

INTERNATIONAL STANDARD

**Electrical installations in ships –
Part 302-2: Low voltage switchgear and controlgear assemblies – Marine power**

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INTERNATIONAL STANDARD

**Electrical installations in ships –
Part 302-2: Low voltage switchgear and controlgear assemblies – Marine power**

INTERNATIONAL
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COMMISSION

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

ELECTRICAL INSTALLATIONS IN SHIPS –**Part 302-2: Low voltage switchgear and
controlgear assemblies – Marine power****FOREWORD**

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International Standard IEC 60092-302-2 has been prepared by IEC technical committee 18: Electrical installations of ships and of mobile and fixed offshore units.

This first edition cancels and replaces the fourth edition of IEC 60092-302 published in 1997. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) this document has been renumbered to fall in line with IEC 61439 (all parts);
- b) this document has been restructured to fall in line with IEC 61439 (all parts);
- c) the creepage distances have been modified;
- d) the references to non type tested assemblies (NTTA) have been removed;
- e) non-applicable tables have been removed;

- f) the applicability of IEC 61439 (all parts) annexes have been identified.
- g) specific requirements that were detailed in IEC 60092-302:1997, covered under 7.6.101 have partly been moved to 60092-201.

The text of this document is based on the following documents:

FDIS	Report on voting
18/1656/FDIS	18/1668/RVD

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

This International Standard is to be used in conjunction with IEC 61439-1:2011 and IEC 61439-2:2011.

This document supplements or modifies the corresponding clauses in IEC 61439-1:2011 and IEC 61439-2:2011. Where this document states "addition", "deletion" or "replacement", the relevant text of IEC 61439-1:2011 and IEC 61439-2:2011 is adapted accordingly.

Clauses and subclauses which are additional to those of IEC 61439-1:2011 and IEC 61439-2:2011 are numbered starting from 201. Additional annexes are numbered starting from AAA.

In this document, terms written in small capitals are defined in Clause 3.

Where the abbreviated term PSC-assembly is used in applicable clauses of IEC 61439-2:2011, this refer to MPSC-assembly.

A list of all parts in the IEC 60092 series, published under the general title *Electrical installations in ships*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "<http://webstore.iec.ch>" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

