BS IEC 61892-6:2013

BSI Standards Publication

Mobile and fixed offshore units — Electrical installations

Part 6: Installation

National foreword

This British Standard is the UK implementation of IEC 61892-6:2013. It supersedes BS IEC 61892-6:2007 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee JPEL/18, Electrical installations of ships and of mobile and fixed offshore units.

A list of organizations represented on this committee can be obtained on request to its secretary.

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MOBILE AND FIXED OFFSHORE UNITS – ELECTRICAL INSTALLATIONS –

Part 6: Installation

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of 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, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). 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. 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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International Standard IEC 61892-6 has been prepared by IEC technical committee 18: Electrical installations of ships and of mobile and fixed offshore units.

This third edition cancels and replaces the second edition published in 2007. This edition constitutes a technical revision.

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

a) Table 1, size of earth continuity conductors has been replaced with the table in IEC 61892-4.
b) The requirements for installation of batteries has been rewritten in order to distinguish better between batteries of the vented type and VRLA/sealed type.
c) An informative annex regarding cable termination has been added.

d) The applicability for DC installations has been increased from 750 V to 1 500 V, in accordance with Part 1 of the series.

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

FDIS	Report on voting
18/1351/FDIS	18/1360/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.

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

A list of all parts of the IEC 61892 series, under the general title *Mobile and fixed offshore units – Electrical installations*, can be found on the IEC website.

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

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

INTRODUCTION

The IEC 61892 series of International Standards is 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 series 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.

MOBILE AND FIXED OFFSHORE UNITS – ELECTRICAL INSTALLATIONS –

Part 6: Installation

1 Scope

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

It applies to all installations, whether permanent, temporary, transportable or hand-held, to AC installations up to and including 35 000 V and DC installations up to and including 1 500 V (AC and DC voltages are nominal values).

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

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60092-350:2008, *Electrical installations in ships – Part 350: General construction and test methods of power, control and instrumentation cables for shipboard and offshore applications*

IEC 60447, *Basic and safety principles for man-machine interface, marking and identification – Actuating principles*

IEC 60623, *Secondary cells and batteries containing alkaline or other non-acid electrolytes – Vented nickel-cadmium prismatic rechargeable single cells*

IEC 60825 (all parts), *Safety of laser products*

IEC 60896-11, *Stationary lead-acid batteries – Part 11: Vented types – General requirements and methods of tests*

IEC 61892-1, *Mobile and fixed offshore units – Electrical installations – Part 1: General requirements and conditions*

IEC 61892-2:2012, *Mobile and fixed offshore units – Electrical installations – Part 2: System design*

IEC 61892-3, *Mobile and fixed offshore units – Electrical installations – Part 3: Equipment*

IEC 61892-4:2007, *Mobile and fixed offshore units – Electrical installations – Part 4: Cables*

IEC 61892-7, *Mobile and fixed offshore units – Electrical installations – Part 7: Hazardous areas*

ISO 8468, *Ships and marine technology – Ship's bridge layout and associated equipment – Requirements and guidelines*

SOLAS 1974 *International Convention for the Safety of Life at Sea, Consolidated edition 2009*

IMO, MODU code, *Code for the construction and equipment of mobile offshore drilling units*

IMO, *Code on Alerts and Indicators, 2009*

3 Terms and definitions

For the purposes of this document the terms and definitions given in IEC 61892-1 as well as the following apply.

3.1
battery compartment
compartment comprising dedicated rooms, dedicated lockers and dedicated boxes for installation of batteries

3.2
equipotential bonding
provision of electric connections between conductive parts, intended to achieve equipotentiallity

[SOURCE: IEC 60050-195:1998, 195.01.10]

3.3
cable tray system
cable ladder system
assembly of cable supports consisting of cable tray lengths or cable ladder lengths and other system components

[SOURCE: IEC 61537:2006, 3.1]

3.4
surface heating
trace 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
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 1 to entry: Typical exposed conductive parts are walls of enclosures, operating handles, etc.

[SOURCE: IEC 60050-441:1984, 441.11.10]

3.6
extraneous-conductive-part
conductive part not forming a part of the electrical installation and liable to introduce an electric potential, generally the potential of a local earth

[SOURCE: IEC 60050-195:1998, 195.06.11]

3.7
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

EXAMPLE Units of non-metallic construction or those having substantial non-metallic members.

3.8
extra-low voltage
ELV
voltage which does not exceed 50 V AC r.m.s. between conductors, or between any conductor and earth

Note 1 to entry: 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 converter is operated at its rated supply voltage.

