INTERNATIONAL STANDARD

IEC 61892-6

First edition
1999-02

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Part 6: Installation

Unités mobiles et fixes en mer – Installations électriques –

Partie 6: Installation

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For graphical symbols, and letter symbols and signs approved by the IEC for general use, readers are referred to publications IEC 60027: *Letter symbols to be used in electrical technology*, IEC 60417: *Graphical symbols for use on equipment. Index, survey and compilation of the single sheets* and IEC 60617: *Graphical symbols for diagrams.*

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CONTENTS

Page

FOREWORD 5
INTRODUCTION 6

Clause

1 Scope 7
2 Normative references 7
3 Definitions 8
4 Earthing and bonding 9
4.1 General 9
4.2 Earthing of exposed conductive parts 10
4.3 Equipotential bonding 10
4.4 Bonding connections 11
4.5 Connections to the unit structure 11
4.6 Protection against galvanic corrosion 11
4.7 Metal coverings and mechanical protection of cables 11
4.8 Cable racks and cable tray 12
4.9 Ductings of heating, ventilation, air-condition (HVAC) and vessels 12
5 Cables and wiring 13
5.1 General 13
5.2 Installation 13
6 Generators and motors 13
6.1 General 13
6.2 Installation 13
7 Transformers 14
7.1 General 14
7.2 Installation and location 14
7.3 Isolation of windings 14
8 Switchgear and controlgear assemblies 15
8.1 General 15
8.2 Location 15
8.3 Insulating mats 15
8.4 Passageways in front of switchgear and controlgear assemblies 15
8.5 Space at the rear and passsageways 15
8.6 Positions of section and distribution boards 16
9 Semiconductor convertors 16

Clause Page

10 Secondary cells and batteries 16
10.1 General 16
10.2 Location 16
10.3 Access 17
10.4 Electrical installation in secondary battery compartments 17
10.5 Protection against corrosion 17
10.6 Fixing and supports 18
10.7 Protection of circuits from secondary batteries 18
11 Luminaires 18
11.1 General 18
11.2 Degree of protection and safety requirements 18
11.3 Discharge lighting of voltage above 250 V 18
11.4 Emergency lighting 19
12 Heating and cooking appliances 19
12.1 Guarding of combustible materials 19
12.2 Position of controlgear and switchgear 19
12.3 Mounting of space-heating appliances 19
13 Trace and surface heating 19
13.1 General 19
13.2 Trace heating cables 19
13.3 Marking 20
13.4 Protection 20
13.5 Mechanical protection 20
13.6 Junction boxes 20
14 Control and instrumentation 20
14.1 General 20
14.2 Layout 20
14.3 Compatibility 20
14.4 Labelling 20
14.5 Labels 21
14.6 Display colours 21
14.7 Illumination 21
14.8 Protection against fluid leakage 21
14.9 Isolation of control rooms 21
14.10 Protection from condensation 21
14.11 Protection during installation period 22
14.12 External cables and wiring 22
14.13 Interference 22
14.14 Sensors 22
14.15 Measurements and indications 22

Clause Page

14.16 Controls 23
14.17 Alarm system 23
15 Communication 24
16 Lightning protection 24
16.1 General 24
16.2 Protection against primary structural damage 24
16.3 Air terminals 25
16.4 Down conductors 25
16.5 Protection against secondary damage 25
17 Test of completed installation 26
17.1 General 26
17.2 Inspections and tests 26
17.3 Insulation-testing instruments 26
17.4 Insulation resistance 27
17.5 Generators 27
17.6 Switchgear 27
17.7 Lighting, heating and galley equipment 28
17.8 Communication systems 28
17.9 Emergency and safety systems 28
17.10 Earthing 28
17.11 Voltage drop 28
17.12 Requirements of International Convention on Safety of Life at Sea (SOLAS) 28
18 Documentation 28
18.1 General 28
18.2 Equipment 29
18.3 Testing 29
18.4 Maintenance 29

Annex A (informative) Bibliography 30

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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MOBILE AND FIXED OFFSHORE UNITS – ELECTRICAL INSTALLATIONS –

Part 6: Installation

FOREWORD

1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, the IEC publishes International Standards. Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. The IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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3) The documents produced have the form of recommendations for international use and are published in the form of standards, technical reports or guides and they are accepted by the National Committees in that sense.
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5) The IEC provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with one of its standards.
6) Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. The IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 61892-6 has been prepared by IEC technical committee 18: Electrical installations of ships and of mobile and fixed offshore units.

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

FDIS	Report on voting
18/854/FDIS	18/861/RVD

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

Annex A is for information only.

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

IEC 61892 consists of the following parts, under the general title: *Mobile and fixed offshore units – Electrical installations.*

Part 1: General requirements and conditions
Part 2: System design
Part 3: Equipment
Part 4: Cables
Part 5: Mobile units
Part 6: Installation
Part 7: Hazardous areas

INTRODUCTION

IEC 61892 forms a series of International Standards intended to ensure safety in the design, selection, installation, maintenance and use of electrical equipment for the generation, storage, distribution and utilization of electrical energy for all purposes in offshore units which are used for the exploration or exploitation of petroleum resources.

This part of IEC 61892 also incorporates and co-ordinates, as far as possible, existing rules and forms a code of interpretation, where applicable, of the requirements laid down by the International Maritime Organization, and constitutes a guide for future regulations which may be prepared and a statement of practice for offshore unit owners, constructors and appropriate organizations.

This standard is based on equipment and practices which are in current use, but it is not intended in any way to impede development of new or improved techniques.

The ultimate aim has been to produce a set of International Standards exclusively for the offshore petroleum industry.

In this part of IEC 61892, references are made to other parts of the standard, which are still in preparation. Footnotes are attached to such references. A footnote indicates which current standard should be used until the part in preparation is published.

MOBILE AND FIXED OFFSHORE UNITS – ELECTRICAL INSTALLATIONS –

Part 6: Installation

1 Scope

This part of IEC 61892 contains provisions for the installation of electrical equipment in mobile and fixed units, including pipelines, pumping or "pigging" stations, compressor stations and exposed location single-buoy moorings, used in the offshore petroleum industry for drilling, production, processing and for storage purposes.

This standard applies to equipment in all installations, whether permanent, temporary, transportable or hand-held, to a.c. installations up to and including 15 000 V, and d.c. installations up to and including 1 000 V.

