external conductors

This rule requires that the indication of terminal capacity, as well as the possibility of accommodating aluminum or copper, be specified to the end user.
It also includes verification of all types of terminals that can be used for cable entry or exit (Neutral, PEN, PE symbol, etc.).

8 Dielectric properties

Dielectric tests check the insulation performance of the assembly for maximum operating voltages.
They are carried out at the power frequency of 50/60 Hz and using voltage waves simulating a lightning impulse.
These tests must be carried out in accordance with IEC 61439-2.

9 Temperature rise limits

The temperature rise verification of assemblies ensures proper system operation under maximum operating conditions (current, number of devices, enclosure volume).
It helps define the thermal balance elements for a large number of components in the electrical panel, with a reference ambient temperature of 35°C.
Temperature rise limits are required by the standard for different sub-parts of the assembly.

10 Short-circuit withstand strength

Tests performed guarantee, with respect to thermal and electrodynamic stresses, the strength of busbars and their supports, cables, switching devices, protection devices and enclosures.

11 Electromagnetic compatibility (EMC)

This verification ensures that the integrated devices comply with the requirements of their own standards and that the manufacturers' installation recommendations are followed.

TABLE OF THE 11 DESIGN VERIFICATIONS

Below is a summary table of the 11 design verifications
- carried out by the Original Manufacturer;
or
- to be carried out by the Assembly Manufacturer (by test, comparison, or evaluation according to the table below), if the design of the assembly produced is not identical in every respect to that of the Original Manufacturer.

DESIGN VERIFICATIONS

No.	Characteristics to Verify	Article or Paragraphs	Standardized verification methods			Certificate / Declaration of Conformity
			Tests	Comparison	Evaluation	
1	**Strength of materials and parts:**	10.2				YES
	- Corrosion resistance	10.2.2	YES	YES	NO	
	- Properties of insulating materials:	10.2.3				
	Thermal stability	10.2.3.1	YES	YES	NO	
	Resistance of insulating materials to abnormal heat and fire caused by internal electrical effects	10.2.3.2	YES	YES	YES	
	- Resistance to ultraviolet (UV) radiation	10.2.4	YES	YES	YES	
	- Lifting	10.2.5	YES	YES	NO	
	- Mechanical impact (IK)	10.2.6	YES	YES	NO	
	- Marking	10.2.7	YES	YES	NO	
	- Mechanical operations	10.2.8	YES	YES	NO	
2	**Degree of protection provided by enclosures (IP)**	10.3	YES	NO	YES	YES
3	**Clearances and creepage distances**	10.4	YES	NO	NO	YES
4	**Protection against electric shock and integrity of protective circuits:**	10.5				YES
	- Actual continuity between exposed conductive parts and protective circuit in Class I assemblies	10.5.2	YES	NO	NO	
	- Short-circuit withstand capability of protective circuits	10.5.3	YES	YES	NO	



DESIGN VERIFICATIONS (continued)

No.	Characteristics to Verify	Article or Paragraphs	Standardized verification methods			Certificate / Declaration of Conformity
			Test	Comparison	Evaluation	
5	**Integration of connection devices and components**	10.6	NO	NO	YES	YES
6	**Internal electrical circuits and connections**	10.7	NO	NO	YES	YES
7	**Terminals for external conductors**	10.8	NO	NO	YES	YES
8	**Dielectric properties:**	10.9				YES
	- Power frequency withstand voltage	10.9.2	YES	NO	NO	
	- Impulse withstand voltage	10.9.3	YES	NO	YES	
	- Enclosures made of insulating material	10.9.4	YES	NO	NO	
	- External controls made of insulating material	10.9.5	YES	NO	NO	
	- Conductors covered with insulating material to provide protection against electric shock	10.9.6	YES	NO	NO	
9	**Temperature rise limits**	10.10	YES	YES	YES	YES
10	**Short-circuit withstand capability**	10.11	YES	YES	NO	YES
11	**Electromagnetic compatibility (EMC)**	10.12	YES	NO	YES	YES

INDIVIDUAL SERIES VERIFICATIONS

The IEC 61439-2 standard requires that an individual series verification be carried out on each fully assembled equipment assembly (including wiring) before it leaves its place of production or the dispatch area at the PSC(1) manufacturer. These verifications can be performed during the construction process or as a final operation by the equipment Assembly Manufacturer (PSC).