Note 2 to entry: Information about protection by extra-low voltage is given in IEC 60364-4-41.

3.9
sealed cell
cell which remains closed and does not release either gas or liquid when operated within the limits specified by the manufacturer

Note 1 to entry: A sealed cell may be equipped with a safety device to prevent a dangerously high internal pressure and is designed to operate during its life in its original sealed state.

[SOURCE IEC 60050-482:2004: 482.05.17)

3.10
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

Note 1 to entry: 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.

3.11
superstructure
any additional structure which is above a baseline

EXAMPLE Hull.

3.12
support device
system component designed to provide mechanical support and which may limit movement of a cable runway

[SOURCE: IEC 61537:2006, 3.7]

3.13
system component
part used within the system as cable tray length or cable ladder length, cable tray fitting or cable ladder fitting, support device, mounting device and system accessory

Note 1 to entry: System components may not necessarily be included together in a system. Different combinations of system components may be used.

[SOURCE: IEC 61537:2006, 3.2]

3.14
valve regulated lead acid battery
VRLA
secondary battery in which cells are closed but have a valve which allows the escape of gas if the internal pressure exceeds a predetermined value

Note 1 to entry: The cell or battery cannot normally receive addition to the electrolyte.

Note 2 to entry: This note applies to the French language only.

[SOURCE IEC 60050-482:2004, 482.05.15]

3.15
vented cell
secondary cell having a cover provided with an opening through which products of electrolysis and evaporation are allowed to escape freely from the cell to the atmosphere

[SOURCE: IEC 60050-482:2004, 482.05.14]

4 General requirements

4.1 Labelling

Each 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.

4.2 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.

The labels shall be engraved or embossed on plastic-laminated or metallic material and be permanently fixed.

If other fixing means than screws or rivets are used, they shall provide an equivalent level of reliability.

4.3 Protection from condensation

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

4.4 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.

5 Equipment earthing and bonding

5.1 General

5.1.1 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 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.

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.

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

For the definition of IT- and TN-S system, and requirements to earthing of system neutral points, see IEC 61892-2.

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

5.1.2 Earth bars, when provided, shall be easily accessible for usage, inspection and maintenance. All earthing bars and terminals shall be visible and possible to be checked also after termination of cables. Separate connections shall be used for each individual earth conductor.

5.2 Earthing of exposed conductive parts

5.2.1 Unless specifically included in the following exemptions, all exposed conductive parts shall be earthed.

Exemption:

– lamp caps;
– shades, reflectors and guards, supported on lampholders or luminaires constructed of, or shrouded in, non-conducting material;
– metal parts on non-conducting material, 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 supplementary insulation (see IEC 61892-1) 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.

5.2.2 Metal parts of portable appliances, other than current-carrying parts and parts exempted in 5.2.1, 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.

Table 1 – Sizes of earth continuity conductors and equipment earthing connections

Arrangement of earth conductor		Cross-section *Q* of associated current-carrying conductor (one phase or pole) mm^2	Minimum cross-section of earth conductor
1	i) Insulated earth conductor in cable for fixed installation. ii) Copper braid of cable for fixed installation according to 4.8 of IEC 60092-350:2008. iii) Separate, insulated earth conductor for fixed installation in pipes in dry accommodation spaces, when carried in the same pipe as the supply cable. iv) Separate, insulated earth conductor when installed inside enclosures or behind covers or panels, including earth conductor for hinged doors.	$Q \leq 16$	Q
		$Q > 16$	50 % of the current-carrying conductor, but not less than 16 mm^2
2	Uninsulated earth conductor in cable for fixed installation, being laid under the cable's armour or copper braid and in metal-to-metal contact with this.	$Q \leq 2,5$	1 mm^2
		$2,5 < Q \leq 6$	1,5 mm^2
		$Q > 6$	Not permitted
3	Separately installed earth conductor for fixed installation other than specified in 1 iii) and 1 iv).	$Q < 2,5$	Same as current-carrying conductor subject to min. 1,5 mm^2 for stranded earthing connection or 2,5 mm^2 for unstranded earthing connection
		$2,5 < Q \leq 120$	50 % of current-carrying conductor, but not less than 4 mm^2
		$Q > 120$	70 mm^2
4	Insulated earth conductor in flexible cable.	$Q \leq 16$	Same as current-carrying conductor
		$Q > 16$	50 % of current-carrying conductor, but minimum 16 mm^2
Refer also to 4.3.1 of IEC 61892-4:2007 for method based on rating of fuses or circuit protective device. For earthed distribution systems, the size of the earthing conductor is to be not less than 50 % of the phase conductor, with a minimum of 4 mm^2.			