This standard does not apply to electrical installations in rooms used for medical purposes, or in tankers.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of IEC 61892. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this part of IEC 61892 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 60092-101:1994, *Electrical installations in ships – Part 101: Definitions and general requirements*

IEC 60092-201:1994, *Electrical installations in ships – Part 201: System design – General*

IEC 60092-203:1985, *Electrical installations in ships – Part 203: System design – Acoustic and optical signals*

IEC 60092-301:1980, *Electrical installations in ships – Part 301: Equipment – Generators and motors*

IEC 60092-350:1988, *Electrical installations in ships – Part 350: Low-voltage shipboard power cables – General construction and test requirements*

IEC 60092-352:1997, *Electrical installations in ships – Part 352: Choice and installation of cables for low-voltage power systems*

IEC 60092-401:1980, *Electrical installations in ships – Part 401: Installation and test of completed installation*
Amendment 1 (1987)

IEC 60447:1993, *Man-machine interface (MMI) – Actuating principles*

IEC 60825-1:1993, *Safety of laser products – Part 1: Equipment classification, requirements and user's guide*

IEC 61892-3: – *Mobile and fixed offshore units – Electrical installations – Part 3: Equipment* (to be published)

ISO 8468:1990, *Ship's bridge layout and associated equipment – Requirements and guidelines*

3 Definitions

For the purpose of this part of IEC 61892, the following definitions apply.

3.1
bond
connection of non-current-carrying parts to ensure continuity of electrical connection, or to equalize the potential between parts

3.2
earth
general mass of the structure or hull of a unit

NOTE – In the USA and Canada "ground" is used instead of "earth".

3.3
earthed
connected to the general mass of the structure or hull of a unit in such a manner as will ensure at all times an immediate discharge of electrical energy without danger

3.4
electric surface heating
heat generated in the surface layer of a body to be heated by electrical means in order to raise or maintain its temperature

3.5
electric surface heating system
system of electric surface heating devices together with any controls, thermal insulation and protective cladding designed to meet a specified electric surface heating requirement

3.6
emergency switchboard
switchgear and controlgear assembly which is normally supplied by the main switchboard but, in the event of failure of the main electrical power supply system, is directly supplied by the emergency source of electrical power or the transitional source of emergency power and is intended to distribute and control electrical energy to the emergency services for all electrical consumers essential for the safety of the crew and the unit under emergency conditions

3.7
equipotential bonding
electrical connection putting various exposed conductive parts and extraneous conductive parts at a substantially equal potential

3.8
exposed conductive part
conductive part which can readily be touched and which is not normally alive, but which may become alive under fault conditions

NOTE – Typical exposed conductive parts are walls of enclosures, operating handles, etc.

3.9
extraneous conductive part
conductive part not forming a part of the electrical installation and liable to propagate a potential, including earth potential

3.10
main switchboard
switchgear and controlgear assembly which is directly supplied by the main source of electrical power and is intended to distribute and control electrical energy to the unit's services

3.11
primary structural damage
damage which can result from lightning strike to units which do not provide a path of low resistance to earth for the passage of lightning currents, for example units of non-metallic construction or those having substantial non-metallic members

3.12
safety voltage (extra low voltage)
voltage which does not exceed 50 V a.c. r.m.s. between conductors, or between any conductor and earth, in a circuit isolated from the supply by means such as a safety isolating transformer, or convertor with separate windings; a voltage which does not exceed 50 V d.c. between conductors, or between any conductor and earth, in a circuit which is isolated from higher voltage circuits

NOTE 1 – Consideration should be given to the use of equipment operating at less than 50 V under certain conditions, such as wet surroundings, exposure to heavy seas or powerful water jets where direct contact with live parts is involved.

NOTE 2 – The voltage limit should not be exceeded either at full load or no-load but it is assumed, for the purpose of this definition, that any transformer or convertor is operated at its rated supply voltage.

3.13
secondary damage
damage to units or to their electrical installations which can result as an indirect consequence of a lightning strike to a unit or to its immediate vicinity. A path to earth of low resistance may not prevent secondary damage which may occur as a result of high values of induced or resistance drop voltages produced by the passage of lightning currents

3.14
secondary battery *Syn.* (rechargeable) battery; storage battery (USA)
two or more secondary cells connected together and used as a source of electric energy.

4 Equipment earthing and bonding

4.1 General

4.1.1 This clause 4, Equipment earthing and bonding contains mainly provisions for earthing of exposed conductive parts and bonding of extraneous conductive parts, various other bonding connections and a table for sizes of earth-continuity conductors and earthing connections.

4.1.2 All metallic parts of a unit, that are not normally current-carrying parts, shall be designated as either an exposed conductive part or an extraneous conductive part.

a) Exposed conductive parts shall be connected to earth under the specific conditions for each type of system earthing:
   – for TT- and IT-systems, the exposed conductive parts shall be connected directly to earth;
   – for TN-S systems, the exposed conductive parts shall be connected to the protective conductor, which is connected to earth at the neutral point of the distribution system.

   NOTE 1 – For the definition of TT-, IT- and TN-S-systems, see IEC 60364-3.

   NOTE 2 – Earth or an equipotential bonding system may be the steel structure or the hull of a unit.

b) Extraneous conductive parts shall be connected to an equipotential bonding system.

For units that have separate modules and/or concrete structures, equipotential bonding shall be installed between extraneous conductive parts.

It shall be ensured that there is no detrimental mutual influence between the different protective measures applied in the same installation or in part of an installation.

NOTE 1 – For earthing requirements of system neutral points, see IEC 61892-2 [1)]

NOTE 2 – For earthing and bonding requirements in hazardous areas, see IEC 61892-7.

4.2 Earthing of exposed conductive parts

4.2.1 Unless specifically included in the following exemptions, all exposed conductive parts shall be earthed:

– lamp caps;

– shades, reflectors and guards, supported on lampholders or luminaires constructed of, or shrouded in, non-conducting material;

– metal parts on, or screws in or through, non-conducting material, which are separated by such material from current-carrying parts, and from earthed non-current-carrying parts in such a way that in normal use they cannot become live or come into contact with earthed parts;

– portable appliances which have a double and/or reinforced insulation (see IEC 61892-1 [2)]) provided that the appliances conform with recognized safety requirements;

– bearing housings which are insulated in order to prevent the circulation of current in the bearings;

– clips for fluorescent lighting tubes;

– equipment supplied at extra-low voltage (safety voltage);

– cable clips;

– equipment of "all-insulated" construction in which the insulation enclosing the equipment is durable and continuous;

– fixed equipment or parts of equipment which, although not shrouded in insulation material, are nevertheless protected in such a way that they cannot be touched and cannot come into contact with exposed metal;

– equipment located in special earth-free rooms.

4.2.2 Metal parts of portable appliances, other than current-carrying parts and parts exempted in 4.2.1, shall be connected to earth by means of a conductor in the flexible cable or cord, which complies with table 1 and which is connected, for example, through the associated plug and socket-outlet.