This essential step aims to detect any potential defects in components or assembly and to confirm the proper functioning of the PSC in accordance with safety rules and customer expectations.
The individual series verifications of PSC are described in clause 11 of the IEC 61439-2 standard. These verifications are carried out using simple tests and inspections, including comparisons with the Original Manufacturer's instructions.
The Assembly Manufacturer must provide a declaration or certificate of conformity.

Individual series verifications are not required for equipment or devices that comply with their own standard, as well as for specific components incorporated and installed in the PSC in accordance with the manufacturer's assembly instructions.

▪ The 9 Individual Series Verifications

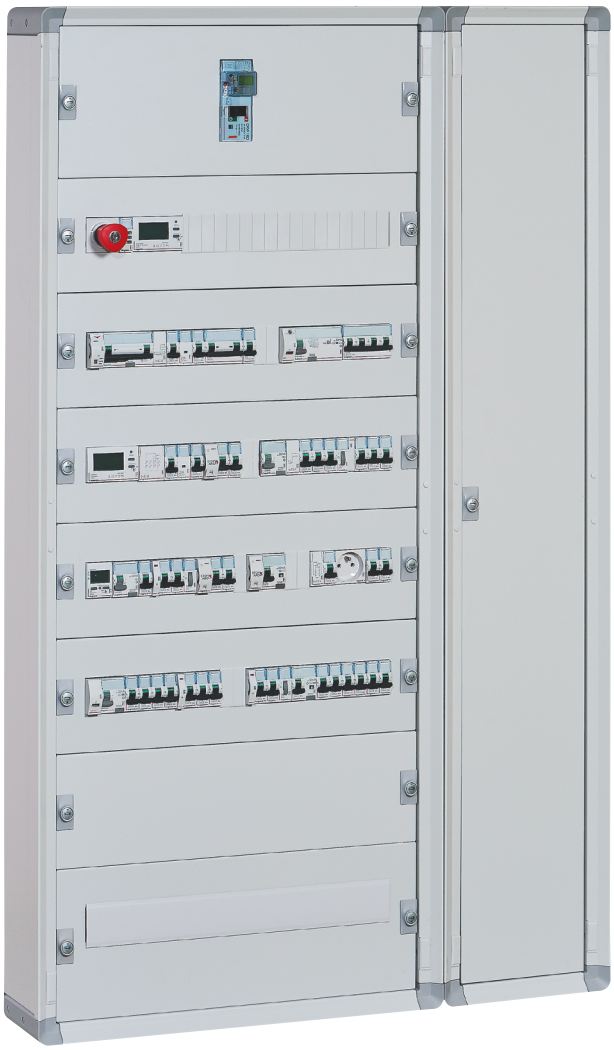
To carry out all individual verification operations, the PSC manufacturer has two methods available:
Visual inspection or test

Verification	Clause of the standard	Objective	Methods
Degree of protection provided by enclosures	11.2	Verify the degree of protection required by the customer or the standard	Visual inspection
Clearances and creepage distances	11.3	Verify the insulation performance of a device to ensure the protection of persons under normal or abnormal operation	Visual inspection, dimensional measurement, or impulse withstand voltage test in case of persistent doubt
Protection against electric shock and integrity of protective circuits	11.4	Verify the main protective measures and in case of fault	Visual inspection, if possible, or continuity test with a current of at least 10 A (see paragraph 10.5.2 of the standard).
Integration of connection devices and components	11.5	Verify the installation of devices in accordance with the manufacturer's instructions	Visual inspection
Internal electrical circuits and connections	11.6	The tightening of connections, especially screwed and bolted ones, must be verified by random sampling. Conductors must be verified in accordance with the Assembly Manufacturer's instructions	Visual inspection and random testing
Terminals for external conductors	11.7	Verify the number, type, and identification of terminals. They must comply with the Assembly Manufacturer's instructions	Visual inspection
Mechanical operation	11.8	Verify the proper operation of moving parts and mechanisms	Visual inspection and operational tests
Dielectric properties	11.9	Verify the resistance to breakdown voltages	Test
Wiring, electrical operation, and function	11.10	Verify the provided instructions, proper wiring execution, and basic operations...	Visual inspection with simple functional tests if necessary