5.2.3 Secondary windings of instrument transformers shall be earthed.

5.2.4 The earthing 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.

5.3 Equipotential bonding

5.3.1 Extraneous-conductive-parts shall be connected to the equipotential bonding system as described in 5.4.

5.3.2 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 5.4.

5.3.3 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 5.3.2.

Enclosures of high-voltage equipment located in hazardous areas shall be connected to PE and bonded to the main structure.

5.4 Bonding connections

5.4.1 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.

5.4.2 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.

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

5.5 Connections to the unit structure

5.5.1 The bonding shall be achieved by means of a separate bonding conductor unless the parts under consideration are installed in accordance with 5.3.2.

5.5.2 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.

5.5.3 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.

5.5.4 To minimize shock from high-frequency voltage induced by the radar and/or radio transmitter on another ship, handles, handrails, etc., made of metal shall be in good electrical connection with the hull or superstructure.

5.6 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.

5.7 Metal coverings of cables

5.7.1 All metal coverings of cables shall be earthed at both ends, except in so far as the provisions given for single-core cables for AC wiring apply (see 6.2). Single-point earthing is admitted for final sub-circuits (at the supply end) and in those installations (control and instrumentation cables, intrinsically safe circuits, control circuits, etc.) where it is required for technical or security reasons, if any.

To avoid sparking, any power and lighting circuit or final sub-circuit shall have the metal covering of cable earthed at equipment side when installed in hazardous area.

5.7.2 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.

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

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

5.7.5 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.

5.7.6 Metallic covering of cable and conduits, may be earthed by means of clamps or clips of corrosion-resistant and galvanically compatible metal, making effective contact with the metallic covering and earthed metal.

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

5.7.8 Instrument cables without armour shall normally have the screen earthed at both ends. If the screen is earthed in one end only, this should be at the supply end.

An evaluation shall be made regarding the need for earthing in one or both ends of the armour/screen in relation to the required suppression of the frequency band.

5.7.9 Instrument cables with armour shall have screen and armour insulated from each other with the screen earthed at the supply end 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 field instrument side or, in the case of intrinsically safe circuits, in accordance with 5.7.10.

An evaluation shall be made regarding the need for earthing in one or both ends of the armour/screen in relation to the required suppression of the frequency band.

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

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.

5.8 Cable racks and cable trays

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, unless cable ladder, rack or tray is insulated from the steel structure or hull to prevent galvanic corrosion. In these cases bonding shall be carried out as required in 5.4.

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

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.

In order to achieve good earth connection of the HVAC ducts and any vessels which are not seam-welded to the structure, a bonding conductor of at least 6 mm^2 is required. For ventilation ducts located such that the chance for a lightning strike has to be considered, a bonding conductor with a cross sectional are of 35 mm^2 shall be used.

6 Cables and wiring

6.1 General

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

6.2 Installation

All cables shall be routed on cable ladders or trays.

Cables for high voltage, low voltage, control and instrumentation shall not be installed on the same cable ladders or trays. Where insufficient space makes this impossible, cables for low voltage, control and instrumentation may be installed on the same tray, but not in the same cable bunch.

A partition separator made of the same material as the cable tray should be installed on the tray or ladder if different types of cables are installed on the same tray or ladder.

Cable ladders installed horizontally shall have sufficient space to facilitate cable pulling and cleating/strapping, minimum 300 mm free space between top of one ladder edge to bottom of next ladder edge, and from top ladder edge to roof.

NOTE 1 Guidance can be found in IEC 60533 and IEC/TR 62482.

Trunking or conduits may be used for special mechanical protection of single field routed cables for shorter distances (maximum 5 m). Where conduits are used, they shall be installed with open ends.

Access for maintenance and an orderly layout shall be ensured. This is also valid when cables are installed below raised floor.

Once a cable has been cut, a protective cap/sealing shall be applied on the end, when being exposed to humid atmosphere.

All cable entries to equipment located outdoors, or in areas subject to fire fighting by water and in wash down areas shall be from below. Side entry may be used provided the cable is installed with a drip nose.

Sufficient cable spare length shall be provided for equipment that needs future adjustments (floodlights, loudspeakers, etc.) or where equipment has to be dismounted for maintenance and calibration without disconnecting the cable.

Single core cables for three-phase AC shall run in trefoil formation. All cables shall have the same length. The length of lay is to be equal for all cables. The braided armour shall be earthed in one end only. For equipment installed in hazardous areas, the braid shall be earthed at the hazardous end. When using single core cables, additional cables for earthing have to be installed.