4.2.3 Secondary windings of instrument transformers shall be earthed.

4.2.4 The bonding shall be such as to give a substantially equal potential and a sufficiently low earth-fault loop impedance to ensure correct operation of protective devices.

4.3 Equipotential bonding

4.3.1 Extraneous conductive parts shall be connected to the equipotential bonding system as described in 4.4.

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1) In preparation. Before IEC 61892-2 is published, see IEC 60092-201.

2) In preparation. Before IEC 61892-1 is published, see IEC 60092-101.

4.3.2 Metal frames or enclosures of equipment mounted in direct metallic contact with the unit structure need no supplementary bonding, provided that the surfaces in contact are clean and free from rust, scale or paint when installed and are firmly bolted together. Alternatively, they may be connected to the unit structure by a connection complying with 4.4.

4.3.3 Removable gland plates shall be separately bonded to the parent equipment, unless the connection between the gland plate and the parent equipment complies with the requirement of 4.3.2.

4.4 Bonding connections

4.4.1 Every bonding connection to earth shall be of copper or other corrosion-resistant material and shall be securely installed and protected where necessary against damage and also against galvanic corrosion. Connections shall be secured against becoming loose due to vibration.

4.4.2 The nominal cross-sectional area of every copper bonding connection shall be not less than required in table 1. Every other bonding connection shall have a conductance not less than that specified for a copper bonding connection.

4.4.3 Equipotential bonding connections for extraneous conductive parts shall have a cross-sectional area of at least 6 mm^2.

4.5 Connections to the unit structure

4.5.1 The bonding shall be achieved by means of a separate bonding conductor unless the parts under consideration are installed in accordance with 4.3.2.

4.5.2 Every connection of an earth conductor or a bonding conductor to the unit structure or hull shall be made in an accessible position, and shall be secured by a screw of brass or other corrosion resistant material, which shall be used for this purpose only. In all cases, care shall be taken to ensure clean metallic surfaces free from rust at the contact areas immediately before the screw is tightened.

4.5.3 Any electrical or instrumentation equipment attached, but not welded, to the structure steelwork, for example to hand rails, ladders and stairways, shall be bonded to the nearest structural steelwork.

4.5.4 To minimize shock from high-frequency voltage induced by the radio transmitter, handles, handrails, etc., made of metal on the bridge or upper decks shall be in good electrical connection with the hull or superstructure.

NOTE – See IEC 60533.

4.6 Protection against galvanic corrosion

Methods of securing dissimilar materials, for example aluminium to the structure or steel hull of a unit, often include insulation to prevent galvanic corrosion between the materials. In such cases, a separate bonding connection shall be provided between, for example, an aluminium superstructure and structure or hull, which shall be made in such a manner that galvanic corrosion is avoided and the points of connection may be readily inspected.

4.7 Metal coverings and mechanical protection of cables

4.7.1 All metal coverings of cables shall be earthed at both ends, except in so far as the provisions given for single-core cables for a.c wiring apply (see clause 5). Single-point earthing is admitted for final subcircuits (at the supply end) and in those installations (control and instrumentation cables, mineral-insulated cables, intrinsically safe circuits, control circuits, etc.) where it is required for technical or security reasons, if any.

4.7.2 Earthing connections shall be carried out with conductors that have cross-sectional areas (see table 1) related to the current rating of the cables, or by equivalent means, such as metal clamps gripping the metal covering of the cable and connected to earth.

The metal covering of cables may be earthed by means of glands intended for that purpose and so designed as to ensure an effective earth connection.

The glands shall be firmly attached to, and in effective contact with, a metal structure earthed in accordance with this standard.

4.7.3 The electrical continuity of all-metal coverings throughout the length of the cables, particularly at joints and tappings, shall be ensured.

4.7.4 Metal casings, pipes and conduits or trunking shall be effectively earthed.

4.7.5 Conduits may be earthed by being screwed into a metal enclosure, or by nuts on both sides of the wall of a metal enclosure, provided the surfaces in contact are clean and free from rust, scale or paint and that the enclosure is in accordance with these provisions on earthing. The connections shall be painted immediately after assembly in order to prevent corrosion.

4.7.6 Cable sheaths and armour, and conduits, may be earthed by means of clamps or clips of corrosion-resistant and galvanically compatible metal, making effective contact with sheath or armour and earthed metal.

4.7.7 All joints in metal conduits and ducts and in metallic sheaths of cables used for earth continuity shall be soundly made and protected, where necessary, against corrosion.

4.7.8 Instrument cables without armour shall normally have screens earthed at the control equipment.

4.7.9 Instrument cables with armour shall have screen and armour insulated from each other with the screen earthed at the control equipment only and the armour earthed at both ends, unless it is required for functional reasons to be earthed at one end only, in which case it shall normally be earthed at the equipment or, in the case of intrinsically safe circuits, in accordance with 4.7.10.

4.7.10 Intrinsically safe (IS) cables shall normally have a screen connected to the IS earth bar.

4.7.11 Spare cores of glanded multi-core or multi-pair electrical and instrumentation cables shall be connected to terminal blocks and be collectively earthed.

NOTE – Due to the lack of international provisions covering the use of cable armours, metal sheaths or shields as protective earthing conductors for connected equipment, reference is made to national codes.

4.8 Cable racks and cable tray

4.8.1 Electrical continuity shall be maintained at splices between sections of cable ladder, rack or tray by the use of splice plates. Additional bonding is not required.

4.9 Ductings of heating, ventilation, air-condition (HVAC) and vessels

4.9.1 Vessels and equipment skids which are not seam-welded to the structural steel shall be bonded to earth using the integral earthing bosses supplied with the equipment.

4.9.2 Electrical continuity shall be maintained between HVAC ducting sections and between ducting and the main structure.

Table 1 – Sizes of protective-earthing (PE) conductors and earthing connections

Type of earthing connection	Cross-sectional area of associated current-carrying conductor	Minimum cross-sectional area of copper earthing connection
1. PE conductor in flexible cable or flexible cord	Any	Same as current-carrying conductor up to and including 16 mm², or one-half above 16 mm² but at least 16 mm²
2. PE conductor incorporated in fixed cable	Up to and including 16 mm²	Same as current-carrying conductor up to and including 16 mm² but at least 1,5 mm²
a) insulated PE conductor	Over 16 mm²	50 % of the current-carrying conductor but at least 16 mm²
b) bare PE conductor in contact with metallic covering	1 mm² to 2,5 mm²	1 mm²
	4 mm² to 6 mm²	1,5 mm²
3. Separate fixed earthing conductor	Not exceeding 3 mm²	Same as current-carrying conductor subject to minimum of 1,5 mm² for stranded earth conductor, or 3 mm² for solid earth conductor
	Exceeding 3 mm² but not exceeding 125 mm²	One-half of the cross-sectional area of the current-carrying conductor, subject to a minimum of 3 mm²
	Exceeding 125 mm²	64 mm²

5 Cables and wiring

5.1 General

This clause contains provisions for the installation of cables and wiring, while IEC 61892-4 (under consideration) contains provisions for the construction, rating and selection of cables.

