



CONNECT AND PROTECT

IEC 61439

White Paper



HOFFMAN

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1. Introduction

The new standard IEC 61439 “Low-voltage switchgear and control gear assemblies” came into force in November 2014. This standard withdraws the previous standard IEC 60439.

IEC 61439 describes the definitions and states the service conditions, construction requirements, technical characteristics, and verification requirements for low-voltage switchgear and control gear assemblies.

This standard applies to low-voltage assemblies intended for use in connection with the generation, transmission, distribution and conversion of electric energy, and for the control of electric energy.

Need to conform to this standard.

The CE marking is required for the low-voltage switchgear and control gear assemblies in the European Economic Area. It states that the product is assessed before being placed on the market and meets EU safety, health and environmental protection requirements. The manufacturer must prepare a Declaration of Conformity (CE DoC) and must be able to demonstrate that they have met the Low Voltage Directive, and the way to do that is to comply with the relevant harmonised standards which for electrical panels is at least the IEC 61439.

Affected market segments.

In the past there was the feeling that the IEC 60439 was affecting only to the Power & Distribution panels but all the segments are affected by the new standard (Automation & Control, Machine builders, Building).

nVent HOFFMAN provides the market with enclosure solutions that are part of the assembly, therefore nVent HOFFMAN products are affected directly by the IEC 61439 standard:

- Enclosures
- Busbar supports
- Thermal management equipment



2. IEC 61439

2.1. Standard structure

2.2. Main content

2.2.1. Terms and definitions.

Important definitions to understand the standard are:

- Low-voltage switchgear and control gear assembly: is a combination of one or more switching devices together with associated control, measuring, signalling, protective, regulating equipment, with all the internal electrical and mechanical interconnections and structural parts. We can say that the assemblies are made with: enclosure, operational components, electrical connections, and thermal management components.
- Assembly system: is a full range of mechanical and electrical components (enclosures, busbars, functional units, etc.), as defined by the original manufacturer, which can be assembled in accordance with the original manufacturer's instructions in order to produce various assemblies.
- Original manufacturer: is the organization that has carried out the original design and the associated verification of an assembly in accordance with the relevant assembly standard.
- Assembly manufacturer: is the organization taking the responsibility for the completed assembly. The assembly manufacturer may be a different organisation to the original manufacturer.
- User: is the party who will specify, purchase, use and/or operate the assembly, or someone acting on their behalf.
- Design verification: is the verification made on a sample of an assembly or on parts of assemblies to show that the design meets the requirements of the relevant assembly standard.
- Routine verification: is the verification of each assembly performed during and/or after manufacture to confirm whether it complies with the requirements of the relevant assembly standard.

2.2.2. Interface characteristics

The characteristics of the assembly will ensure compatibility with the ratings of the circuits to which it is connected and the installation conditions, and will be declared by the assembly manufacturer.

- Voltage ratings
- Current ratings
- Rated diversity factor (RDF)
- Rated frequency
- Other characteristics (Special service conditions, pollution degree, ...)

2.2.3. Service conditions

Normal service conditions, assemblies conforming to this standard are intended for use under the defined normal service conditions.

- Ambient air temperature, -5°C to 35°C for indoor, and -25°C to 35°C for outdoor.
- Humidity conditions, less than 50% at 40°C for indoor, and 100% at 25°C for outdoor.
- Pollution degree, for industrial applications usually pollution degree 3
- Altitude, less than 2000 m



2.2.4. Constructional and performance requirements:

- | | |
|---|---|
| ▪ Strength of materials and parts | ▪ Cooling |
| ▪ Degree of protection | ▪ Terminal for external conductors |
| ▪ Clearances and creepage distances | ▪ Dielectric properties |
| ▪ Protection against electric shock | ▪ Temperature rise limits |
| ▪ Incorporation of switching devices and components | ▪ Short-circuit protection and short-circuit withstand strength |
| ▪ Internal electrical circuits and connections | ▪ Electromagnetic compatibility (EMC) |



2.2.5. Design verification

Design verification is intended to check the assembly's design compliance with the requirements. There are three verification methods: test, comparison with a tested reference design, and verification assessment.

- Construction features verification
- Performance verification

2.2.6. Routine verification

Routine verification is intended to detect faults in materials and workmanship and determine proper functioning of the manufactured assembly. This verification is made on every assembly.

- Construction features verification
- Performance verification





3. nVent HOFFMAN approach to the IEC 61439

3.1. nVent HOFFMAN as empty enclosures supplier

nVent HOFFMAN enclosures must comply with the relevant requirements included in the standard IEC 61439 for enclosures. The relevant requirements for enclosures are included in section 8.1 of the standard "Strength of materials and parts", and in section 8.2 "Degree of protection provided by an assembly enclosure". The design verification for these requirements is explained in sections 10.2 and 10.3, and nVent HOFFMAN supports this verification process in the following way:

3.1.1. Strength of material parts:

The standard states the following "where an empty enclosure in accordance with IEC 62208 is used, and it has not been modified so as to degrade the performance of the enclosure, no repetition of the enclosure testing is required".

3.1.2. Degree of protection of enclosures:

The standard states the following "where an empty enclosure in accordance with IEC 62208 is used, a verification assessment shall be performed to ensure that any external modification that has been carried out does not result in a deterioration of the degree of protection. In this case no further testing is required".

nVent HOFFMAN enclosures have been tested according to the standard IEC 62208 by the independent laboratory KEMA-DEKRA who has issued the certificates, and enclosures are marked with the KEMA KEUR mark. The information about the KEMA-DEKRA certificates is included in Annex 01.