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Article 11.2 - Degree of Protection Provided by Enclosures

The degree of protection of an assembly defines its ability to protect persons from direct contact with live parts and to prevent the ingress of solid foreign objects or liquids. It is specified by the IP code (Ingress Protection), with tests described in standard IEC 60529 (see below). The IP code required for an enclosed assembly depends on its installation conditions and the external influences it is subjected to. In all cases, it must be at least IP 2X.



WHAT THE ASSEMBLY MANUFACTURER MUST DO

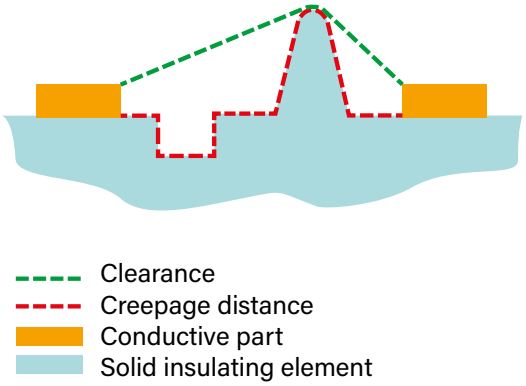
The Assembly Manufacturer must ensure, through visual inspection once the assembly of the various components is completed, that the declared degree of protection of the enclosure and its components is maintained.

For example, if control and signaling auxiliaries are installed on a door or panel, their own IP rating and installation must comply with the declared IP degree.

In this case, no additional testing is required.

Article 11.3 - Clearances and Creepage Distances

Clearances represent the shortest path through air between two conductive parts at different potentials. In the event of disruptive breakdown of air, the electric arc would follow this path.
The minimum clearance distances are determined based on the impulse withstand voltage (Uimp) of the assembly.
Creepage distances represent the shortest path along the surface of insulating materials.
The minimum creepage distances are determined based on the rated insulation voltage (Ui) declared for the assembly and the pollution degree of the installation environment in which the PSC(1) must operate.



Reminder on Common Pollution Degrees:
- **Pollution Degree 2** generally intended for residential environments.

Presence of non-conductive pollution only. Occasionally, slight condensation (such as dew) may cause temporary electrical conduction.
- **Pollution Degree 3** generally intended for industrial environments.

Presence of conductive pollution or dry, non-conductive pollution that may become conductive due to condensation.

Principle of Microenvironment and Macroenvironment:
The IEC 61439-2 standard allows devices designed for Pollution Degree 2 to be installed in a microenvironment protected by an enclosure resistant to a more severe external environment, called the macroenvironment (for example: Pollution Degree 3).

WHAT THE ASSEMBLY MANUFACTURER MUST DO

Compliance with clearances and creepage distances largely depends on following the prescribed requirements and the care taken during the assembly of components. It is therefore the responsibility of the Assembly Manufacturer to verify the finished assembly through visual inspection or physical measurement if visual inspection is insufficient.

Distances are measured between live parts of different polarities, as well as between live parts and exposed conductive parts. The measurement methods are described in Annex F of the IEC 61439-1:2020 standard.

Experience shows that the greatest risk lies in assembly and wiring. Connectors, bolted joints, splices, and unsuitable metal supports can reduce clearances. Particular attention must therefore be paid to:
- distances between device connections (lugs, terminals, etc.) and nearby exposed conductive parts (chassis, mounting plate, etc.);
- distances between connections;
- bolted connections and connections on busbars (distances from other busbars and from exposed conductive parts).

If necessary, partitions or insulating barriers may be installed to increase air clearances.

If the clearances are less than the values in the adjacent table, an impulse withstand voltage test must be performed.

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MINIMUM AIR CLEARANCE DISTANCES ACCORDING TO IEC 61439-1	
Rated impulse withstand voltage Uimp (kV)	Minimum air clearance distance[1] (mm)
≤ 2.5	1.5
4	3
6	5.5
8	8
12	14

[1] Based on non-homogeneous field conditions and pollution degree 3

The correspondence between the rated voltage of the power supply network and the equipment's rated impulse withstand voltage (Uimp) is given in Table G1 of IEC 61439-1.