5.2 Installation

Low-voltage cables and their accessories shall be installed in accordance with the requirements given in IEC 60092-401, Section Nine and Amendment 1, except for clause 36, and IEC 60092-352.

6 Generators and motors

6.1 General

This clause contains provisions for the installation of all types of electrical rotating machines on offshore units. Regarding location of generators, see IEC 61892-2 [1)].

6.2 Installation

6.2.1 Generators and motors shall, where practicable, be installed to minimise the effect of motion of the unit.

NOTE – Regarding requirements for lubrication, see IEC 61892-3.

[1)] In preparation. Before future IEC 61892-2 is published, see IEC 60092-201.

6.2.2 Generators shall be located in well-ventilated spaces where combustible gases cannot accumulate.

NOTE – This requirement does not preclude the installation of generators and prime movers in zone 2, provided sufficient precautions are taken with regard to ventilation and to explosion protection of equipment. For additional requirements for installations in hazardous areas, see IEC 61892-7.

7 Transformers

7.1 General

This clause contains provisions for the installation of all types of transformers used for power and lighting on offshore units.

7.2 Installation and location

7.2.1 Transformers shall be installed in well-ventilated compartments, accessible only to authorized personnel. The one exception to this rule is that air-cooled transformers provided with means of protection against accidental contact with live parts need not be installed in special compartments.

7.2.2 Liquid-immersed transformers shall be installed in an area with provisions for containment and drainage of liquid leakage. When flammable liquid such as oil is used, consideration shall be given to the need for fire extinguishing equipment, taking into account other equipment that may be installed within the same space.

7.2.3 Suitable arrangements shall be provided for cooling and containing all the liquid which might escape from a damaged tank. Contamination of bilges shall be avoided by the provision of suitable drip-trays or save-alls.

7.2.4 Transformers and their connections shall be protected against such mechanical damage, condensation and corrosion as may reasonably be expected.

7.2.5 Where liquid cooling is used, consideration shall be given to the provision of a device capable of detecting leakage into the enclosure and provision of an alarm signal in either primary or secondary cooling circuit, as relevant. In addition, the flow of coolant shall be monitored in order to operate an alarm in the event of a loss of flow.

7.2.6 Where provision is made for breathing, a suitable desiccator shall be provided.

7.2.7 Where forced cooling is used, it shall be possible to operate the transformer at reduced power on failure of a pump or fan. Consideration shall be given to the provision of a suitable temperature indicator and alarm facilities.

7.3 Isolation of windings

7.3.1 Means shall be provided for the isolation of secondary windings which can be connected to a source of voltage.

7.3.2 Where transformers are arranged to operate in parallel, means shall be provided for the isolation of the primary and secondary windings.

7.3.3 A suitable warning label indicating the points of isolation shall be provided near the point of access.

8 Switchgear and controlgear assemblies

8.1 General

This clause contains provisions for the installation of low-voltage switchgear and controlgear assemblies.

8.2 Location

8.2.1 Switchgear and controlgear assemblies shall, in so far as practically possible, be installed in easily accessible and well-ventilated locations where combustible gases, acid vapours or similar do not occur, and shall be located well clear of heat sources such as boilers, heated oil tanks, steam exhaust pipes or other heated pipes.

In addition to complying with the appropriate requirements of IEC 61892-1[1)], all switchgear and controlgear assemblies shall be so installed that no pipes or tanks are above them within the same space or at their rear. Where this is unavoidable, pipes shall be continuous and without openings in such locations.

8.2.2 Where switchgear and controlgear assemblies are located in dedicated rooms, pipes or conduits for water, steam, gas, oil, etc., which are not related to the electrical equipment, are not permitted.

8.3 Insulating mats

When the voltage exceeds the extra-low voltage (safety voltage) as defined in clause 3, an insulating mat or grating shall be provided in front of switchgear and controlgear assemblies and also at the rear, if access from the rear is required. The insulating mat or grating shall be oil-resistant and non-slip.

NOTE 1 – If an assembly contains withdrawable equipment, the insulating mat or grating should be provided in front of and on both sides of the equipment in its fully withdrawn position.

NOTE 2 – Removable mats for use only during repair and maintenance should be considered.

NOTE 3 – See IEC 61111.

NOTE 4 – This requirement does not apply when the floor is made of an insulating layer.

8.4 Passageways in front of switchgear and controlgear assemblies

8.4.1 An unobstructed passageway extending not less than 1 m wide from the furthest projection shall be provided in front of any assemblies.

8.4.2 When an assembly contains withdrawable equipment, for example circuit-breaker and starter chassis, the unobstructed passageway shall not be less than 0,4 m wide with this equipment in its fully withdrawn position.

8.4.3 For small units, the unobstructed passageway may be reduced subject to agreement by the appropriate authority.

8.5 Space at the rear and passsageways

When a space is provided at the rear of switchgear and controlgear assemblies, it shall be ample to permit maintenance and in general shall be not less than 0,6 m in the clear, except that the width may be reduced to 0,5 m where there are stiffeners and frames.

NOTE – For nominal voltages exceeding 600 V, it is recommended to increase this space.

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1) In preparation. Before IEC 61892-1 is published, see IEC 60092-101.

Passageways behind main and emergency switchboards with open rear shall be of ample height and shall, where practicable, be provided at each end with an access door fitted with an external lock which can at all times be opened from the interior. The access doors shall carry a permanent and prominent indication of the maximum voltage.

8.6 Positions of section and distribution boards

In accommodation spaces where open-type assemblies are surrounded by combustible material, a fire barrier of incombustible material shall be provided.

9 Semiconductor convertors

9.1 Where semiconductor convertor stacks or equipment are air-cooled, they shall be installed in such a manner that the circulation of air to and from the stacks, associated equipment or enclosures (if any) is not impeded, and that the temperature of the cooling inlet air to convertor stacks does not exceed the ambient temperature for which the stacks are specified.

9.2 Convertor stacks and associated equipment shall not be mounted near sources of radiant heat energy, such as resistors, steampipes and engine exhaust pipes.

9.3 For liquid-immersed-type convertors, the same installation precautions as specified in clause 7 for liquid-cooled transformers apply.