The standard IEC 61439 is for complete assemblies, therefore a certification cannot be issued for empty enclosures according to this standard. However, nVent HOFFMAN can state that:

"nVent HOFFMAN enclosures comply with the new standard IEC 61439"

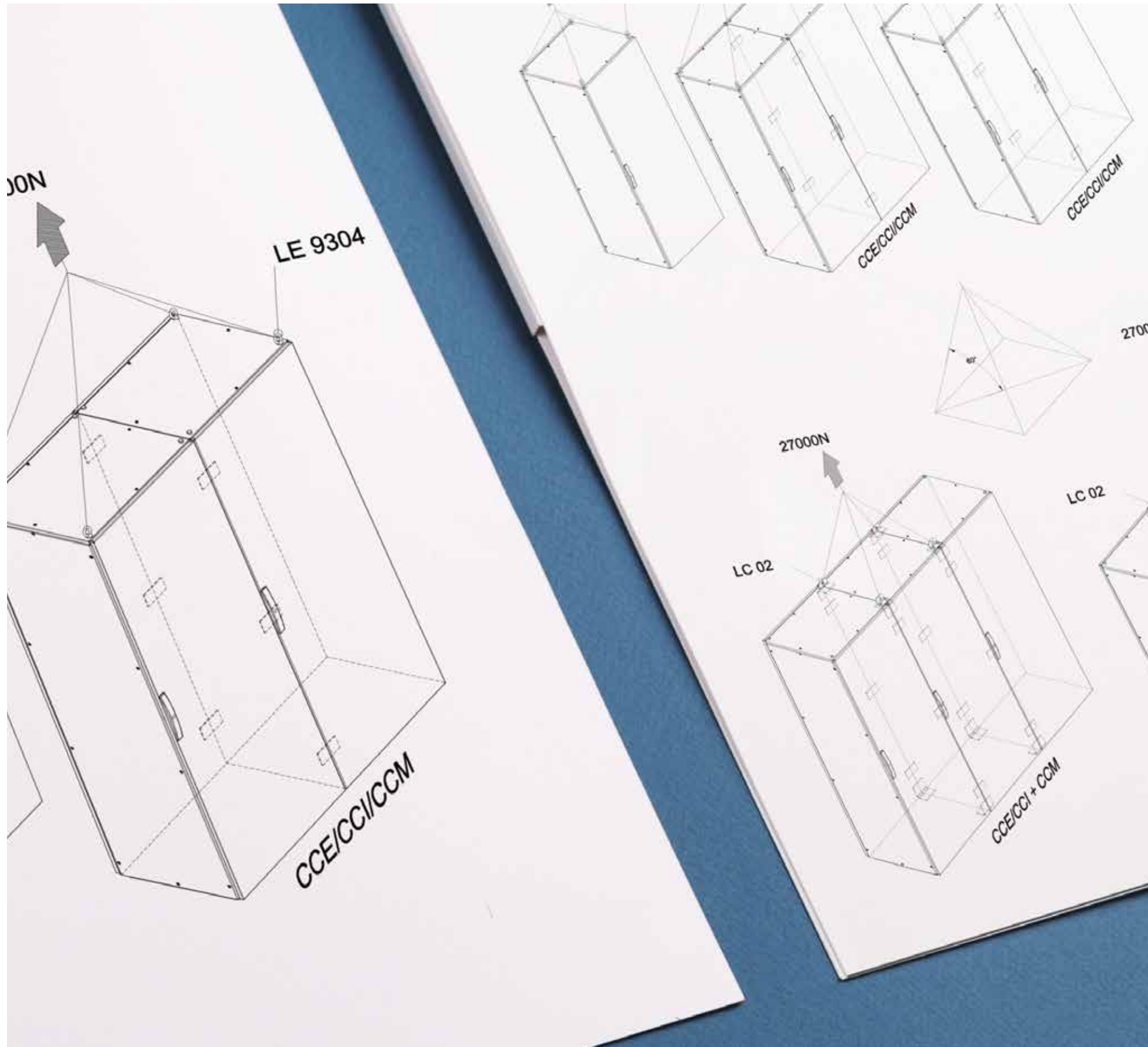
3.2. nVent HOFFMAN as "Original Manufacturer" and assembly system supplier

nVent HOFFMAN, with the EPS assembly system, has manufactured assemblies with different components brands (switches), and these assemblies have been tested by the independent Swedish laboratory Intertek-Semko. Test results have been recorded in the STR (Statement of Test Results) SE-1405658 by Intertek-Semko.

nVent HOFFMAN becomes an "original manufacturer", and in conclusion all assemblies manufactured using the nVent HOFFMAN assembly system and follow the design and manufacturing rules included in the EPS manual; do not need to be tested again. The tested assemblies can be used as a reference design verified by test.

Therefore nVent HOFFMAN can state:

"nVent HOFFMAN's EPS is a tested assembly system according to IEC 61439"



4. nVent HOFFMAN support in the design verification stage

nVent HOFFMAN has carried out different tests and developed specific tools to facilitate design verification of the assemblies according to the standard IEC 61439.

The "design verification" comprises of the following verifications:

4.1. Strength of materials and parts

Assemblies shall be manufactured of materials capable of withstanding the mechanical, electrical, thermal, and environmental stresses.

The verification includes different tests:

- Resistance to corrosion
- Properties of insulating materials
- Resistance to ultra-violet (UV) radiation
- Lifting
- Mechanical impact
- Marking

nVent HOFFMAN enclosures have been tested and certified according to the IEC 62208:2011 by KEMA-DEKRA. This test lets our customers use the certificate without performing any additional test but only if the enclosure has not been modified in any way so as to degrade the performance of the enclosure.

KEMA-DEKRA certificate details can be found in Annex 01.

4.2. Degree of protection of enclosures

The degree of protection provided by the assembly against contact with live parts, ingress of solid foreign bodies and water is indicated by the IP. The protection against mechanical impact, if necessary, shall be defined by the IK.