When multiple cables in parallel are used, three-core cables are preferred. If three core cables are not used, the recommended arrangement for installation of single core cables is given in Figure 1 and Figure 2.

NOTE 2 Symmetrical 3-core cables ensure better current balance between the cables than the use of single core cables.

Single core cables shall not be installed separately through openings surrounded by magnetic materials. Non-magnetic stainless steel separation walls and stay plates shall be used in multi cable transits utilised for single core cables.

All cables shall be marked for easy identification, at least on each end. The marking should indicate type of cable, i.e. high voltage, low voltage, control/instrumentation and consumer.

The minimum permissible bending radius is given in 4.15, Tables 9 and 10 of IEC 61892-4:2007.

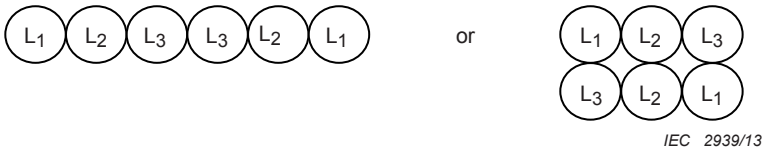


Figure 1 – Recommended arrangement for installation of single core cables – flat configuration

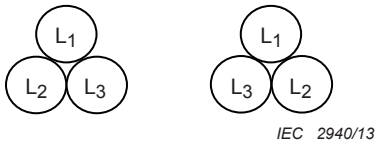


Figure 2 – Recommended arrangement for installation of single core cables – trefoil configuration

6.3 Cable-runs

Cable-runs shall be selected so as to avoid action from condensed moisture or dripping water. Cables shall, as far as possible, be routed out of, or far away from fire risk zone or fire risk equipment, be remote from sources of heat and protected from avoidable risks of mechanical damage.

In the case of essential electrical equipment for which it is mandatory to have at least two supplies, the supply and any associated control cables shall follow different routes, which shall be separated both vertically and horizontally as far as practical.

Cable-runs subject to green water (seawater waves boarding on the deck) shall be securely protected by pipes or equivalent.

6.4 Cable cleating and strapping

Stainless steel straps shall be used for all runs outside, in non-ventilated areas, or for horizontal runs in the vertical plane indoors. When cut, no sharp ends shall be left in cutting end.

Plastic straps may be used for horizontal runs indoors.

Where cables are run on the underside of ladders or trays, or otherwise such that the cables could be released in a fire, stainless steel straps shall be used.

For strapping of fibre-optical and coaxial cables, supplier guidelines shall be adhered to.

The distance between supports shall be chosen according to the type of cable and the probability of vibration. It shall not exceed 400 mm for a horizontal cable run where the cables are laid on cable supports in the form of tray plates, separate brackets or hanger ladders. The spacing for the cable retention device may be up to 900 mm, provided that there are supports with maximum spacing as specified above.

Trefoil cable cleats for single core power cables shall be approved for the potential short circuit stress. Outdoors, in naturally ventilated areas and wash down areas the cleats shall be made of stainless steel, AISI 316L or AISI 316.

The distance between trefoil cleats for single core cables shall be as specified by the cable manufacturer based on the calculated short circuit level.

6.5 Joints and tappings

Cable runs shall not normally include joints (splices). If, in the case of repair or sectional construction of the unit, a joint is necessary, the joint shall be of such a type that electrical continuity, insulation, mechanical strength and protection earthing and fire-resisting or flame-retardant characteristics are not less than those required for the cables.

Tappings (branch circuits) shall be made in enclosures of such design that the conductors remain adequately insulated and protected appropriate to the current rating.

Joints and tappings shall be clearly marked to identify the cable(s) and core(s).

For splicing of cables in hazardous areas, see IEC 61892-7.

6.6 Cable ends

Cable glands/blanking and drain plugs shall be of a material which is compatible with the material used in the enclosure.

Recommended types of cable glands are given in Table 2.

Table 2 – Enclosure-gland type

Type of enclosure	Type of gland
Plastic enclosures (relevant for field cables)	Plastic for size below M32
Plastic enclosures, reinforced with a metal gland plate for support of large supply- and multi-core cables	Brass
Metal enclosures (except aluminium)	Brass/stainless steel
Aluminium enclosures	Stainless steel/nickel plated brass
Only sea water resistant aluminium shall be used. Plastic glands shall not be used for armoured cables. For cable glands for explosion protected equipment, see IEC 61892-7. Shrouds and similar shall not be used on cable glands.	