10 Secondary cells and batteries

10.1 General

This clause contains provisions for vented batteries only.

Secondary cells and batteries shall be installed in accordance with the requirements of the appropriate authority.

10.2 Location

10.2.1 Secondary cells and batteries shall be located where they are not exposed to excessive heat, extreme cold, spray, steam or other conditions which would impair performance or accelerate deterioration. Batteries for emergency service, including emergency diesel-engine starting, shall be located where they are protected as far as is practicable from damage caused by collision, fire or any other casualty (in accordance with the International Convention for Safety of Life at Sea).

Batteries shall be located so that the vapours generated cannot harm surrounding appliances.

NOTE – For ventilation of battery compartments, see IEC 61892-7.

10.2.2 Secondary cells and batteries connected to a charging device shall be installed dependent on the output power of the device (calculated from the maximum obtainable charging current and the nominal voltage of the battery) as follows:

– power above 2 kW in a room assigned to batteries only or, if a room is not available, in a suitable well-ventilated locker on deck;

– power between 0,2 kW and 2 kW, as above, but may also be installed in a box or locker in some suitable space, or, if protected from falling objects, in a machinery space or in a similar well-ventilated compartment;

– power below 0,2 kW, as above, but may also be stored in the open air, if protected from falling objects, or in a battery box in any suitable space.

10.2.3 Starter batteries shall be located as close as practicable to the engine or engines served in order to limit voltage drop in the cables.

10.2.4 Secondary cells and batteries (unless of the valve regulated type batteries) shall not be placed in sleeping quarters.

10.2.5 Ventilated lead-acid batteries and alkaline secondary batteries shall not be placed in the same battery compartment.

10.2.6 A danger notice shall be permanently secured to doors or covers of battery compartments, lockers and boxes, indicating that any source of ignition in these rooms or in their vicinity is prohibited.

10.3 Access

10.3.1 Batteries shall be arranged to permit ready access for replacement, inspection, testing, replenishing and cleaning.

10.4 Electrical installation in secondary battery compartments

10.4.1 Cables, with the exception of those pertaining to the battery or the battery compartment lighting, shall, as far as possible, not be installed in the battery compartments. If, however, such an installation is necessary, the cables shall have a protective covering resistant to the vapours developed by the electrolyte or shall be otherwise protected against these vapours.

10.4.2 Lighting equipment shall be in accordance with relevant requirements of IEC 61892-2[1)].

10.4.3 Devices liable to arc shall not be installed in any compartment assigned principally to secondary cells and batteries.

10.5 Protection against corrosion

10.5.1 The interior of battery compartments, including crates, trays, boxes, shelves and other structural parts therein, shall be protected against the deteriorating effect of the electrolyte by:

– electrolyte-resistant coating, or

– lining of electrolyte-resistant material, for example lead sheet for lead-acid, steel for alkaline secondary batteries.

NOTE 1 – Alternatively, the floor of battery compartments may be lined with electrolyte-resistant material spanning the entire floor. The lining should be watertight and carried up to at least 150 mm on all sides. Walls and deck-heads of battery compartments should all be protected with electrolyte-resistant coating.

NOTE 2 – Interior surfaces of metal shelves for lead cells, whether or not grouped in crates or trays, or for alkaline secondary batteries, should be protected by a lining of electrolyte-resistant material. The lining should be watertight and carried up to at least 75 mm on all sides. Linings should have a minimum thickness of 1,5 mm if made of lead sheet, and of 0,8 mm if made of steel. Exterior surfaces of metal shelves should have at least an electrolyte-resistant coating.

NOTE 3 – The use of lead sheets should be re-evaluated in relation to environmental considerations.

NOTE 4 – Deck boxes should be lined in accordance with notes 1 and 2. Boxes for small batteries should be lined to a depth of 75 mm consistent with the methods described above.

NOTE 5 – Materials used for coating and lining should not be likely to emit vapours detrimental to the batteries.

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1) In preparation. Before IEC 61892-2 is published, see IEC 60092-201.

10.6 Fixing and supports

Where movement is possible, batteries shall be securely fixed. The trays shall be arranged to give them access to the air on all sides. Any isolating supports shall be non-absorbent to the electrolyte.

10.7 Protection of circuits from secondary batteries

When conductors from the batteries are not protected against short-circuiting and overload, they shall be installed so as to be adequately protected against short-circuits and earth faults.

NOTE – This requirement can be met by using for example single-core double-insulated cables.

11 Luminaires

11.1 General

This clause contains provisions for the installation of all types of luminaires, including discharge lamp luminaires with a voltage above 250 V.

11.2 Degree of protection and safety requirements

Depending on their location, luminaires shall as a minimum have the degree of protection and safety requirements given in IEC 61892-2 [1)].

Luminaires likely to be exposed to more than the ordinary risk of mechanical damage shall be protected against such shock or be of specially robust construction.

NOTE – Particular attention should be paid to the mechanical protection of luminaires located in or near landing areas where cranes are operating.

11.3 Discharge lighting of voltage above 250 V

11.3.1 Discharge lamps operating at a voltage above 250 V shall be used only in fixed luminaires. Discharge lamp installations shall be provided with a durable and suitable notice bearing the inscription:

11.3.2 All live parts of discharge lamp luminaires shall be so placed and installed that they cannot be touched accidentally or inadvertently, the creepage distance along the surface of the glass tube being taken into consideration.

11.3.3 All non-current-carrying metallic parts of the installation shall be effectively earthed. It is, however, not always necessary to earth metallic clips or clamps used in positions remote from the terminals to support discharge lamps, but it may be found desirable to earth such clips or clamps in order to reduce interference with radio reception (see clause 4).

11.3.4 Each discharge lamp luminaire or installation shall be provided with a multipole (all pole) disconnecting switch in an accessible location. Such a switch shall be clearly marked and a warning notice shall be placed nearby.

[1)] In preparation. Before IEC 61892-2 is published, see IEC 60092-201.

Switches or other current-interrupting devices shall not be installed in the secondary circuit of transformers.

11.4 Emergency lighting

Emergency lights shall be marked for easy identification.

12 Heating and cooking appliances

12.1 Guarding of combustible materials

All combustible materials in the vicinity of heating and cooking appliances shall be protected by suitable incombustible and thermal insulating materials.

12.2 Position of controlgear and switchgear

The position of fuses, switches and other control elements fitted in or near appliances shall be such that they will not be subject to temperatures above that for which they are designed and they shall be accessible for inspection, for example through separate covers.

12.3 Mounting of space-heating appliances

Space-heating appliances shall be so mounted that there will be no risk of dangerous heating of the deck, bulkhead or other surroundings.