The accepted verification methods are:

- Testing: nVent HOFFMAN enclosures have been tested and certified according to the IEC 62208:2011 by KEMA-DEKRA. This certification includes the required IP test according to IEC 60529, and the IK test according to IEC 62262
- Assessment: verification assessment shall be performed to ensure that any external modification that has been carried out does not result in a deterioration of the degree of protection, then no further testing is required. KEMA-DEKRA certificate details can be found in Annex 01.



4.3. Clearances and creepage distances

The requirements for clearances and creepage distances are intended to provide insulation co-ordination within the installation, and the values are stated by the standard. The only accepted verification method is by testing (measuring) minimum values depending on the voltage, pollution degree, and the material group of insulation materials used.

In the EPS assembly system design verification Intertek-Semko has tested the required clearances and creepage distances for the nVent HOFFMAN affected products as busbar supports and it is recorded in the STR (Statement of Test Results) SE-1405658. Details for the different busbar systems can be found in Annex 02.



4.4. Protection against electric shock and integrity of protective circuits

The effectiveness of the protective circuit shall guarantee the protection against the consequences of internal faults through the effective earth continuity between the exposed conductive parts and the protective circuit, and the consequences of external faults through the short-circuit withstand strength of the protective circuit.

There are two verifications included:

- Effective earth continuity: test is the only accepted verification method, and it is exactly the same included in the standard IEC 62208:2011 and nVent HOFFMAN enclosures have passed it. The customers do not require to have further verification for nVent HOFFMAN enclosures and related accessories. KEMA-DEKRA certificate details can be found in Annex 01.
- Short-circuit withstand strength of the protective circuit: verification may be by test or by comparison with a reference design.

Test: KEMA-DEKRA has carried out the short-circuit tests in the different earthing connections of the enclosures and the test results are available for design purposes. KEMA Test report N° 2088000.01, certificate details can be found in Annex 03.

Comparison with a reference design: verification is achieved when comparison following check list included in table 13 of the standard (items 1 to 6 and 8 to 10) between assembly and reference design does not show deviations. KEMA Test report N° 2088000.01 can be used as a reference design, certificate details can be found in Annex 03.



4.5. Incorporation of switching devices and components.

The selection must consider the suitability for the application, the installation must be done following manufacturer instructions and it must follow section 8.5 of the standard. The verification must be done by assessment recording the followed criteria and results.

4.6. Internal electrical circuits and connections.

It must be designed to minimize the possibility of internal short-circuits, and it must follow section 8.6 of the standard. The verification must be done by assessment recording the followed criteria and results.

4.7. Terminals for external conductors.

The selection must consider the suitability of the terminals provided for external connections, and to be suitable for the current rating and short-circuit strength of the system. It must follow section 8.8 of the standard.

The verification must be done by assessment recording the followed criteria and results, and the inspection is made performing a visual inspection.



4.8. Dielectric properties.

Each circuit of the assembly shall be capable of withstanding temporary overvoltages and transient overvoltages:

- The ability to withstand temporary overvoltage's is verified by the "power-frequency withstand voltage", applicable to the main and auxiliary circuits following section 9.1.2 of the standard. The verification must be done by test, and Intertek-Semko has tested it in the EPS assembly system and it is recorded in the STR (Statement of Test Results) SE-1405658. Details for the tested voltages can be found in Annex 02.
- The ability to withstand transient overvoltage's is verified by the "impulse withstand voltage", applicable to the main and auxiliary circuits following section 9.1.3 of the standard. The verification must be made by test or by assessment:

Test: Intertek-Semko has tested it in the EPS assembly system and it is recorded in the STR (Statement of Test Results) SE-1405658. Details for the tested voltages can be found in Annex 02.

Assessment: Measuring the clearances (increased by a margin of 50%). In the EPS assembly system design verification Intertek-Semko has verified the clearances in air for the nVent HOFFMAN affected products as busbar supports and it is recorded in the STR (Statement of Test Results) SE-1405658. Details for the different busbar systems can be found in Annex 02. These measurements can be used for the verification assessment.

4.9. Verification of temperature rise

The maximum temperature rises let in the assembly with ambient temperature up to 35°C are specified in section 9.2 of the standard.

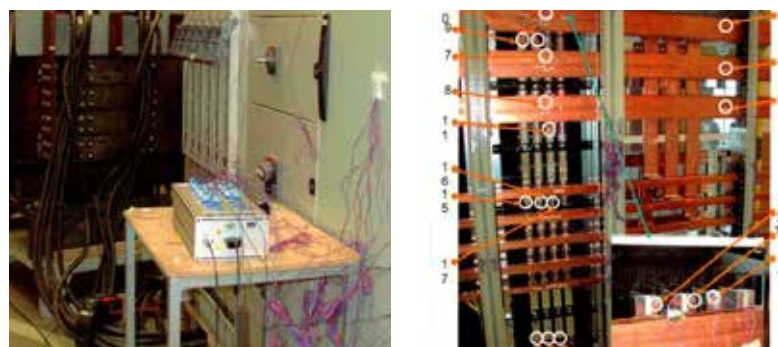
For verification purposes the RDF (Rated Diversity Factor) must be taken in consideration, and the standard grants three methods of verification:

- Testing: applicable in all assemblies.
- Derivation: complying with the rules included in section 10.10.3 of the standard rated currents of variants can be verified by derivation from similar arrangements verified by test. In the EPS assembly system with different brands and sizes of switches Intertek-Semko has tested the temperature rise, and the results have been recorded in the STR (Statement of Test Results) SE-1405658. These values have been used to create temperature rise tables which let to our customers to make derivations avoiding the test.
- Calculation depending on the design and rated current:

Single compartment with rated current not exceeding 630A, complying with conditions in section 10.10.4.2.1 of the standard. Confirmation that the power losses inside the enclosure do not exceed the power dissipation capability of the enclosure. To use this calculation the continuous load of the components does not need to exceed more than 80% of its rated current. nVent HOFFMAN provides Thermal management software to make the verification in these conditions easier.