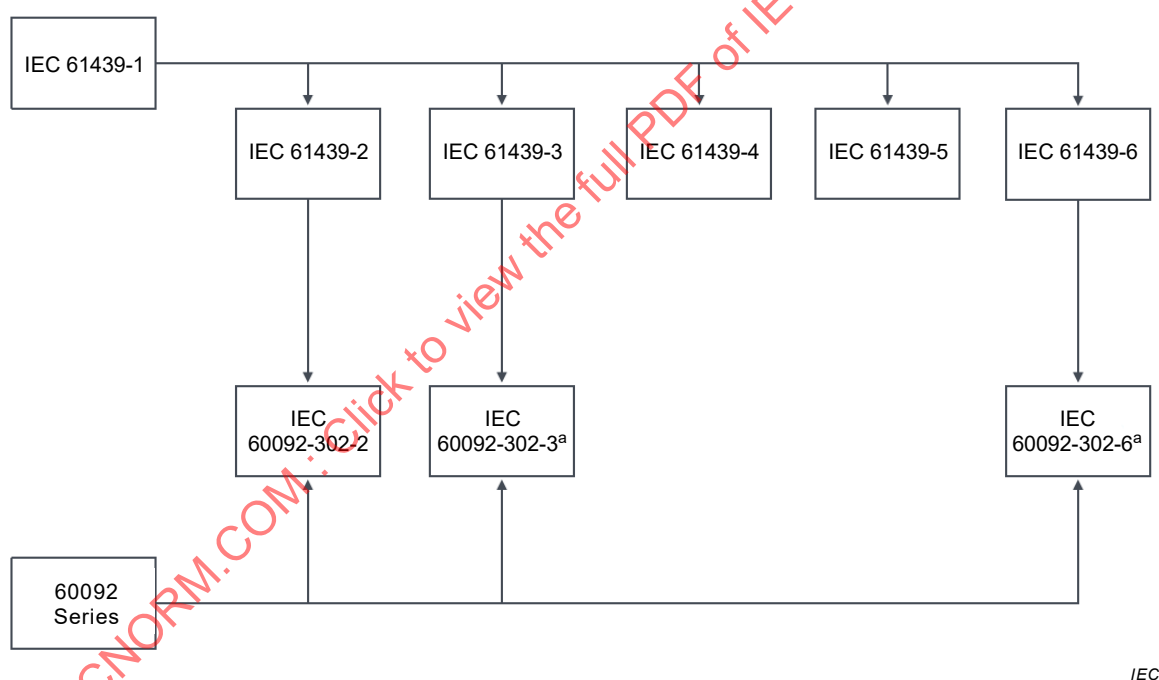
INTRODUCTION

This part of IEC 60092 forms a series of International Standards for electrical installations in sea-going ships, incorporating good practice and coordinating, as far as possible, existing rules.

These standards form a code of practical interpretation and amplification of the requirements of the International Convention for the Safety of Life at Sea, a guide for future regulations which may be prepared and a statement of practice for use by ship owners, shipbuilders and appropriate organizations.

IEC 61439 (all parts) identifies the requirements for land based low voltage switchgear and controlgear assemblies. IEC 60092-302 (all parts) has been developed in-line with Figure 201, which shows the future intention to develop appropriate marine standards for final distribution boards to be operated by ordinary persons; and busbar trunking systems.

IEC 60092 (all parts) remains the lead standard series for electrical installations in ships, and the applicable standards are applied accordingly. Wherever there are differences between IEC 61439 (all parts) and IEC 60092 (all parts), IEC 60092 (all parts) takes precedence.



Key

^a Under consideration.

NOTE At the time of publication, IEC 60092-302-3 and IEC 60092-302-6 are not developed. The figure shows that these standards are potential future projects to align with the IEC 61439 series.

Figure 201 – Relationship of standards

ELECTRICAL INSTALLATIONS IN SHIPS –

Part 302-2: Low voltage switchgear and controlgear assemblies – Marine power

1 Scope

This part of IEC 60092 defines the specific requirements of low voltage marine power switchgear and controlgear assemblies (MPSC-assemblies) as follows:

- stationary assemblies with enclosure for which the rated voltage does not exceed 1 000 V AC or 1500 V DC;
- assemblies intended for use in conjunction with the power generation, distribution and conversion of electric energy, and for the control of electric energy consuming equipment.

This document applies to all assemblies whether they are designed, manufactured and verified on a one-off basis or fully standardised and manufactured in quantity.

The manufacture and/or assembly can be carried out other than by the original manufacturer.

This document does not apply to individual devices and self-contained components, such as motor starters, fuse switches, electronic equipment, which comply with the relevant product standards.

NOTE Individual devices and components include those that are covered by the IEC 60947 series.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60092-101:2018, *Electrical installations in ships – Part 101: Definitions and general requirements*

IEC 60092-201:2019, *Electrical installations in ships – Part 201: System design – General*

IEC 60533, *Electrical and electronic installations in ships – Electromagnetic compatibility (EMC) – Ships with a metallic hull*

IEC 61439-1:2011, *Low-voltage switchgear and controlgear assemblies – Part 1: General rules*

IEC 61439-2:2011, *Low-voltage switchgear and controlgear assemblies – Part 2: Power switchgear and controlgear assemblies*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

Clause 3 of IEC 61439-2:2011 is applicable except as follows.

3.1 General terms

Additional terms and definitions:

3.1.201

MARINE POWER SWITCHGEAR AND CONTROLGEAR ASSEMBLY

MPSC-assembly

low-voltage switchgear and controlgear assembly used to distribute and control energy for all types of loads, intended for marine applications specifically, in ships, operated by skilled or instructed persons only

Note 1 to entry: It is not excluded for a MPSC-assembly to be located in an area accessible to ordinary persons.

3.1.202

MAIN SWITCHBOARD

MPSC-assembly which is directly supplied by the main source of electrical power and is intended to control and distribute electrical energy to the ships services

3.1.203

MOTOR CONTROL CENTRE

MCC

MPSC-assembly which is supplied by main or emergency switchboards and is intended to control and distribute electrical energy

Note 1 to entry: It is possible for the MCC to be a section or sections of the main switchboard.