6.7 Cable termination

Cable glands shall be installed in a manner such that the IP protection of the enclosure is maintained.

If an additional clamping is required to prevent pulling and twisting of the cable transmitting the forces to the conductor terminations inside the enclosure, a clamp shall be provided, as close as practicable to the gland along the cable.

Cable clamps within 300 mm of the end of the cable gland are preferred.

Cables shall be routed straight from the cable gland to avoid lateral tension that may compromise the seal around the cable.

When braided or armoured cables have been terminated within the cable gland, the body components that are intended to retain and secure the cable braid or armour should not be able to be released manually or opened by hand without the use of a tool.

Cables with braid armour shall have outer additional insulation, e.g. a sleeve, which is fitted over the complete cable make-off.

Instrument and telecommunication cables with both braid armour and screen shall have inner and outer additional insulation. The outer insulation shall be fitted over the complete cable make-off.

When “through-type” cable glands are used the inner insulation shall be drawn over the inner cable sheath, i.e. passed under the braiding providing insulation between braiding and screen.

See Figures B.1 to B.5.

The inner sleeve may be excluded at terminations providing a minimum of 50 mm inner sheath.

Where the screen shall be left disconnected (applicable for field instrument) it shall be sealed and isolated with an isolating cap, which allows for insulation testing without any disconnecting.

To minimize the extent of hot work, sleeves of type self-vulcanizing tape may be used on units in operation.

High-voltage cables shall be fitted with compression lugs, unless another termination type is specified.

All cable conductors shall be terminated by use of compression lugs or ferrules dependent upon the type of termination, unless the terminal is of a type designed to be used without ferrules. The compression ferrule should be the type where the conductor strands are inserted through the whole ferrule and reach the bottom of the terminal.

Support for cleating of cables when entering panels should be provided.

In switchboards and distribution boards, adequate space shall be provided for the use of a clip-on ampere meter without causing undue stress on the cable conductors or connections.

The braid armour and the screen shall be separated from each other as well as from the conductors and fitted as required. This shall be done without any reduction of the cross sectional area. The connection should, by preference, be with a 360° connection. Pigtails should be avoided.

Only one conductor shall be connected to each terminal of a terminal block/row for external connections. This is not related to terminals approved for two conductors for internal components (e.g. relays, contactors).

Spare conductors in instrument and telecom cables shall be isolated at the field and connected to IE or IS earth (instrument or intrinsically safe earth) at the source end.

In cabinets all spare conductors shall be marked with a terminal number and connected to terminals linked together by solid terminal links, which shall be connected to the relevant earth bar.

Spare cores in instrument and telecom cables shall be connected to IE (instrument earth) in supply end only.

If there are no spare terminals left in the cabinet, all spare conductors shall be covered with yellow/green sleeves and marked with relevant cable number and connected directly to the relevant earth bar.

6.8 Cable ladders and trays

Cable support systems located outdoors, in natural ventilated areas and wash down areas should be made of stainless steel, AISI 316L (recommended) or AISI 316. For indoor ventilated areas cable support systems made of galvanized carbon steel may be used.

If supports and cable trays or cable ladders are not of the same material, precautions regarding risk of corrosion shall be considered.

AISI 316L/316 is suitable for a lifetime of approximately 30 years. For installations designed for a substantially shorter lifetime, other materials can be used.

When support devices are of different material from the material used in ladders or trays, and insulation is used between the ladders and/or trays to avoid galvanic corrosion, the need for bonding conductor(s) in order to ensure electrical continuity should be considered.

Aluminium or fibreglass cable support system can be considered with the necessary precautions regarding mechanical strength and requirement for installation in hazardous area.

Cable protection shields shall be made of the same material as the cable support system in the area.

Maximum distance between the supports for cable ladders and trays shall be as specified by the supplier.

NOTE Typical support distance is every 3 m.

All surfaces shall be cleaned prior to bolting together.

Support devices shall be located to leave sufficient space for surface protection of adjacent structure.

In offices and living quarters where multidiscipline socket outlets are grouped together, multipurpose cable channels designed for recessed installed outlets should be used.

Kick plate shall be fitted around penetrations in floor where cables/tubing are exposed to mechanical damages.

Protection shield shall be installed where cables can be exposed to physical damages, minimum 500 mm above the floor.

Cable tray systems and cable ladder systems shall be protected from danger of dropped object and crane handling or similar.

6.9 Cables and wiring for interconnection of equipment

Cables external to an enclosure shall comply with the requirements of IEC 61892-4.

Consideration shall only be given to cables of smaller sizes than allowed for in IEC 61892-4 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 and safety of the system of which they form a part.