Assembly with rated current not exceeding 1600A, complying with conditions in section 10.10.4.3.1 of the standard.

The temperature rise verification can be made by calculation in accordance with the method of IEC 60890 from the total power losses inside the enclosure. To use this calculation the continuous load of the components does not need to exceed more than 80% of its rated current. nVent HOFFMAN has software available to apply the standard verification in these conditions easier.



4.10. Short-circuit withstand strength

Confirmation that the assembly will be able to withstand thermal and dynamic stresses resulting from short-circuits currents. Section 10.11.2 of the standard states the exempted circuits, for example when the prospective short-circuit current at the incoming terminals does not exceed 17 kA cut-off / 10 kA r.m.s.

There are available two methods of verification:

- Verification by test. The test must be carried out following section 10.11.5 of the standard.
- Verification by comparison with a reference design. This comparison can be made using a check list or calculation:

Check list: verification is made comparing the verified assembly to the already tested design using the check list in the table 13 of the standard.

Calculation: verification is made comparing the verified assembly to the already tested design in accordance with Annex P of the standard and checking that each circuit meet the requirements of part of the check list in the table 13 of the standard (6, 8, 9, 10).



Using as a reference design the assemblies tested by Intertek-Semko, nVent HOFFMAN has created the design tables for the different busbar supports. Following the rules in this tables our customers can design derivations which will comply with the standard and making possible a short-circuit verification by comparison with a reference design using calculation. The design tables are included in Annex 04.

4.11. Electromagnetic compatibility

The standard considers two possible environments (A and B) based in the EMC requirements, and the assembly manufacturer will declare which environment is the assembly suitable for. No EMC tests are required on final assemblies if the following conditions are fulfilled:

- Incorporated components comply with the relevant EMC product standards.
- Installation and wiring has been made following the component manufacturers mounting instructions.
- Two methods of verification are available:
- Verification by test: the test must be carried out following Annex J of the standard.
- Verification by assessment: no EMC tests are required on final assemblies if the following conditions are fulfilled:

Incorporated components complies with the relevant EMC product standards

Installation and wiring has been made following the component manufacturers mounting instructions

In normal conditions the verification will be done by assessment of the component's technical information and how the installation and wiring has been made.

4.12. Mechanical operation

The mechanical operation verification can only be made by test following section 10.13 of the standard. This verification test will not be applied on components which have already been type tested according to their relevant product standard, unless their mechanical operation have been modified during mounting.

nVent HOFFMAN enclosures have been tested according to their relevant product standard, IEC62208, and if all other components have been tested too, no additional tests are required.

5. FAQ's (Frequently Asked Questions)

New standard and evolution

What are the reasons for the new standard?

The main reasons for the standard revision are the following:

- The IEC 60439 standard is difficult to understand and apply, without clear content and open to subjective interpretations.
- Difficult compliance verification with the concepts "Type Tested Assemblies" and "Partially Type Tested Assemblies" (TTA – PTTA)".
- Old standard structure is not representing the current situation.

Scope of the standard

Is this standard applicable to all electrical panels?

No, it is applicable only to low-voltage switchgear and controlgear assemblies, but this does not mean that other relevant standards for specific applications must not be complied with.

Is the standard only applicable to Power & Distribution panels?

No, different parts of the standard corresponds to different electrical panel typologies. For example part 2 corresponds to "Power switchgear and controlgear assemblies", and part 3 corresponds to "Distribution boards". It includes the control panels installed in automation and control processes, or in machines.

Stakeholders and their role

To which stakeholders is the new standard referring to?

- User: party who will specify, purchase, use and/or operate the assembly
- Original manufacturer: organization that has carried out the original design
- Assembly manufacturer: organization taking the responsibility of the final assembly following the original design

Who is responsible for what?

- The user: is responsible to provide all the relevant information about the assembly purpose to make the correct design feasible. The standard includes a part (IEC61439-0) with all details that should be provided in a complete specification.
- Original manufacturer: is responsible to carry out the design verification of the assembly.
- Assembly manufacturer: responsible to follow the original design specifications and carry out the routine verification.

Standard compliance

Is the compliance with this standard obligatory?

The assembly compliance with this standard is the easiest way to comply with the applicable EC Directives (EMC and Low-Voltage), which are required to put the CE mark in the assembly.

Can nVent HOFFMAN certify his products according to the IEC 61439 standard?

No, nVent HOFFMAN is not providing switchboard or controlgear assemblies, then nVent HOFFMAN can not make a certificate for his products according to this standard. nVent HOFFMAN is offering the certificate for his products (empty enclosures) according to the relevant standard for this type of products "IEC 62208, Empty enclosures for low-voltage switchgear and controlgear assemblies".

Is nVent HOFFMAN providing the IEC 61439 certificate for their empty enclosures?

No, it is not possible because the standard compliance must be stated by the design and routine verification which must be done for the complete enclosure and taking in consideration the application.

Do nVent HOFFMAN enclosures comply with the IEC 61439 standard?

Yes, because nVent HOFFMAN enclosures have been tested according to the IEC 62208 and it covers the IEC 61439 relevant requirements for the enclosures. On top of that the nVent HOFFMAN certificate about the IEC 62208 lets to our customers use this certificate and avoid further verifications about:

- Strength of material and parts
- Degree of protection of enclosures

nVent HOFFMAN is providing a Declaration of Compliance of the enclosures with the relevant requirements stated in the standard IEC 61439-1&2 for the empty enclosures.

The tests already carried out according to the old standard IEC 60439 must be repeated?

No, the tests conducted in accordance with IEC 60439, fulfil the requirements of the relevant part of IEC 61439, and they don't need to be repeated. For example the temperature rise tests carried out by nVent HOFFMAN for the EPS system, or the short-circuit tests carried out for the enclosures earthing connections, can be used for the design verification of new designs.

nVent HOFFMAN enclosures with filter fans mounted in our factory comply with the standard?