3.1.204

EMERGENCY SWITCHBOARD

MPSC-assembly which is normally supplied by the main switchboard, but in the event of failure of the main electrical power system is directly supplied by the emergency source of electrical power and is intended to control and distribute electrical energy to the emergency services

3.1.205

DISTRIBUTION BOARD

MPSC-assembly which is supplied by a main or emergency switchboard, or distribution boards and is used to distribute and control energy to other distribution boards, final distribution boards or final sub circuits

Note 1 to entry: The definition of "section board" as defined in previous versions of IEC 60092-302 has been replaced by the one of "distribution board".

4 Symbols and abbreviations

Clause 4 of IEC 61439-2:2011 is applicable.

5 Interface characteristics

Clause 5 of IEC 61439-2:2011 is applicable except as follows.

5.2 Voltage ratings

5.2.3 Rated insulation voltage (U_i) (of a circuit of an assembly)

Replacement of 5.2.3 of IEC 61439-1:2011:

The rated insulation voltage of a circuit of an assembly is the voltage value to which dielectric test voltages and creepage distances are referred.

Due to the potential effects of the marine environment on creepage distances, the rated insulation voltage of a circuit shall be 1,5 times higher than the values stated for U_n and for U_e for the same circuit up to a final maximum of U_i 1 000 V AC or 1 250 V DC. Any DC application requiring U_i exceeding 1 250 V DC shall need to have special consideration.

For single-phase circuits derived from IT systems (see IEC 60364-5-52), the rated insulation voltage should be at least equal to the voltage between phases of the supply.

While it is advisable to use the above safety factor for all internal components and devices; those that have been tested in accordance with their own product standard need not have this safety factor applied.

5.6 Other characteristics

Replacement of item g) of IEC 61439-1:2011:

g) operated by skilled and instructed persons only;

6 Information

Clause 6 of IEC 61439-2:2011 is applicable except as follows.

6.1 Assembly designation marking

Replacement of item d):

d) IEC 60092-302-2;

Addition of item e):

e) ambient air temperature (see 7.1.1.1 and 7.1.1.2).

6.3 Device and/or component identification

Addition:

Individual circuits and their devices shall have the following durable and permanent markings and meet the requirements of IEC 60092-201:2019, 5.3.

- The rated current of the circuit I_{nc} and assigned settings of adjustable protective devices (see 6.2.2 of IEC 61439-1:2011 for documentation of settings requirements).
- When, for fuse systems above 500 V, the fuseholders permit the insertion of fuse links for lower rated voltage, special warning labels or symbols, for example "Caution 690 V fuse links only".
- Arranging warning labels where polarized circuit-breakers are installed in DC systems so as to guard against the possibility of incorrect connections during maintenance or replacement.
- Withdrawable and/or removable parts along with relevant fixed parts of an assembly shall be provided with permanent markings in order to identify where the parts can be correctly reassembled.

Compliance is checked according to the test of 10.2.7 of IEC 61439-1 2011 and by inspection.

7 Service conditions

Clause 7 of IEC 61439-1:2011 is applicable except as follows.

7.1.1.1 Ambient air temperature for indoor installations

Replacement:

The ambient air temperature does not exceed +45 °C, and its average over a period of 24 h does not exceed +40 °C.

The lower limit of the ambient air temperature is 5 °C.

NOTE Where the ambient air temperature of the assembly is different, details of calculation methods are given in 10.10.3.201.

7.1.1.2 Ambient air temperature for outdoor installations

Replacement:

The ambient air temperature does not exceed +45 °C, and its average over a period of 24 h does not exceed +40 °C.

The lower limit of the ambient air temperature is –25 °C.

NOTE Where the ambient air temperature of the assembly is different, details of calculation methods are given in 10.10.3.201.

7.1.2.1 Humidity conditions for indoor installations

Replacement:

In other parts of the IEC 60092 series, where no "high air temperature" has been specified as a design parameter for equipment, the relative humidity of the air does not exceed 95 % at a maximum temperature of +45 °C.

Moderate condensation should be borne in mind which can occasionally occur due to variations in temperature.

Additional subclauses:

7.1.201 Vibration

MPSC-assemblies shall be unaffected by vibration likely to occur under normal service. Design parameters are detailed in 4.6.3.5 of IEC 60092-101:2018.

7.1.202 Angular deviation and motion

MPSC-assemblies shall be unaffected by movement of the ship likely to occur under normal service. Design parameters are detailed in 4.6.3.4 of IEC 60092-101:2018.

8 Constructional requirements

Clause 8 of IEC 61439-2:2011 is applicable except as follows.