MINIMUM CREEPAGE DISTANCES ACCORDING TO IEC 61439-1								
Rated insulation voltage Ui (V)[1] (Ui ≥ Ue)	Pollution degree							
	1	2			3			
	All material groups[2]	Material group[2]			Material group[2]			
		I	II	IIIa IIIb	I	II	IIIa	IIIb
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	8
630	1.8	3.2	4.5	6.3	8	9	10	10
800	2.4	4	5.6	8	10	11	12.5	
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	

[1] : For lower rated impulse withstand voltages, refer to Table 2 of standard IEC 61439-1.
[2] : Material groups are classified as follows, according to the range of Comparative Tracking Index (CTI) values:
Material Group I : 600 ≤ CTI;
Material Group II : 400 ≤ CTI < 600;
Material Group IIIa : 175 ≤ CTI < 400;
Material Group IIIb : 100 ≤ CTI < 175.

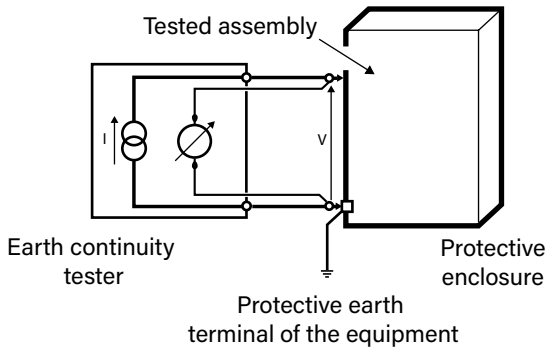
Article 11.4 - Protection against electric shock and integrity of protective circuits

Two levels of protection must be considered:

- **Basic protection** (risk of direct contact with live parts normally under voltage). This protective measure is generally provided by insulating enclosures or barriers (screens) preventing access to these hazardous parts.
- **Fault protection** (risk of indirect contact with a normally inactive and accessible conductive part). This additional protective measure ensures the safety of persons against the effects of a fault inside the PSC(1) and even a fault on an external circuit powered by the PSC.

CONTINUITY TEST PRINCIPLE

The measurement is carried out at a current of at least 10 A, the resistance must not exceed 0.1 Ω.



Each PSC must include a protective circuit to ensure the automatic disconnection of the power supply in the event of a fault. This protective circuit must imperatively connect all accessible exposed conductive parts.
When certain exposed parts of a PSC cannot be directly connected to the protective circuit (loss of continuity) using standard PSC connection components, a conductor of appropriate cross-section must ensure their connection.
Reminder: this protective circuit must be able to withstand stresses resulting from the maximum fault current (Ifmax) that may occur at the PSC installation point (see Annex B of IEC 61439-1).

WHAT THE ASSEMBLY MANUFACTURER MUST DO

It must be verified that the various exposed conductive parts of the assembly are effectively connected to the terminal of the incoming external protective conductor.

The verification can be carried out by actual visual inspection, and when this is not possible, the verification shall be performed by a test at a minimum current of 10 A (alternating or direct current) followed by a resistance measurement that must not exceed 0.1 Ω.

The tightening of screwed and bolted joints must be randomly checked by sampling.



The assembly of the enclosures ensures the continuity of exposed conductive parts.

It is recommended to limit the duration of the test in order to prevent overheating of the equipment.

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Article 11.5 - Integration of Connection Devices and Components

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

For example, for a low-voltage main switchboard specified for an operating voltage Ue = 400 V, and therefore intended for use on a 400 V network, no product within the assembly should have an insulation voltage Ui lower than 400 V.
Likewise, its main switch must, among other requirements, be rated for the short-circuit current.
Any information regarding the associated protection must appear on the nameplate and in the technical file.
Adjustment and reset devices, as well as connection terminals, must be easily accessible.
All products must be installed according to the Original Manufacturer's instructions.