The assembly of filter fans and exhaust filters can affect the IP and IK of the enclosures, and enclosure values must be updated according to the filter fans information. The components selected in accordance with the standard, and installed following the manufacturer's mounting instructions, can avoid the repetition of component verifications. The verification of the assembly about the degree of protection can be made by "verification assessment" taking in consideration the degree of protection provided by the filter fans and exhaust filters.

Annex 01

KEMA-DEKRA Certificate

KEMA-DEKRA declares in the below certificates that the product ranges included have been certified on the basis of a type test according to the standard IEC 62208:2011.

KEMA-DEKRA Certificate N° 2171237-01 includes the following product ranges:

Wall mounted enclosures: **MAS, MAD, MAP, ASR, ADR, AFS**

Floor standing enclosures: **MCS, MCD, MKS, MKD, MCSS, MCDS**

MAS, Mild steel wall mounted enclosure, single door

- Method of fixing: Wall mounted
- Type of material: Powder painted steel
- Intended location: Indoor (severity corrosion test A)
- Resistance to ultra-violet radiation: N/A because is intended for indoor locations
- Lifting: N/A
- Degree of protection, mechanical impact: IK10
- Degree of protection, solids and liquids: IP66

ASR, Stainless steel wall mounted enclosure, single door

- Method of fixing: Wall mounted
- Type of material: Stainless steel
- Intended location: Outdoor (severity corrosion test B)
- Resistance to ultra-violet radiation: N/A because is not powder coated
- Lifting: N/A
- Degree of protection, mechanical impact: IK10
- Degree of protection, solids and liquids: IP66

MCS, Mild steel floor standing enclosure, single door

- Method of fixing: Floor standing
- Type of material: Powder painted steel
- Intended location: Indoor (severity corrosion test A)
- Resistance to ultra-violet radiation: N/A because is intended for indoor locations
- Lifting: With lifting eyes LE, 3400 N 45° max
With lifting devices LC, 6750N 45° max
- Degree of protection, mechanical impact: IK10
- Degree of protection, solids and liquids: IP55

MAD, Mild steel wall mounted enclosure, double door

- Method of fixing: Wall mounted
- Type of material: Powder painted steel
- Intended location: Indoor (severity corrosion test A)
- Resistance to ultra-violet radiation: N/A because is intended for indoor locations
- Lifting: N/A
- Degree of protection, mechanical impact: IK10
- Degree of protection, solids and liquids: IP55

ADR, Stainless steel wall mounted enclosure, double door

- Method of fixing: Wall mounted
- Type of material: Stainless steel
- Intended location: Outdoor (severity corrosion test B)
- Resistance to ultra-violet radiation: N/A because is not powder coated
- Lifting: N/A
- Degree of protection, mechanical impact: IK10
- Degree of protection, solids and liquids: IP55

MCD, Mild steel floor standing enclosure, double door

- Method of fixing: Floor standing
- Type of material: Powder painted steel
- Intended location: Indoor (severity corrosion test A)
- Resistance to ultra-violet radiation: N/A because is intended for indoor locations
- Lifting: With lifting eyes LE, 3400 N 45° max
With lifting devices LC, 6750N 45° max
- Degree of protection, mechanical impact: IK10
- Degree of protection, solids and liquids: IP55

MAP, Mild steel wall mounted enclosure, panel

- Method of fixing: Wall mounted
- Type of material: Powder painted steel
- Intended location: Indoor (severity corrosion test A)
- Resistance to ultra-violet radiation: N/A because is intended for indoor locations
- Lifting: N/A
- Degree of protection, mechanical impact: IK10
- Degree of protection, solids and liquids: IP55

AFS, Stainless steel wall mounted enclosure, single door & sloping roof

- Method of fixing: Wall mounted
- Type of material: Stainless steel
- Intended location: Outdoor (severity corrosion test B)
- Resistance to ultra-violet radiation: N/A because is not powder coated
- Lifting: N/A
- Degree of protection, mechanical impact: IK10
- Degree of protection, solids and liquids: IP66

MKS, Mild steel compact floor standing enclosure, single door

- Method of fixing: Floor standing
- Type of material: Powder painted steel
- Intended location: Indoor (severity corrosion test A)
- Resistance to ultra-violet radiation: N/A because is intended for indoor locations
- Lifting: With lifting eyes LE, 3400 N 45° max
- Degree of protection, mechanical impact: IK10
- Degree of protection, solids and liquids: IP55

MCSS, Stainless steel floor standing enclosure, single door

- Method of fixing: Floor standing
- Type of material: Powder painted steel
- Intended location: Outdoor (severity corrosion test B)
- Resistance to ultra-violet radiation: N/A because is not powder coated
- Lifting: With lifting eyes LE, 3400 N 45° max
With lifting devices LC, 6750N 45° max
- Degree of protection, mechanical impact: IK10
- Degree of protection, solids and liquids: IP55

KEMA-DEKRA Certificate N° 2171237-02 includes the following product ranges:

Floor standing enclosures: **EKSS, EKDS**

EKSS, Stainless steel compact floor standing enclosure, single door

- Method of fixing: Floor standing
- Type of material: Powder painted steel
- Intended location: Outdoor (severity corrosion test B)
- Resistance to ultra-violet radiation: N/A because is not powder coated
- Lifting: With lifting eyes LE, 3400 N 45° max
- Degree of protection, mechanical impact: IK10
- Degree of protection, solids and liquids: IP66

KEMA-DEKRA Certificate N° 2171237-03 includes the following product ranges:

Terminal boxes: **STB, SSTB**

STB, Mild steel terminal box

- Method of fixing: Wall mounted
- Type of material: Powder painted steel
- Intended location: Indoor (severity corrosion test A)
- Resistance to ultra-violet radiation: N/A because is intended for indoor locations
- Lifting: N/A
- Degree of protection, mechanical impact: IK10
- Degree of protection, solids and liquids: IP66