7 Generators and motors

7.1 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.

7.2 Installation

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

Regarding requirements for lubrication, see IEC 61892-3.

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

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.

8 Transformers

8.1 Installation and location

8.1.1 Transformers shall be installed in sufficiently 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.

Transformers may be installed outdoor provided the transformer has a suitable IP degree of protection.

Regarding types of transformers, see IEC 61892-3.

8.1.2 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 detection and extinguishing equipment and thermal and structural class A subdivision.

8.1.3 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.

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

8.1.5 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.

8.1.6 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.

8.2 Isolation of windings

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

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

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

9 Switchgear and controlgear assemblies

9.1 Location

9.1.1 Switchgear and controlgear assemblies shall be installed in easily accessible and well-ventilated locations where high humidity, 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.

Power distribution switchgear assemblies shall have enough free space above to allow hot gasses expansion from arc generated by short-circuit or circuit-breaker opening, according to manufacturer’s recommendation. In this space the installation of HVAC ducts, cable ladders and any other obstructions shall be avoided.

In addition to complying with the appropriate requirements of IEC 61892-1, 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. In addition a drip pan shall be installed for protection of the switchgear and controlgear.

9.1.2 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.

9.1.3 Doors to rooms containing high-voltage switchboards shall be marked with suitable warning signs.

9.2 Insulating mats

When the voltage exceeds the extra-low 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 accessible. The insulating mat or grating shall be oil-resistant and non-slip.

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

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

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

See IEC 61111 regarding insulation mats.

9.3 Passageways in front of switchgear and controlgear assemblies

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

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.

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

9.4 Space at the rear and passageways

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

Passageways and corridors formed between switchboards line-ups should have escape way at both ends when longer than 6 m.

Doors to high voltage rooms shall be lockable. They shall open outwards from the room. They should be equipped with a manual panic device that can be opened at all time from the interior, e.g. a vertical bar or push-button operated device that is operable from inside the room by the use of the knee, elbow or other part of the body, also by a person who is crawling.

9.5 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.

10 Semiconductor converters

10.1 Where semiconductor converter 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 converter stacks does not exceed the ambient temperature for which the stacks are specified.

10.2 Converter stacks and associated equipment shall not be mounted near sources of radiant heat energy, such as resistors, steam pipes and engine exhaust pipes.

10.3 For liquid cooled type converters, the same installation precautions as specified in Clause 8 for liquid-cooled transformers apply.

11 Secondary cells and batteries

11.1 Location

11.1.1 Secondary cells and batteries shall be arranged to permit ready access for replacing, inspection, testing, replenishing and cleaning. They 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.

The secondary cells and batteries shall be grouped in crates or trays of rigid construction and suitable material, equipped with handles to facilitate handling. Lead shall not be used.

The number of cells in a crate will depend on the weight and on the space available in the installation. The mass of crates or trays should preferably not exceed 100 kg. This requirement does not apply to cells whose mass is such that grouping in crates or trays is impracticable.

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, flooding, spillage or any other casualty which may give limitation for offshore operation, (in accordance with the MODU Code).

Batteries shall not be installed in hazardous area locations, except in rooms considered hazardous area solely by the presence of the batteries themselves. Batteries shall be located so that the vapours generated from the batteries cannot harm surrounding appliances.

Battery bank assemblies inside chargers or UPS enclosures should be avoided due to corrosive vapours and possible release of hydrogen.

The best operating conditions for a battery are obtained when the ambient temperature is within the range 15 °C to 25 °C. Sustained ambient temperature outside this range will affect secondary battery performance and will therefore require special consideration.

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

11.1.2 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 given in Tables 3 and 4.

Table 3 – Location of batteries versus charging power – vented cell type

Charging power	Location
Power above 2 kW	A dedicated battery room
Power between 0,2 kW and 2 kW	A dedicated battery room or a dedicated battery locker
Power below 0,2 kW	A dedicated battery room or a dedicated battery locker or battery box
When two or more batteries are grouped in the same room, locker or box, the sum of output power of all charging devices shall be considered. For ventilation requirements for battery rooms see IEC 61892-7.	