13 Trace and surface heating

13.1 General

Trace and surface heating shall be installed in accordance with the system documentation. Special care shall be taken to ensure that any limits specified in the system documentation are not exceeded.

Systems installed in hazardous areas shall be installed in accordance with a standard acceptable to the relevant authority.

13.2 Trace heating cables

Trace heating cables shall not be spliced.

Trace heating cables shall be strapped to equipment and pipes using glass fibre tape or another method in accordance with the manufacturer's documentation, and shall be spaced approximately at 300 mm intervals along pipes, and as required elsewhere.

Trace heating cables shall normally be installed along the lower semi-circle of the pipes.

Where practicable, cables shall pass through thermal insulation from below.

Trace heating cables shall be installed in such a way as to allow dismantling of joints, valves, instruments, etc. without cutting or damaging the cable.

For protection against condensation, the trace heating cable shall form a loop inside the junction box if not fitted with a drain plug.

Flexible conduits protecting trace heating cables shall be fixed to supports approximately every 200 mm.

13.3 Marking

The outside of the thermal insulation or protective cladding shall be clearly and durably marked at appropriate intervals to indicate the presence of electric trace and surface heating equipment.

13.4 Protection

Circuits which supply trace and surface heating circuits shall be provided with earth-fault or residual current circuit-breakers that have a trip current not greater than 30 mA.

13.5 Mechanical protection

In situations where the cable is liable to mechanical damage it shall be provided with suitable protection.

NOTE – Where the trace heating cables are crossing flanges, thermal insulation covers or other sharp edges, protectors of stainless steel AISI 316 should be used.

13.6 Junction boxes

Where practicable, junction boxes shall be installed on steel supports, fixed directly to the heated pipes.

14 Control and instrumentation

14.1 General

The provisions of this clause are applicable to electrical, electronic and programmable equipment intended for control, monitoring, alarm and protection systems for use in offshore units.

NOTE – If control and instrumentation aspects of closures in watertight bulkheads or shell plating, bilge pumping, fire protection and fire extinction are carried out by electrical methods, attention is drawn to additional requirements in SOLAS Chapter II-1, Regulations 15, 16, 17, 21 and Chapter II-2.

14.2 Layout

Control positions shall be ergonomically arranged for the convenience of the operator and hence the accuracy and safety of the operation.

Area or group identification shall be considered, especially in complex layouts, for example adequate spacing between display and control groups.

Equipment in the control room shall meet the requirements of ISO 8468.

14.3 Compatibility

The arrangement of indicating instruments and control shall follow a logical sequence. Where it is desirable, mimic diagrams can be used.

As far as possible, operation and the resulting movements of the indicating instruments shall be consistent with each other.

14.4 Labelling

Each operator control panel, subpanel, indicating instrument, control handle, alarm, signal lamp, recording instrument, etc. shall be clearly and systematically identified by means of self-explanatory and unambiguous labels, for example as shown in table 2.

Table 2 – Examples of labelling

On main panels	Controlled area	Main engines
On subpanels	Controlled subarea	Starboard engine
On indicating and recording instruments	Measured parameter	Lubricating oil temperature
On instrument dials	Unit of measurement	°C
On controls	Controlled parameter	Lubricating oil temperature
On control dials	Effect of motion	Increase/decrease
On alarm groups	Alarm object	Lubricating oil
On alarms	Designation of sensor	Main engine cooling water inlet temperature

14.5 Labels

Labels shall be permanently secured, placed consistently relative to instruments, etc. and shall be made of durable material, bearing clear and indelible characters and numbers.

14.6 Display colours

Colours for the differentiation of operating conditions shall be readily distinguishable and identifiable.

14.7 Illumination

Instruments and controls shall be illuminated so that they can be clearly read and operated in all ambient light conditions under which they are intended to be operated, without uncomfortable shadow or glare. If the surrounding illumination makes it difficult to detect an indicator light, a suitable shade shall be provided. If equipment is installed in the bridge area, means shall be provided to avoid interference with night vision by any light source, for example by dimming. Equipment mounted outside (for example on bridge wings) shall be satisfactorily illuminated for operation in both daylight and darkness.

14.8 Protection against fluid leakage

Electrical equipment, where practical, shall not be installed in the same panel or cabinet as equipment employing a hydraulic medium, or pipelines carrying water, oil or steam, unless effective means have been provided to protect the electrical equipment in case of leakage.

Through-runs of pipelines carrying hydraulic mediums, water, oil or steam, shall be avoided in control rooms.

14.9 Isolation of control rooms

Deckheads and bulkheads of control rooms shall be made sufficiently waterproof to prevent seepage of water, oil, etc. into the compartment. All cable and pipe entries into control rooms shall be suitably sealed to prevent steam or oil-laden air from being drawn into the compartment.

14.10 Protection from condensation

As far as practicable, arrangements shall be made to prevent condensation in enclosures.

14.11 Protection during installation period

Electrical equipment shall be well protected during the installation period to prevent damage from welding, caulking, painting and similar injurious operations.

14.12 External cables and wiring

External cables and wiring shall comply with clause 5.

Consideration shall only be given to cables and interconnecting wiring of smaller sizes than those indicated above when they are adapted for equipment requiring currents of very small value. The mechanical strength and insulation qualities of such cables and wiring shall not affect the reliability of the system of which they form a part.

14.13 Interference

In order to reduce the effect of interference, the guidelines given in IEC 61892-2 [1)] shall be considered.

14.14 Sensors

14.14.1 Site of sensors

All sensors shall be sited so that the sensor output is a realistic measure of the variable for which it is intended to indicate a condition. Sensors shall be installed in places where there is minimal risk of damage during normal overhaul and maintenance.

14.14.2 Enclosure

The enclosure of sensors and their terminal boxes shall be adequate for the expected place of installation (see IEC 61892-2 [1)]) and for the type of cables installed.

Temperature sensors shall be installed in pockets of suitable material. Connections shall be arranged so as to permit withdrawal for testing purposes. Pressure sensors exposed to shocks and strong vibration in their working medium shall be protected by damping chambers.

14.14.3 Testing

Sensors shall be provided with facilities for testing.

14.15 Measurements and indications

14.15.1 Instrument similarity

Instruments measuring the same or similar quantities shall have the same or similar dial numbering and scale breakdown.

14.15.2 Direction of scale values

Scale values shall increase methodically from left to right, from bottom to top, or clockwise.

14.15.3 Scale division

Scales shall be divided to avoid the need for interpolation.

[1)] In preparation. Before IEC 61892-2 is published, see IEC 60092-201.