WHAT THE ASSEMBLY MANUFACTURER MUST DO

The Assembly Manufacturer must ensure that the products and their identification comply with the assembly specifications and that their implementation follows the Original Manufacturer's instructions.
This verification is carried out through a visual inspection.

They must also compile the technical file with manuals and other instructions provided by the Original Manufacturer.

Article 11.6 - Internal Electrical Circuits and Connections

Busbars and power circuit conductors must be sized and installed according to the prospective short-circuit current that may occur at the assembly's installation point.
The selection of conductors must comply with the requirements of IEC 60364-5-52.
In certain conditions, the cross-section of neutral conductors may be reduced.
The conductors shall be readily identifiable by one or more of the following methods:
- physical location;
- colour coding;
- graphical symbols (in accordance with IEC 60417);
- alphanumeric characters.

Auxiliary circuits shall be protected against the effects of short circuits or shall be designed so as to minimize the risk of a short circuit occurring and/or to limit its consequences.

WHAT THE ASSEMBLY MANUFACTURER MUST DO

The tightening of connections and terminals must be randomly checked by sampling.

A visual inspection shall be carried out on the completed assembly. Compliance with the diagram and conductor identification are the responsibility of the assembly manufacturer.

TIGHTENING TORQUE VERIFICATION CAMPAIGN



Article 11.7 - Terminals for External Conductors

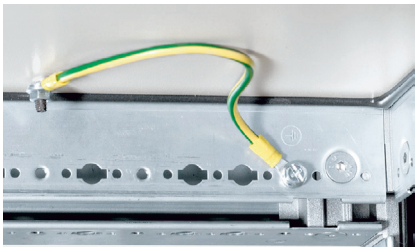
The number, type, and identification of terminals must be verified in accordance with the assembly manufacturing instructions.
Conductors must not be subjected to stresses that could reduce their normal service life.
The Assembly Manufacturer must indicate whether the terminals are suitable for copper conductors, aluminum conductors, or both.
Terminals must allow external conductors to be connected using a method (screws, connectors, etc.) that ensures the necessary contact pressure is maintained, corresponding to the rated current and the short-circuit withstand of the device and circuit.
External conductor terminals must be marked in accordance with IEC 60445.

WHAT THE ASSEMBLY MANUFACTURER MUST DO

The Assembly Manufacturer must verify all types of terminals that may be used for cable entry or exit (Neutral, PEN, etc.) and ensure they are suitable for copper or aluminum conductors, or both.

The identification of external conductor terminals must be carried out.

A visual inspection shall be carried out on the completed assembly. Compliance with the diagram and conductor identification are the responsibility of the assembly manufacturer.



Example : Type A equipotential bonding connection points are identified by the symbol shown opposite.





Example : the conductors are identified by colour and alphanumeric characters at the ends and connection points.

Article 11.8 - Mechanical Operation

The proper operation of mechanical control devices, interlocks and locking mechanisms, including those associated with removable or movable parts, must be verified.

Opening a door or a removable cover must not alter the operating conditions and reliability of the devices or control elements potentially affected by such movement.

WHAT THE ASSEMBLY MANUFACTURER MUST DO

The mechanical operation of doors and hinged front plates must be checked, as well as the mechanical control elements, interlocks and locking mechanisms, including those associated with removable parts.

The test is considered satisfactory if the devices and interlocks are still in good working condition, if the specified degree of protection has not been affected, and if the operating force required is practically the same as before the test.

Article 11.9 - Dielectric Properties

Dielectric tests assess insulation performance for the maximum operating voltage. They are carried out at the power frequency of 50/60 Hz.

Alternatively, for assemblies with an incoming current protection rating less than or equal to 630 A, an insulation resistance measurement may be performed using an insulation measuring device at a voltage of at least 500 V DC.
In this case, the test is considered satisfactory if the insulation resistance between circuits and exposed conductive parts is at least 1000 Ω/V, based on the supply voltage of these circuits relative to earth.

All components containing electronic circuitry or in which the application of the test voltage would cause current to flow shall be disconnected to prevent any damage and/or destruction.

WHAT THE ASSEMBLY MANUFACTURER MUST DO

The dielectric test must be carried out according to the instructions or requirements related to the assembly.
- Power frequency test for a declared insulation value Ui.