MCDS, Stainless steel floor standing enclosure, double door

- Method of fixing: Floor standing
- Type of material: Powder painted steel
- Intended location: Outdoor (severity corrosion test B)
- Resistance to ultra-violet radiation: N/A because is not powder coated
- Lifting: With lifting eyes LE, 3400 N 45° max
With lifting devices LC, 6750N 45° max
- Degree of protection, mechanical impact: IK10
- Degree of protection, solids and liquids: IP55

EKDS, Stainless steel compact floor standing enclosure, double door

- Method of fixing: Floor standing
- Type of material: Powder painted steel
- Intended location: Outdoor (severity corrosion test B)
- Resistance to ultra-violet radiation: N/A because is not powder coated
- Lifting: With lifting eyes LE, 3400 N 45° max
- Degree of protection, mechanical impact: IK10
- Degree of protection, solids and liquids: IP55

MKD, Mild steel compact floor standing enclosure, double door

- Method of fixing: Floor standing
- Type of material: Powder painted steel
- Intended location: Indoor (severity corrosion test A)
- Resistance to ultra-violet radiation: N/A because is intended for indoor locations
- Lifting: With lifting eyes LE, 3400 N 45° max
Degree of protection, mechanical impact: IK10
- Degree of protection, solids and liquids: IP55

Annex 02

Intertek-Semko Statement of Test Result (STR)

Below, you can find the test results details included in the issued STR (Statement of Test Results) SE-1405658 by Intertek-Semko. The tests have been carried out according to the standard IEC 61439.

Clearances and Creepage distance

| Horizontal busbar system nVent HOFFMAN MSHS | Horizontal busbar system nVent HOFFMAN EUBS | Horizontal busbar system nVent HOFFMAN MSFH | Horizontal busbar system nVent HOFFMAN MSVH | Horizontal busbar system nVent HOFFMAN ECBS |
|---|---|--|--|--|
| <ul style="list-style-type: none"> Rated impulse withstand voltage: 8 kV Measured clearances: ≥ 12 mm Rated insulation voltage: 800 V Pollution degree 3 Material group IIIa Measured creepage distances: $\geq 12,5$ mm | <ul style="list-style-type: none"> Rated impulse withstand voltage: 6 kV Measured clearances: $\geq 8,5$ mm Rated insulation voltage: 1000 V Pollution degree 3 Material group IIIa Measured creepage distances: ≥ 16 mm | <ul style="list-style-type: none"> Rated impulse withstand voltage: 8 kV Measured clearances: ≥ 12 mm Rated insulation voltage: 1000 V Pollution degree 3 Material group IIIa Measured creepage distances: ≥ 16 mm | <ul style="list-style-type: none"> Rated impulse withstand voltage: 8 kV Measured clearances: ≥ 12 mm Rated insulation voltage: 1000 V Pollution degree 3 Material group IIIa Measured creepage distances: ≥ 16 mm | <ul style="list-style-type: none"> Rated impulse withstand voltage: 8 kV Measured clearances: ≥ 12 mm Rated insulation voltage: 1000 V Pollution degree 3 Material group IIIa Measured creepage distances: ≥ 16 mm |

Power-frequency withstand voltage

- Semko test report 615772-1
- Voltage tested: 3kV
- Test voltage required for rated insulation voltage (Ui) up to 1000V: 2,2 kV

Impulse withstand voltage, test verification

- EPS assembly system
- Impulse withstand voltage: 7,4 kV

Impulse withstand voltage, verification assessment

| Horizontal busbar system nVent HOFFMAN MSHS | Horizontal busbar system nVent HOFFMAN EUBS | Horizontal busbar system nVent HOFFMAN MSFH | Horizontal busbar system nVent HOFFMAN MSVH | Horizontal busbar system nVent HOFFMAN ECBS |
|--|--|--|--|--|
| <ul style="list-style-type: none"> Impulse withstand voltage: 8 kV Minimum required clearance in air for 8 kV for verification assessment (1,5 times value in Table 1): $8 \text{ mm} \times 1,5 = 12 \text{ mm}$ Measured clearances: ≥ 12 mm | <ul style="list-style-type: none"> Impulse withstand voltage: 6 kV Minimum required clearance in air for 8 kV for verification assessment (1,5 times value in Table 1): $5,5 \text{ mm} \times 1,5 = 8,25 \text{ mm}$ Measured clearances: ≥ 10 mm | <ul style="list-style-type: none"> Impulse withstand voltage: 8 kV Minimum required clearance in air for 8 kV for verification assessment (1,5 times value in Table 1): $8 \text{ mm} \times 1,5 = 12 \text{ mm}$ Measured clearances: ≥ 12 mm | <ul style="list-style-type: none"> Impulse withstand voltage: 8 kV Minimum required clearance in air for 8 kV for verification assessment (1,5 times value in Table 1): $8 \text{ mm} \times 1,5 = 12 \text{ mm}$ Measured clearances: ≥ 12 mm | <ul style="list-style-type: none"> Impulse withstand voltage: 8 kV Minimum required clearance in air for 8 kV for verification assessment (1,5 times value in Table 1): $8 \text{ mm} \times 1,5 = 12 \text{ mm}$ Measured clearances: ≥ 12 mm |

Annex 03

KEMA Test Report N°2088000.01

Below, you can find the test results details included in the KEMA Test report N°2088000.01.