14.15.4 Automatic control sequence

Instruments for monitoring an automatic control sequence shall preferably display the sequential steps of operation and indicate if the sequential schedule is not being fulfilled.

14.15.5 Centralized control

Where centralized control can be performed from more than one control position, means shall be provided to indicate which control position is in operation.

14.16 Controls

14.16.1 Direction of motion

Where applicable, the motion of controls determined in relation to the person facing the control device shall be as follows:

For an increase in the value of the measured quantity, a direction of motion:

– "to the right";
– "upwards";
– "forward", or
– "clockwise", when the movement is regarded chiefly as a rotation.

For more detailed instructions, see IEC 60447.

14.16.2 Control levers

Control levers, handles and push-buttons shall be easy to manipulate.

The need for extreme force shall be avoided.

Motions shall be limited by noticeable mechanical stops.

Where necessary, protection against inadvertent operation shall be fitted.

14.16.3 Identification

In addition to identification by labels, consideration shall be given to the use of different shapes of control levers and handles for the various functions, so that the operator will learn to associate a control function with a particular shape.

14.17 Alarm system

14.17.1 Acoustic and optical signals and indications

The acoustic and optical signals and indications used in alarm systems shall meet the requirements of IEC 60092-203.

NOTE – See IMO Resolution A.830 (19) Code on Alarms and Indicators, 1995.

15 Communication

15.1 The radio equipment shall be so installed and such precautions taken in the installing of other equipment as to ensure the proper operation of these services.

15.2 The electrical installation of the equipment shall be carried out in accordance with IEC 61892-2 [1)] in order to achieve and maintain electromagnetic compatibility between systems.

15.3 Where several systems are grouped in close proximity, they shall be so installed as to be protected from physical damage and interference from adjacent systems during normal and fault conditions.

15.4 Laser systems shall be installed in accordance with IEC 60825-1.

16 Lightning protection

16.1 General

This clause contains provisions for the installation of lightning protection against primary structural damage and secondary damage to electrical systems.

16.2 Protection against primary structural damage

16.2.1 Measures shall be taken to minimise the risks of damage to a unit and its electrical installation due to lightning.

16.2.2 Where protective systems are required they shall include air terminals, down conductors and earth terminations so installed as to minimize the possibility of voltages being induced in electric cables due to the passage of electric currents.

16.2.3 A protective system need not be fitted to a unit of metallic construction, where a low resistance path to earth will be inherently provided by bolted and welded steelwork from the highest point of the unit to earth.

16.2.4 A protective system shall be fitted to any unit of non-metallic construction or having a substantial number of non-metallic members.

16.2.5 Metallic masts and metallic structural members may form part or all of any protective system.

16.2.6 Metal rigging, such as stays, etc., may act as fortuitous down conductors and shall be bonded to the protective system.

16.2.7 Joints in down conductors shall be accessible and be located or protected so as to minimize accidental damage. They shall be made using copper rivets or clamps. Clamps may be of copper or of copper alloy, and shall preferably be of the serrated contact type and effectively locked. No connection shall be dependent on a soldered joint.

16.2.8 Suitable means shall be provided to enable units, when in dry dock or on a slipway, to have their protective systems or metal hull connected to an efficient earth on shore.

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1) In preparation. Before IEC 61892-2 is published, see IEC 60092-201.

16.3 Air terminals

16.3.1 An air terminal shall be fitted to each non-metallic mast.

16.3.2 Air terminals shall be made of copper or copper alloy conducting bar of not less than 12 mm diameter, and shall project at least 300 mm beyond the top of the mast. Other materials may be used, for example stainless steel or aluminium alloys, or steel bars effectively protected against corrosion, subject to the requirement of 16.4.2. The material shall be resistant to sea water.

16.4 Down conductors

16.4.1 Down conductors shall be made of copper, or copper alloy, tapes or cables. Cable is preferred as both the insulation and circular shape inhibit surface discharge. Other materials may be used, for example, stainless steel or aluminium alloys, subject to the requirement of 16.4.2. The material shall be resistant to sea water.

16.4.2 The resistance between air terminals and earth terminals shall not exceed 0,02 Ω.

16.4.3 A flare boom, drilling rig or crane shall be bonded to the main structure. If satisfactory conductance through the structure is not achieved, additional earthing conductors shall be installed where necessary.

16.4.4 Pipes and ventilation ducts shall be interconnected and connected to the main structure at the points where they penetrate it.

16.5 Protection against secondary damage

16.5.1 Equipment shall be so installed as to limit the effect of secondary damage to the electrical system.

16.5.2 Metallic enclosures shall be earthed to the metal structure or hull or to the protective system. Particular attention shall be paid to navigation lights and other equipment at the top of masts and other elevated structures.

16.5.3 Cable screens or armour, though normally earthed for reasons of signal interference, shall not provide the sole lightning path to earth for the equipment. Separate earthing, as required by 16.5.2, shall be provided.

16.5.4 Lightning earth connections to the protective system shall follow the most direct route.

16.5.5 The formation of cable loops, or metallic loops such as pipework, in proximity to down conductors shall be avoided. Cables in close proximity to down conductors shall be installed in metal pipes.

16.5.6 On metal units, cabling along decks shall be installed close to the deck to minimize the cross-sectional area of the loop existing between the cable and the deck. When choosing routes along decks, advantage shall be taken of the screening effect of earthed metallic structures near to or above the cable runs, for example handrails, pipes, etc.

16.5.7 Means shall be provided for the discharging to earth of any lightning energy that may be induced in, for example, radio and navigational equipment antennas. Consideration shall be given to installing devices such as spark gaps or surge diverters to provide protection from voltage transients.

17 Test of completed installation

17.1 General

This clause contains provisions for inspection and test of low- and high-voltage installations. Recommended test voltages and values for insulation resistance are included.

17.2 Inspections and tests

17.2.1 Commissioning procedures and a record of the commissioning shall be documented and carried out in accordance with an established programme.

17.2.2 The commissioning of installations shall be carried out only by experienced personnel whose training has included instruction on the various types of equipment and installation practices, and relevant rules and regulations. Appropriate refresher training courses shall be given to such personnel on a regular basis.

17.2.3 Before new installations, or alterations of, or additions to, an existing installation are put into service, the appropriate inspections and tests specified below shall be carried out.

Test methods and their results shall be recorded.

NOTE 1 – Such inspections and tests should be in addition to, and not in substitution for, the acceptance tests of the individual items of plant at the manufacturer's works; they are intended to indicate the general condition of the installation at the time of completion.

NOTE 2 – Tests which simulate conditions to establish the integrity of the equipment and circuits may be used provided that the effect is the same as in the specified tests and/or conditions.