The tested assembly must be de-energized, and no receiving device must be connected.
All switching devices must be in position I (ON).
The test voltage is applied in the following sequence:
- between each pole of every circuit (power, control, auxiliary) and the assembly's exposed conductive parts;
- between each pole of the main circuit and the other poles (between each phase and between each phase and the neutral);
- between each circuit if they are not electrically connected (e.g., separate control circuit or SELV and main circuit);
- between the protective circuit and the exposed conductive parts for Class II assemblies;
- between disconnected or separated parts for the disconnection function.

TABLE 8 – POWER-FREQUENCY WITHSTAND VOLTAGE FOR MAIN CIRCUITS (VALUES TAKEN FROM CLAUSE 10.9.2)

Rated insulation voltage Ui (between phases AC or DC) (V)	RMS AC dielectric test voltage (V)	DC dielectric test voltage (V)
Ui ≤ 60	1000	1415
60 < Ui ≤ 300	1500	2120
300 < Ui ≤ 690	1890	2670
690 < Ui ≤ 800	2000	2830
800 < Ui ≤ 1000	2200	3110
1000 < Ui ≤ 1500(1)	2700	3820

(1): for direct current only

TABLE 9 – POWER-FREQUENCY WITHSTAND VOLTAGE FOR AUXILIARY AND CONTROL CIRCUITS (VALUES TAKEN FROM CLAUSE 10.9.2)

Rated insulation voltage, Ui (between phases) (V)	RMS AC dielectric test voltage (V)	DC dielectric test voltage (V)
Ui ≤ 12	250	355
12 < Ui ≤ 60	500	710
60 < Ui	See Table 8	See Table 8

Article 11.10 - Wiring, Electrical Operation and Function

It is necessary to verify that the information and markings specified are complete.
The Assembly Manufacturer must be able to identify each assembly with a nameplate, marked in a durable manner and placed in an easily visible location when the assembly is installed and in operation.
Depending on the complexity of the assembly, it may be necessary to examine the wiring and perform an electrical operation test.
The test procedure and number of tests depend on whether there are interlocks, complex control sequences, etc.

WHAT THE ASSEMBLY MANUFACTURER MUST DO

Information and markings must be verified.

A functional test is necessary before putting the assembly into service.

The following information must be found on the nameplate:
- Name of the Assembly Manufacturer or brand (responsible for final assembly),

e.g.: Company Name of the Assembly Manufacturer;
- Designation of type or identification number,

e.g.: TD01 - RDC or 918732;
- Date of manufacture identification,

e.g.: 2015 or 2015 - 03 or 12W09
- Applicable standard: IEC 61439-X (the specific part X identified),

e.g.: IEC 61439-2.

Example of nameplate:

Nameplate	TD01 - RDC
2015	IEC 61439-2
Ina = 3100 A Un = 400 V fn = 50 Hz	

The following additional information should be provided in the technical documentation supplied with the assembly (technical file):
- Rated voltage of the assembly (Un), e.g.: Un = 400 V;
- Rated operational voltage (Ue), e.g.: Ue = 230 V (if different from Un);
- Rated impulse withstand voltage (Uimp), e.g.: Uimp = 6 kV;
- Rated insulation voltage (Ui), e.g.: Ui = 800 V;
- Rated current of the assembly (Ina), e.g.: Ina = 3100 A;
- Rated current of a circuit (Inc), e.g.: Inc = 250 A;
- Peak withstand current rating (Ipk), e.g.: Ipk = 140 kA;
- Short-time withstand current rating (Icw), e.g.: Icw = 50 kA/1 s;
- Conditional short-circuit current rating (Icc), e.g.: Icc = 70 kA;
- Frequency rating (fn), e.g.: fn = 50 Hz;
- Diversity factor (RDF). e.g.: RDF = 0.7.

⚠ In certain cases, it may be necessary to carry out or repeat this test on-site before commissioning the installation.

All technical information mentioned opposite must, where applicable, be compiled in the technical file or documentation of the Assembly Manufacturer and delivered with the assembly.
The Assembly Manufacturer must also specify any conditions for handling, installation, operation, and maintenance of the assembly and the equipment it contains.







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