Earthing stud M8

Test conditions

- Cable section: 35 mm²
- Torque: 15 Nm

Test results

- Short-time withstand current (I_{cw}): 17,7 kA during 71 ms
- Peak withstand current (I_{pk}): 35,3 kA

Earthing mounting plate connection M8

Test conditions

- Cable section: 35 mm²
- Torque: 15 Nm

Test results

- Short-time withstand current (I_{cw}): 20,5 kA during 62 ms
- Peak withstand current (I_{pk}): 40,7 kA

Earthing floor standing enclosures bottom plate connection M6

Test conditions

- Cable section: 25 mm²
- Torque: 15 Nm

Test results

- Short-time withstand current (I_{cw}): 10,7 kA during 61 ms
- Peak withstand current (I_{pk}): 21,2 kA

Annex 04

nVent HOFFMAN Busbar Supports short-circuit withstand strength.

ECBS, Compact Busbar Supports

| ECBS205TN | | | | | | | | | | |
|------------------|----|---|---------------------------------|-----|-----|-----|-----|-----|--|--|
| | mm | | Ipk KA _{lcc} rms KA 1s | | | | | | | |
| | | | 11 | 24 | 48 | 63 | 82 | 114 | | |
| | | | 6,5 | 12 | 23 | 30 | 39 | 52 | | |
| 1 bar per phase | 25 | 5 | 1000 | 477 | 237 | 182 | 140 | 100 | | |
| | 30 | 5 | 1000 | 525 | 261 | 200 | 154 | 110 | | |
| | 40 | 5 | 1000 | 614 | 305 | 234 | 180 | 114 | | |
| | 50 | 5 | 1000 | 696 | 346 | 265 | 204 | 117 | | |
| | 63 | 5 | 1000 | 797 | 365 | 303 | 233 | 122 | | |
| 2 bars per phase | 25 | 5 | 894 | 411 | 204 | 156 | 120 | 86 | | |
| | 30 | 5 | 1000 | 465 | 231 | 177 | 136 | 97 | | |
| | 40 | 5 | 1000 | 568 | 282 | 216 | 166 | 119 | | |
| | 50 | 5 | 1000 | 666 | 331 | 254 | 195 | 139 | | |
| | 63 | 5 | 1000 | 789 | 378 | 300 | 231 | 160 | | |
| | 80 | 5 | 1000 | 944 | 382 | 356 | 276 | 169 | | |

| ECBS110TN | | | | | | | | | | |
|-----------------|----|----|---------------------------------|------|-----|-----|-----|--|--|--|
| | mm | | Ipk KA _{lcc} rms KA 1s | | | | | | | |
| | | | 11 | 24 | 48 | 63 | 82 | | | |
| | | | 6,5 | 12 | 23 | 30 | 39 | | | |
| 1 bar per phase | 25 | 10 | 1000 | 918 | 456 | 349 | 269 | | | |
| | 30 | 10 | 1000 | 1000 | 502 | 385 | 296 | | | |
| | 40 | 10 | 1000 | 1000 | 512 | 451 | 314 | | | |
| | 50 | 10 | 1000 | 1000 | 513 | 470 | 324 | | | |
| | 60 | 10 | 1000 | 1000 | 516 | 481 | 336 | | | |
| | 80 | 10 | 1000 | 1000 | 520 | 492 | 356 | | | |

EUBS, Universal Busbar Support

| EUBS110TN | | | | | | | | | | | | |
|-----------------|-----|----|---------------------------------|------|-----|-----|-----|-----|-----|-----|-----|-----|
| | mm | | Ipk KA _{lcc} rms KA 1s | | | | | | | | | |
| | | | 24 | 48 | 63 | 82 | 114 | 145 | 152 | 165 | 187 | 209 |
| | | | 12 | 23 | 30 | 39 | 52 | 66 | 69 | 75 | 85 | 95 |
| 1 bar per phase | 30 | 10 | 1000 | 540 | 414 | 318 | 228 | 179 | 172 | 158 | 129 | 103 |
| | 40 | 10 | 1000 | 630 | 483 | 372 | 266 | 209 | 200 | 169 | 132 | 105 |
| | 50 | 10 | 1000 | 714 | 530 | 421 | 301 | 224 | 205 | 173 | 135 | 108 |
| | 60 | 10 | 1000 | 793 | 532 | 467 | 334 | 230 | 211 | 178 | 139 | 111 |
| | 80 | 10 | 1000 | 943 | 537 | 503 | 377 | 245 | 224 | 189 | 147 | 118 |
| | 100 | 10 | 1000 | 1000 | 543 | 506 | 393 | 261 | 239 | 202 | 157 | 126 |
| | 120 | 10 | 1000 | 1000 | 548 | 510 | 410 | 278 | 254 | 215 | 167 | 134 |

| EUBS210TN | | | | | | | | | | | | | |
|------------------|-----|----|---------------------------------|------|------|-----|-----|-----|-----|-----|-----|-----|-----|
| | mm | | Ipk KA _{lcc} rms KA 1s | | | | | | | | | | |
| | | | 24 | 48 | 63 | 82 | 114 | 145 | 152 | 165 | 187 | 209 | 231 |
| | | | 12 | 23 | 30 | 39 | 52 | 66 | 69 | 75 | 85 | 95 | 105 |
| 1 bar per phase | 30 | 10 | 1000 | 672 | 515 | 396 | 283 | 223 | 214 | 196 | 173 | 155 | 140 |
| | 40 | 10 | 1000 | 780 | 598 | 460 | 329 | 259 | 248 | 228 | 201 | 180 | 163 |
| | 50 | 10 | 1000 | 877 | 672 | 517 | 370 | 291 | 279 | 256 | 226 | 202 | 167 |
| | 60 | 10 | 1000 | 967 | 741 | 540 | 408 | 321 | 307 | 283 | 249 | 207 | 169 |
| | 80 | 10 | 1000 | 1000 | 869 | 543 | 478 | 377 | 360 | 332 | 267 | 213 | 175 |
| | 100 | 10 | 1000 | 1000 | 989 | 546 | 501 | 417 | 393 | 352 | 276 | 221 | 181 |
| 2 bars per phase | 30 | 10 | 1000 | 571 | 438 | 337 | 241 | 190 | 181 | 167 | 147 | 132 | 119 |
| | 40 | 10 | 1000 | 685 | 525 | 404 | 289 | 227 | 218 | 200 | 176 | 158 | 143 |
| | 50 | 10 | 1000 | 792 | 607 | 467 | 334 | 263 | 252 | 232 | 204 | 183 | 165 |
| | 60 | 10 | 1000 | 896 | 687 | 528 | 378 | 298 | 285 | 262 | 231 | 207 | 187 |
| | 80 | 10 | 1000 | 1000 | 838 | 644 | 461 | 363 | 347 | 320 | 282 | 252 | 228 |
| | 100 | 10 | 1000 | 1000 | 982 | 755 | 523 | 426 | 407 | 375 | 331 | 296 | 264 |
| | 120 | 10 | 1000 | 1000 | 1000 | 863 | 526 | 487 | 465 | 428 | 378 | 335 | 274 |