8.2.2 Protection against contact with live parts, ingress of solid foreign bodies and water

Deletion of Note 1 in 8.2.2 of IEC 61439-1:2011.

8.3.2 Clearances

Deletion of the note in 8.3.2 of IEC 61439-1:2011.

8.3.3 Creepage distances

Replacement of the third paragraph in 8.3.3 of IEC 61439-1:2011:

Creepage distances shall correspond to a pollution degree as specified in 7.1.3 and to the corresponding material group at the rated insulation voltage given in Table 2. Devices that have been tested in accordance with their own product standard need not have this safety factor applied.

Deletion of Note 2 in 8.3.3 of IEC 61439-1:2011.

8.4.3 Fault protection

8.4.3 of IEC 61439-1:2011 is applicable except as follows.

Additional paragraph:

8.4.3.201 Protection against electric shock for accessibility maintenance

If earth bars (protective conductor) are installed in main and emergency switchboards, MCCs and distribution boards shall be installed and located to ensure their easy access and access to their terminations, during and after installation.

8.4.6 Operating and servicing conditions

8.4.6 of IEC 61439-1:2011 is applicable except as follows.

8.4.6.2.3 Requirements related to accessibility for maintenance

Addition:

It shall be possible to replace or maintain all devices used for isolation of the main source of electrical power without complete blackout of the main source of electrical power.

Where polarized circuit breakers are installed in DC systems, and in all other similar cases, warning labels shall be arranged so as to guard against the possibility of incorrect connection during maintenance.

8.5 Incorporation of switching devices and components

8.5 of IEC 61439-1:2011 is applicable except as follows.

8.5.4 Installation of switching devices and components

Addition:

Wherever possible, components of main circuits with different nominal voltages shall be installed separate from each other.

8.6 Internal electrical circuits and connections

8.6 of IEC 61439-1:2011 is applicable except as follows.

8.6.2 Auxillary circuits

Addition:

Wiring shall comply with the relevant requirements given in the cable standards within the IEC 60092 series.

8.6.3 Bare and insulated conductors

Addition:

Cables shall comply with the relevant requirements given in the cable standards within the IEC 60092 series.

Additional subclauses:

8.6.3.201 Busbars

8.6.3.201.1 General

Busbars shall be of a composition suited for operation in a salt-laden atmosphere.

EXAMPLE Electrolytic copper or copper-clad aluminium.

8.6.3.201.2 Sub-division of main switchboard main busbar

The MPSC-assembly shall meet the specific requirement of the system as detailed in IEC 60092-201:2019, Clause 8.

Where there is a functional requirement for more than one incoming device within the assembly, the main busbars of the assembly shall be subdivided into at least two isolated parts; this is to be done by a multipole switch or circuit breaker.

8.6.3.201.3 Busbar phase or polarity arrangements

Where practicable, a standard pattern of busbar phase and polarity arrangements shall be used. Examples for such a pattern as viewed from the front of the assembly are as follows:

- a) for AC MPSC-assemblies – busbar L1, L2, L3... counting from front to rear, top to bottom or left to right (when viewed from the front of the switchgear assembly);
- b) polarities on DC switchgear and controlgear busbars and connections to be: positive, neutral, negative, counting from front to rear, top to bottom or left to right.

8.8 Terminals for external conductors

Deletion of Note 1 of IEC 61439-1:2011.

8.101 Internal separation of PSC-assemblies

8.101 of IEC 61439-2:2011 is applicable except as follows.

Addition after the second paragraph:

Incoming and section interconnection devices and any circuit with I_{nc} above 600 A used within main and emergency switchboards shall be contained in their own compartment providing at least a degree of protection of IP XXB.

Replacement of Note 1:

NOTE 1 The degree of protection IP 2X covers the degree of protection IP XXB.

Additional subclauses:

8.201 Constructional requirements for marine applications

8.201.1 Structural parts of aluminium alloy

If aluminium alloy is used in construction, the material shall be suitable for the use in the marine environment, and precautions shall be taken to avoid galvanic corrosion.

8.201.2 Handrails or handles

Every main or emergency switchboard, MCC and distribution board, required for essential and emergency services shall be provided with an insulated handrail or insulated handles to enable these assemblies to be operated safely during the vessels possible motion. These should be suitably located on a fixed part on the front of the assemblies. Where access to the rear of the above mentioned switchboards is necessary for operational, maintenance, or similar purposes, an insulated handrail or insulated handles should be suitably located on a fixed part of the assembly.