Table 4 – Location of batteries versus charging power– VRLA or sealed cell type

Charging power	Location
Power above 20 kW	A dedicated battery room
Power between 2 kW and 20 kW	A dedicated battery room, a dedicated battery box or open battery stand in an equipment room
Power between 0,2 kW and 2 kW	A separate battery room, a dedicated battery box or a dedicated part of an electrical assembly
Power below 0,2 kW	A dedicated battery room, a dedicated battery box or a dedicated part of an electrical assembly or inside an electrical assembly
When two or more batteries are grouped in the same room, locker, box or inside an electrical assembly, the sum of output power of all charging devices shall be considered. The above criteria are valid when the requirements of 11.6 are complied with. Otherwise, the requirement of Table 3 should be considered. For ventilation requirements for battery rooms see IEC 61892-7.	

11.1.3 When a dedicated battery room, battery locker or battery box is required, only batteries and related equipment is allowed in the room/locker/box.

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

11.1.5 Secondary cells and batteries (with the exception of valve regulated type batteries with recharging power below 4 kW) shall not be placed in accommodation, office and control room areas.

11.1.6 Ventilated lead-acid batteries and alkaline secondary batteries shall not be placed in the same battery box or battery locker. When different electrolyte type batteries are located in the same room, precautions and warning labels shall be installed to avoid mixing of maintenance tools, electrolyte and topping up water.

11.1.7 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.

11.2 Electrical installation in secondary battery compartments

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.

Due to the risk of corrosion only equipment essential for the use of the battery room shall be installed inside the room, when a separate battery room is used. For requirements with respect to explosion protection of equipment inside the room, see IEC 61892-7.

11.3 Protection against corrosion

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 glass fibre for lead acid, steel for alkaline secondary batteries.

Alternatively, the floor of battery compartments may be lined with impermeable and 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 or ceramic floor.

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 0,8 mm if made of steel. Exterior surfaces of metal shelves should have at least an electrolyte-resistant coating.

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

11.4 Fixing and supports

Where movement is possible, in floating units for example, 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.

The distance between valve regulated lead acid cells or monobloc batteries should be not less than 5 mm.

11.5 Protection of circuits from secondary batteries

Appropriate circuit breakers or switches shall be provided to disconnect the battery installation from all lines of incoming and outgoing circuits and from earth potential.

For special applications, e.g. starting batteries for emergency generators or fire pump engines, protective devices may be omitted. The conductors from the batteries shall then be installed so as to be adequately protected against short-circuits and earth faults and as short as possible. This requirement can be met by using for example single-core double-insulated cables. (See 4.3.1 e) of IEC 60092-350:2008).

11.6 Additional requirements for valve regulated lead acid (VRLA) type batteries

VRLA batteries shall be designed for operation in a nominal ambient temperature of 25 °C.

VRLA type batteries should be installed in conditioned rooms with recommended average temperature between 20 °C to 25 °C, except for short periods of time operating in a different temperature range, to avoid lifetime shortening and thermal avalanche effect.

VRLA batteries shall have a charger with cell temperature compensation floating charge and shall not have boosting charge mode.

VRLA battery chargers shall have less than 1 % current ripple.

Sealed or VRLA type batteries should not be used for diesel engine starting, like emergency generators or fire pumps.

The VRLA type of batteries is not suitable for rapid, high cycle discharging and recharging.

11.7 Protection against electric shock

Measures shall be taken in stationary battery installations for protection against direct contact and indirect contact or both. Battery assemblies shall have insulated caps for each pole and connector.

Protection by obstacles or by placing out of reach is expressly permitted in battery installations. It requires however that batteries with nominal voltages from 60 V DC to 120 V DC between terminals and/or with nominal voltages from 60 V DC to 120 V DC with respect to earth shall be located in boxes or cabinets with restricted access, and batteries with a nominal voltage above 120 V DC shall be located in locked cabinets or rooms with restricted access. Doors to battery rooms and cabinets are regarded as obstacles and shall be marked with the warning labels according to 11.8.

If protection by barriers or enclosures is applied, a degree of protection at least IP 2X or IPXXB according to IEC 60529 should at least be used.

A nominal touch voltage of 120 V DC should not be exceeded for direct and indirect contact (see IEC 61201).

Metallic boxes and metallic fixing supports shall be earthed.

Batteries with nominal voltages up to or equal 60 V DC do not require protection against direct contact, as long as the whole installation corresponds to the conditions for SELV (safety extra low voltage) or PELV (protective extra low voltage).

NOTE Further guidance is given in IEC 61140.

11.8 Identification labels or marking

The identification label or marking shall be durably fixed on each battery assembly unit and shall include the information as required in IEC 60896-11 and IEC 60623.

Each crate or tray shall be provided with a durable nameplate securely attached, bearing the manufacturer's name, the ampere-hour rating at a specific rate of discharge (preferably the one corresponding to the duty for the specific application), the voltage and the specific gravity of the electrolyte (in the case of a lead acid battery, the specific gravity when the battery is fully charged).