| EUBS310TN | | | | | | | | | | | | | |
|------------------|-----|----|---------------------------------|------|------|------|-----|-----|-----|-----|-----|-----|-----|
| | mm | | Ipk KA _{lcc} rms KA 1s | | | | | | | | | | |
| | | | 24 | 48 | 63 | 82 | 114 | 145 | 152 | 165 | 187 | 209 | 231 |
| | | | 12 | 23 | 30 | 39 | 52 | 66 | 69 | 75 | 85 | 95 | 105 |
| 1 bar per phase | 30 | 10 | 1000 | 672 | 515 | 396 | 283 | 223 | 214 | 196 | 173 | 155 | 140 |
| | 40 | 10 | 1000 | 780 | 598 | 460 | 329 | 259 | 248 | 228 | 201 | 180 | 163 |
| | 50 | 10 | 1000 | 877 | 672 | 517 | 370 | 291 | 279 | 256 | 226 | 202 | 178 |
| | 60 | 10 | 1000 | 967 | 741 | 546 | 408 | 321 | 307 | 283 | 249 | 221 | 180 |
| | 80 | 10 | 1000 | 1000 | 869 | 549 | 478 | 377 | 360 | 332 | 284 | 228 | 186 |
| | 100 | 10 | 1000 | 1000 | 989 | 569 | 504 | 429 | 410 | 367 | 295 | 236 | 193 |
| 2 bars per phase | 30 | 10 | 1000 | 571 | 438 | 337 | 241 | 190 | 181 | 167 | 147 | 132 | 119 |
| | 40 | 10 | 1000 | 685 | 525 | 404 | 289 | 227 | 218 | 200 | 176 | 158 | 143 |
| | 50 | 10 | 1000 | 792 | 607 | 467 | 334 | 263 | 252 | 232 | 204 | 183 | 165 |
| | 60 | 10 | 1000 | 896 | 687 | 528 | 378 | 298 | 285 | 262 | 231 | 207 | 187 |
| | 80 | 10 | 1000 | 1000 | 838 | 644 | 461 | 363 | 347 | 320 | 282 | 252 | 219 |
| | 100 | 10 | 1000 | 1000 | 982 | 755 | 513 | 426 | 407 | 375 | 331 | 278 | 228 |
| 3 bars per phase | 30 | 10 | 1000 | 685 | 525 | 404 | 289 | 228 | 218 | 200 | 177 | 158 | 143 |
| | 40 | 10 | 1000 | 816 | 625 | 481 | 344 | 271 | 259 | 238 | 210 | 188 | 170 |
| | 50 | 10 | 1000 | 939 | 720 | 554 | 396 | 312 | 298 | 275 | 242 | 217 | 196 |
| | 60 | 10 | 1000 | 1000 | 811 | 615 | 446 | 351 | 336 | 309 | 273 | 244 | 208 |
| | 80 | 10 | 1000 | 1000 | 984 | 637 | 510 | 427 | 408 | 375 | 330 | 264 | 216 |
| | 100 | 10 | 1000 | 1000 | 1000 | 662 | 512 | 481 | 453 | 406 | 343 | 274 | 224 |
| | 120 | 10 | 1000 | 1000 | 1000 | 1000 | 515 | 491 | 466 | 417 | 354 | 286 | 234 |

MSHS, Main Busbar Support
Short-circuit withstand current (kA)

| Distance between supports | | | | | | Part No. |
|---------------------------|--------|--------|--------|--------|--------|------------|
| 600 mm | | | 800 mm | | | |
| Peak | RMS 1s | RMS 3s | Peak | RMS 1s | RMS 3s | |
| 97 | 44 | 28 | 73 | 33 | 28 | MSHS403010 |
| 105 | 48 | 30 | 79 | 36 | 30 | MSHS404010 |
| 123 | 56 | 35 | 92 | 42 | 35 | MSHS405010 |
| 132 | 56 | 35 | 92 | 42 | 35 | MSHS406010 |
| 132 | 60 | 40 | 106 | 48 | 40 | MSHS408010 |
| 132 | 60 | 45 | 119 | 54 | 45 | MSHS410010 |
| 132 | 60 | 50 | 132 | 60 | 50 | MSHS412010 |

MSFH, Vertical rear busbar support
Short-circuit withstand current (kA)

| Distance between supports | | | | | | | | | Part No. |
|---------------------------|--------|--------|--------|--------|--------|--------|--------|--------|-------------------------|
| 300 mm | | | 400 mm | | | 600 mm | | | |
| Peak | RMS 1s | RMS 3s | Peak | RMS 1s | RMS 3s | Peak | RMS 1s | RMS 3s | |
| 53 | 35 | 25 | 63 | 30 | 30 | 53 | 25 | 25 | Front support |
| 74 | 50 | 35 | 90 | 43 | 30 | 74 | 35 | 25 | Front and rear supports |

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