8.201.3 Door latching

Hinged doors which may be opened for operation, maintenance or similar purposes shall be provided with a latching or locking facility to keep the door open during normal movement of the ship.

9 Performance requirements

Clause 9 of IEC 61439-2:2011 is applicable except as follows.

9.1.3.1 Impulse withstand voltages of main circuits

Addition at the end of 9.1.3.1 of IEC 61439-1:2011:

The rated impulse withstand voltage for a given rated operational voltage shall not be less than that corresponding in Annex G to the nominal voltage of the supply system of the circuit at the point where the assembly is to be used and with the overvoltage category III.

9.2 Temperature rise limits

Delete Note 2 of IEC 61439-1:2011.

Addition at the end of 9.2 of IEC 61439-1:2011:

The temperature rise limits given in Table 6 apply for a mean ambient air temperature up to 40 °C. MPSC-assemblies are required to operate in a higher ambient temperature under service conditions (see 7.1). A reduction of the permissible rises shown to reflect the raised ambient should be made. During verification, a different ambient air temperature is permissible (see 10.10.2.3.4).

10 Design verification

Clause 10 of IEC 61439-1:2011 is applicable with the following additions.

10.10.2.3.1 General

Addition:

To reduce the testing required to determine the rated current of a circuit I_1 at the maximum permissible temperature rise ΔT_1 , the current rating may be calculated from the actual test current I_2 if the measured temperature rise ΔT_2 of the current carrying parts (e.g. busbars and terminals) deviates from the permissible value by not more than ± 5 K, using the following formula¹:

$$\frac{I_1}{I_2} = \left(\frac{\Delta T_1}{\Delta T_2} \right)^{0.61}$$

where

I_1 is the current at which the temperature rise test is carried out;

I_2 is the current rating to be determined at the specific ambient air temperature between 20 °C and 55 °C;

ΔT_1 is the temperature rise measured by test with a current of I_1 ;

ΔT_2 is the maximum permissible temperature rise at the specific ambient air temperature between 20 °C and 55 °C.

NOTE The formula can only be applied if the power loss of the devices and conductors is substantially proportional to I^2 .

Care shall be taken to ensure that all other measurement points will not reach their maximum temperature at this higher current. The most critical location of highest temperature point shall be identified either by test or thermal simulation.

Care is required when determining the number of points where this calculation is applied so as to ensure the effects of changing several currents having an influence on other measuring points (including internal air temperature) due to the changed power loss.

10.10.3.5 Functional units – Device substitution

Replacement of 10.10.3.5 of IEC 61439-1:2011, including its title

10.10.3.5 Functional units – Temperature-rise considerations for device substitution

A device within a circuit may be substituted with a similar device from another series from the same or a different device manufacturer to that used in the original verification, provided that the power loss and terminal temperature rise of the substituting device is the same or lower than the device used in the original verification, when both are tested in accordance with the devices' product standard.

Alternatively, the substitution is possible if the following conditions are met.

¹ Formula reproduced from Copper Development Association, Publication No. 22:1996, with the permission of Copper Development Association Inc.

- a) The temperature rise at the terminals of the original device, when tested in the assembly, is at least 10 K below the limit permitted by the assembly standard.
- b) The substituting device has a temperature rise limit on the terminals declared by the manufacturer of the substituting device, no less than the temperature rise limit on the terminals declared by the manufacturer of the original device. If there is no declared temperature rise limit, the default temperature rise limit is that permitted by the device standard.
- c) The power loss of the substituting device does not exceed that of the original device.

Alternatively, when the original device and the substituted device are from the same device manufacturer, the device manufacturer may issue a declaration of temperature rise performance. The declaration shall confirm that the substituting device can replace the original device with no further need for verification in respect of temperature rise.

In addition, for each of the above options, the physical arrangement within the functional unit shall be maintained. The rating of a functional unit shall not be increased. The physical arrangements shall include terminal shields, conductor type, material, and connection sizes, mounting orientation, clearances to other parts, ventilation arrangements and terminal arrangement.

The performance data on terminal temperatures and power loss may be obtained from the device manufacturer or from comparison tests undertaken by those responsible for the substitution. Any test shall be conducted on new samples.

Refer to Table D.1 for other design characteristics, including short-circuit withstand, that require consideration when substituting devices.