17.2.4 High-voltage tests

Equipment rated at or above 1 kV a.c. and assembled on-site shall be subject to a high-voltage dielectric test after assembly.

Tests on completed cables, operating at or above 1 kV, shall be carried out in accordance with IEC 60092-350.

17.3 Insulation-testing instruments

The insulation resistance shall be measured, preferably by self-contained instruments such as a direct reading insulation resistance tester, applying an appropriate voltage.

NOTE 1 – When an insulation test is carried out on a circuit incorporating capacitors of a total capacitance exceeding 2 μF, an insulation tester of the constant-voltage type should be used in order to ensure that accurate test readings are obtained.

NOTE 2 – Care should be taken on equipment operating below 60 V and on semiconductor devices to ensure that no damage is sustained due to the application of excessive voltages.

NOTE 3 – Unless specific instructions are given by the equipment manufacturer regarding test voltages, the following values should be used as a guideline:

Nominal voltages d.c. or a.c. r.m.s. V	**Test voltages d.c.** V
≤ 500	500
500 to 1 000	1 000
1 000 to 6 000	2 500
6 000 to 15 000	5 000

17.4 Insulation resistance

17.4.1 Wiring

A test for insulation resistance should be applied to all permanent wiring of communication, lighting and power circuits between all insulated poles and earth and, where practicable, between poles.

NOTE 1 – It is not considered practicable to specify a minimum value for insulation resistance as this will depend on climatic conditions at the time of the test. However, a minimum value of 1 MΩ between each conductor and earth should be obtained under average conditions on circuits operating at a nominal voltage of 50 V and above up to 400 V, and not less than 0,3 MΩ for circuits operating at a nominal voltage below 50 V.

NOTE 2 – For nominal voltages above 400 V the minimum insulation resistance should be not less than:

$$\frac{\text{Nominal voltage}}{1\,000} + 1{,}0\ \text{M}\Omega$$

NOTE 3 – The installation may be subdivided to any desired extent and appliances may be disconnected if initial tests give results lower than those indicated above.

17.4.2 Generators and motors

The insulation resistance of generators and motors shall be measured on-site.

NOTE 1 – If possible, the insulation resistance should be measured in warm condition immediately after a running with normal load.

NOTE 2 – The results obtained depend not only on the characteristics of the insulation materials and on the way in which they are applied, but also on the test conditions. It is therefore necessary that the measured values be completed by recording these conditions, particularly those concerning the ambient temperature and the degree of humidity at the time of the test.

17.4.3 Switchboards, section boards and distribution boards

Before switchboards, section boards and distribution boards are put into service, their insulation resistance shall be not less than 1 MΩ when measured between each busbar and earth and between each insulated busbar and busbars connected to the other pole(s) .

NOTE – The installation may be subdivided to any desired extent and appliances may be disconnected if tests give results lower than those set out in notes 1 and 2 of 17.4.1.

17.5 Generators

All generating sets shall be run at rated load for a sufficient time to demonstrate that the commutation, electrical characteristics, overspeed trips, governing, range of excitation control, lubrication and vibration level are satisfactory. If sets are intended to operate in parallel, they shall be tested over a range of loading sufficient to demonstrate that load sharing and parallel operation are satisfactory. Voltage and speed regulation when the load is suddenly thrown on and taken off shall be satisfactory (see IEC 61892-3).

17.6 Switchgear

All switchgear shall be loaded as nearly as practicable to its working load in order to ensure that no overheating takes place owing to faulty connections, incorrect rating or alternative tests and measurements taken. Switches and circuit-breakers shall be operated to test their suitability.

NOTE 1 – Full load tests may not always be possible. Thermographic tests may be considered as an alternative.

NOTE 2 – Prior to commencing tests of protective devices, their size, type and ratings should be checked against the design. The operation of protective relays and devices should be effectively demonstrated, which may be achieved by the use of suitable injection techniques. Direct acting overcurrent relays can only be tested by primary injection methods but secondary injection may be acceptable elsewhere when the associated current transformers and circuitry should also be tested.

17.7 Lighting, heating and galley equipment

All electrical devices and circuits shall be tested under operating conditions to ensure that they are suitable and satisfactory for their purpose.

17.8 Communication systems

Each communication system shall be thoroughly tested to determine its suitability and to verify its specified functioning, which includes engine-order telegraphs, and similar signal or alarm systems.

17.9 Emergency and safety systems

Particular attention shall be paid to the testing of the unit emergency communication systems, including ESD-systems and fire and gas detection systems.

17.10 Earthing

Tests shall be performed to verify that all earth-continuity conductors and earthing leads are connected to the frame of the equipment and to the hull, and that in socket-outlets that have earthing contacts, these are connected to hull or structure.

17.11 Voltage drop

Measurements shall be taken to verify that the allowable voltage drop has not been exceeded (see IEC 61892-1 [1)]).

17.12 Requirements of International Convention on Safety of Life at Sea (SOLAS)

Equipment installed to implement the international conventions in force shall be specially tested to ensure that all requirements have been met. Where equipment is required to be supplied from electrical emergency sources of power, it shall be tested for correct operation from such sources and for the required duration, as specified.

18 Documentation

18.1 General

This clause contains provisions for documentation concerning the compliance of the installation with the regulations of the appropriate authority, including documentation of preservation procedures and records, record of tests and maintenance procedures.

Installation shall be carried out in compliance with the detailed design and installation documents and to the satisfaction of the appropriate authority.

After installation, these documents shall incorporate all the variations made during the construction of the unit.

It shall be documented, by means of an installation contractor's declaration, that all equipment, cables, etc. have been installed in accordance with the procedures and guidelines issued by the manufacturer of the equipment, cables, etc., and that the installation has been carried out in accordance with this standard.

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1) In preparation. Before IEC 61892-1 is published, see IEC 60092-101.

18.2 Equipment

18.2.1 Instructions for the preservation of equipment during the construction period shall be provided.

18.2.2 All the equipment or systems of the unit shall be delivered with detailed instructions for the installation and correct operation, together with information about the periodic checks and maintenance.

Particular attention shall be paid to the emergency, safety and alarm systems.

18.3 Testing

Before entering operation, each equipment or system shall be tested according to the relevant test procedure.

A record of these tests shall be kept to compare with the results obtained during the periodical checks and maintenance.

18.4 Maintenance

Maintenance procedures and records for electrical equipment shall be documented, together with a recommended programme. Such a programme shall ensure the continued suitability of the equipment for the application.

Annex A
(informative)

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SOLAS, Chapter II-1 and II-2

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nearly ❑
fairly well ❑
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standard is too academic ❑
standard is too superficial ❑
title is misleading ❑
I made the wrong choice ❑
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