Additional subclause:

10.10.3.201 Calculation of currents based on adjustment of ambient air temperature

To facilitate the probable variation of locations of an assembly in the vessel, the following methodology may be used to adjust the rated current of the assembly. Once a temperature rise test has been carried out applying the temperature rise limits for a daily average ambient air temperature of 40 °C, then up to a daily average ambient air temperature of 55 °C, the rated currents verified by testing can be adjusted by calculation, assuming that the over-temperature of each component or device is proportional to the power loss generated in this component.

Caution should be taken to ensure the devices being assessed have a power loss substantially proportional to I^2 and which is not applied to devices that have substantially fixed losses. By agreement between the user and the manufacturer, in assemblies where the power loss of conductors and devices is substantially proportional to I^2 , the rated current of the circuits at ambient air temperatures (outside the enclosure) between 20 °C and 55 °C may be calculated using the following formula²:

$$\frac{I_1}{I_2} = \left(\frac{\Delta T_1}{\Delta T_2} \right)^{0.61}$$

where

I_1 is the current at which the temperature rise test is carried out;

I_2 is the current rating to be determined at the specific ambient air temperature between 20 °C and 55 °C;

² Formula reproduced from Copper Development Association, Publication No. 22:1996, with the permission of Copper Development Association Inc.

ΔT_1 is the temperature rise measured by test with a current of I_1 ;

ΔT_2 is the maximum permissible temperature rise at the specific ambient air temperature between 20 °C and 55 °C.

I_2 cannot exceed 95 % of the rated current of any device within the circuit being considered, for example a circuit including a 1 600 A circuit-breaker cannot be assigned a current rating greater than 1 520 A.

11 Routine verification

Clause 11 of IEC 61439-2:2011 is applicable.

Table 1 – Minimum clearances in air (8.3.2)

Replace Table 1 of IEC 61439-1:2011 with the following

Table 1 – Minimum clearances in air (8.3.2)

Rated impulse withstand voltage, U_{imp} kV	Minimum clearance ^a mm
$\leq 2,5$	4
4,0	8
6,0	14
8,0	20
12,0	35
^a Based on inhomogeneous field conditions and pollution degree 3. NOTE This table reflects a safety multiplication factor to take into account the marine environment.	

Table 2 – Minimum creepage distances (8.3.3)

Replace Table 2 of IEC 61439-1:2011 with the following

Table 2 – Minimum creepage distances (8.3.3)

Rated insulation voltage U_i	Minimum creepage distance mm							
	Pollution degree							
	1	2			3			
	Material group ^b	Material group ^b			Material group ^b			
	All material groups	I	II	IIIa and IIIb	I	II	IIIa	IIIb
V^c								
32	2,25	2,25	2,25	2,25	2,25	2,25	2,25	2,25
40	2,25	2,25	2,25	2,25	2,25	2,4	2,7	2,7
50	2,25	2,25	2,25	2,25	2,25	2,55	2,85	2,85
63	2,25	2,25	2,25	2,25	2,4	2,7	3	3
80	2,25	2,25	2,25	2,25	2,55	2,85	3,15	3,15
100	2,25	2,25	2,25	2,25	2,7	3	3,3	3,3
125	2,25	2,25	2,25	2,25	2,85	3,15	3,6	3,6
160	2,25	2,25	2,25	2,4	3	3,3	3,75	3,75
200	2,25	2,25	2,25	3	3,75	4,2	4,8	4,8
250	2,25	2,25	2,7	3,75	4,8	5,4	6	6
320	2,25	2,4	3,3	4,8	6	6,75	7,5	7,5
400	2,25	3	4,2	6	7,5	8,4	9,45	9,45
500	2,25	3,75	5,4	7,5	9,45	10,65	12	12
630	2,4	4,8	6,75	9,45	12	13,5	15	15
800	3,6	6	8,4	12	15	16,5	18,75	a
1000	4,8	7,5	10,65	15	18,75	21	24	
1250	6,3	9,45	13,5	18,75	24	27	30	
1600	8,4	12	16,5	24	30	33	37,5	
NOTE 1 The CTI values in footnote c refer to the values obtained in accordance with IEC 60112:2003, method A for the insulating material used.								
NOTE 2 Values taken from IEC 60664-1, but maintaining a minimum value of 2,25 mm.								
NOTE 3 This table reflects a safety multiplication factor to take into account the marine environment.								
a Insulation of material group IIIb is not recommended for use in pollution degree 3 above 630 V.								
b 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								
c The U_i to be used in this table is the increased figure as detailed in 5.2.3								

Table 6 – Temperature rise limits (9.2)

Replace Table 6 of IEC 61439-1:2011 with the following

Table 6 – Temperature rise limits (9.2)

Parts of ASSEMBLIES	Temperature-rise K
Built-in components ^a	In accordance with the relevant product standard requirements for the individual components or, in accordance with the component manufacturer's instructions ^f , taking into consideration the temperature in the ASSEMBLY
Terminals for external insulated conductors	65 ^b
Busbars and conductors	Limited by ^{f,9} : – mechanical strength of conducting material; – possible effect on adjacent equipment; – permissible temperature limit of the insulating materials in contact with the conductor; – effect of the temperature of the conductor on the apparatus connected to it; – for plug-in contacts, nature and surface treatment of the contact material
Manual operating means: – of metal – of insulating material	10 ^c 20 ^c
Accessible external enclosures and covers: – metal surfaces – insulating surfaces	25 ^d 35 ^d
Discrete arrangements of plug and socket-type connections	Determined by the limit for those components of the related equipment of which they form part ^e
NOTE The temperature-rise limits given in this table apply for a daily average ambient air temperature up to 40 °C ^h	
^a The term "built-in components" means: – conventional switchgear and controlgear; – electronic sub-ASSEMBLIES (e.g. rectifier bridge, printed circuit); – parts of the equipment (e.g. regulator, stabilized power supply unit, operational amplifier). ^b The temperature-rise limit of 65 K is a value based on the conventional test of 10.10. An ASSEMBLY used or tested under installation conditions may have connections, the type, nature and disposition of which will not be the same as those adopted for the test, and a different temperature-rise of terminals may result and may be required or accepted. Where the terminals of the built-in component are also the terminals for external insulated conductors, the lower of the corresponding temperature-rise limits shall be applied. The temperature-rise limit is the lower of the maximum temperature-rise specified by the component manufacturer and 65 K. In the absence of manufacturer's instructions, it is the limit specified by the built-in component product standard but not exceeding 65 K. ^c Manual operating means within ASSEMBLIES which are only accessible after the ASSEMBLY has been opened, for example draw-out handles which are operated infrequently, are permitted to sustain a 20 K increase on these temperature-rise limits. ^d Unless otherwise specified, in the case of covers and enclosures, which are accessible but need not be touched during normal operation, a 10 K increase on these temperature-rise limits is permissible. External surfaces and parts over 2 m from the base of the ASSEMBLY are considered inaccessible. ^e This allows a degree of flexibility in respect of equipment (e.g. electronic devices) which is subject to temperature-rise limits different from those normally associated with switchgear and controlgear. ^f For temperature-rise tests according to 10.10, the temperature-rise limits have to be specified by the original manufacturer. It is the responsibility of the original manufacturer to take into account any additional measuring points and limits imposed by the component manufacturer. ⁹ Assuming all other criteria listed are met, a maximum temperature-rise of 80 K for bare copper busbars and conductors shall not be exceeded. The 80 K rise (based on an ambient of 40 °C) acceptable in MPSC-Assemblies reflects the reduced air circulation anticipated in the marine environment aboard ship. Other materials may have a different maximum temperature-rise. ^h Where an assembly is installed in an ambient air temperature different from a daily average of 40 °C, an agreement between the user and the manufacturer may permit calculation. The agreed temperature-rise shall not exceed the values given in this table. See also 10.10.3.201.	

Table 13 – Short-circuit verification by comparison with reference design: check list (10.5.3.3, 10.11.3 and 10.11.4)

Replacement of Item no. 6 in Table 13 of IEC 61439-1:2011:

Are the short-circuit protective devices of each circuit of the assembly to be assessed equivalent, that is of the same manufacturer and series ^a?

In addition, does the short-circuit protective devices of each circuit of the assembly to be assessed

- have a breaking capacity not less than the short-circuit rating of the assembly at the rated operational voltage of the assembly?
- in the case of a current limiting protective device: have a peak let-through current and let-through energy equal or smaller than the reference design at the short-circuit rating and the rated operational voltage of the assembly?
- in the case of a non current limiting device: have a rated short-time withstand current I_{cw} equal to or higher than the reference design?
- fulfil the requirements of coordination with upstream and downstream devices (see 9.3.4 of IEC 61439-1:2011), if required?

Annexes

Annexes of IEC 61439-2:2011 and IEC 61439-1:2011 are applicable except as follows.

Annex C of IEC 61439-1:2011 is not applicable.

Annex J – Electromagnetic compatibility (EMC)

Replacement of Annex J of IEC 61439-1:2011:

IEC 60533 shall be used for ships with metallic hulls.

NOTE A standard for non-metallic hull is under consideration.

Annexes L and M of IEC 61439-1:2011 are not applicable.

Annex BB of IEC 61439-2:2011 is not applicable.

Additional annexes:

Annex AAA (informative)

Items subject to agreement between the assembly manufacturer and the user

The following information is subject to an agreement between the assembly manufacturer and the user. In some cases, information declared by the assembly manufacturer may take the place of an agreement.

**Table AAA.1 – Items subject to agreement between
the assembly manufacturer and the user**

Characteristics	Reference	Default arrangement ^b	Options listed in standard	User requirement ^a
Electrical system				
Earthing system	5.6, 8.4.3.1, 8.4.3.2.3, 8.6.2, 10.5, 11.4 IEC 60092-201	Manufacturer's standard, selected to suit ship requirements	TT/IT, TN-S	
Nominal voltage (V)	3.8.9.1, 5.2.1, 8.5.3	According to installation conditions	max AC 1 000 V or DC 1 500 V	
Transient overvoltages	5.2.4, 8.5.3, 9.1, Annex G	Determined by the electrical system	Overvoltage category III	
Temporary overvoltages	9.1	Nominal system voltage +1 250 V	None	
Rated frequency f_n (Hz)	3.8.12, 5.5, 8.5.3, 10.10.2.3, 10.11.5.4	According to local installation conditions	DC/50 Hz/60 Hz	
Additional on site testing requirements: wiring, operational performance and function	11.10	Manufacturer's standard, according to application	None	
Short-circuit withstand capability				
Prospective short-circuit current at supply terminals I_{cp} (kA)	3.8.7	Determined by the electrical system	None	
Short-circuit current withstand rating I_{cw} (kA)	3.8.10.3	Determined by the electrical system	No less than 1 s	
Prospective short-circuit current in the neutral	10.11.5.3.5	Max. 60 % of phase values	None	
Prospective short-circuit current in the protective circuit	10.11.5.6	Max. 60 % of phase values	None	
SCPD in the incoming functional unit requirement	9.3.2	According to local installation conditions	Yes/No	

Characteristics	Reference	Default arrangement ^b	Options listed in standard	User requirement ^a
Co-ordination of short-circuit protective devices including external short-circuit protective device details	9.3.4	According to local installation conditions	None	
Data associated with loads likely to contribute to the short-circuit current	9.3.2	No loads likely to make a significant contribution allowed for	None	
Protection of persons against electric shock in accordance with IEC 60364-4-41				
Type of protection against electric shock – Basic protection (protection against direct contact)	8.4.2	Basic protection	According to local installation regulations	
Type of protection against electric shock – Fault protection (protection against indirect contact)	8.4.3	According to local installation conditions	Automatic disconnection of supply/electrical separation/total insulation	
Installation environment				
Location type	3.5, 8.1.4, 8.2	Manufacturer's standard, according to application	Indoor/outdoor	
Protection against ingress of solid foreign bodies and ingress of water NOTE See IEC 60092-101 and IEC 60092-201 for environment	8.2.2, 8.2.3	Indoor (enclosed): IP 2X Outdoor (min.): IP 45	IP 00, 2X, 3X, 4X, 5X, 6X	
Protection after removal of withdrawable part	8.2.101	Manufacturer's standard	As for connected position Reduced protection to manufacturer's standard	
External mechanical impact (IK) NOTE IEC 61439-1 does not nominate specific IK codes.	8.2.1, 10.2.6	None	None	
Resistance to UV radiation (applies for outdoor assemblies only unless specified otherwise)	10.2.4	Indoor: not applicable Outdoor: Temperate climate	None	
Resistance to corrosion	10.2.2	Normal Indoor/outdoor arrangements	None	
Ambient air temperature – Lower limit	7.1.1	Indoor: 5 °C Outdoor: –25 °C	None	