The nameplate shall also include reference to the systems supplied by the batteries, e.g. by using cell and battery number, tag number, identifying manufacturer and type, nominal battery voltage, capacity, electrolyte type and other relevant information.

At least the positive terminal shall be clearly identified, either by a red washer or by an indented or raised symbol.

12 Luminaires

12.1 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.

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

Floodlights shall be provided with an extra safeguarding against falling down if the screwed connections loosen.

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

12.2 Emergency and escape lighting

Emergency lights and escape light fixtures shall be marked for easy identification. There shall be a clear difference between the two types.

The escape lights should, unless otherwise required, to the extent possible be located at a low level in confined spaces.

NOTE For explanation of the difference between emergency and escape lighting, see 11.3 and 11.4 of IEC 61892-2:2012.

12.3 Navigation aid system

Navigation aid system shall be installed as required by the appropriate authority.

NOTE For guidance, see IALA, International Association of Marine Aids to Navigation and Lighthouse Authorities, Recommendation O-1239, on the Marking of Man-Made Offshore Structures, 2008.

13 Heating and cooking appliances

13.1 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.

13.2 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.

13.3 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.

14 Trace and surface heating

14.1 General

Trace heating cables shall be strapped to equipment and pipes using glass fibre tape or another method in accordance with the manufacturer’s recommendation.

Further information can be found in IEC 60519-10 and IEC 62395-2.

14.2 Trace heating cables

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.

For splicing of trace heating cables, manufacturer's splicing kit, or instructions issued by the manufacturer shall be used.

14.3 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.

14.4 Protection

The metallic braid of the heating cable shall be connected to the earthing system so as to provide an effective earth path.

Trace heating cables shall have earth fault protection.

14.5 Requirements for installation in hazardous areas

The electrical trace heating system shall be installed in hazardous locations in accordance with the requirements of IEC 61892-7.

14.6 Mechanical protection

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

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

14.7 Junction boxes

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

15 Control and instrumentation

15.1 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.

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 1974 Chapter II-1, Regulations 15, 16, 17, 21 and Chapter II-2.

15.2 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 bridge control room shall meet the requirements of ISO 8468.

15.3 Display colours

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

NOTE Further information can be found in IEC 60073.

15.4 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 the 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.

15.5 Sensors

15.5.1 Location of sensors

All sensors shall be located such that their output is a realistic measure of the parameter. Sensors shall be installed in places where there is minimal risk of damage during operation, normal overhaul and maintenance.

15.5.2 Temperature sensors

Temperature sensors shall be installed in pockets of suitable material. Connections shall be arranged so as to permit withdrawal for testing purposes.

15.5.3 Pressure sensors

Pressure sensors exposed to shocks and strong vibration in their working medium shall be protected by damping chambers.

15.5.4 Enclosure

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

15.5.5 Testing and calibration

Facilities shall be provided for testing and calibration of sensors which cannot be tested during normal operational conditions.

15.6 Measurements and indications

15.6.1 Instrument similarity

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

15.6.2 Scale division

Scales shall be divided to avoid the need for interpolation.

15.6.3 Automatic control sequence

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

15.6.4 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.

15.7 Controls

15.7.1 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 requirements, see IEC 60447.

15.7.2 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.

15.7.3 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.

15.8 Alarm system

The acoustic and optical signals and indications used in alarm systems shall meet the requirements of IMO Code on Alerts and Indicators, 2009, as far as applicable.

16 Communication

16.1 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.

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

16.3 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.

16.4 Laser systems shall be installed in accordance with the IEC 60825 series.

17 Lightning protection

17.1 Protection against primary structural damage

17.1.1 Measures shall be taken to minimise the risks of damage to a unit and its electrical installation due to lightning. An evaluation of the risk to the unit and personnel shall be made.

NOTE Information regarding lightning protection can be found in IEC 62305.

17.1.2 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.

17.1.3 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.

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

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

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

17.1.7 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.

17.1.8 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.

17.2 Air terminals

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

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 17.3.2. The material shall be resistant to seawater.

17.3 Down conductors

17.3.1 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 17.3.2. The material shall be resistant to seawater.

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

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

Special consideration shall be observed for mobile units during dry docking where the normal connection to earth can be missing.

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

17.4 Protection against secondary damage

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

17.4.2 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.

NOTE Further information can be found in IEC 62305 and IEC 61400-24.

17.4.3 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 17.4.2, shall be provided.

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

17.4.5 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.

17.4.6 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.

17.4.7 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.

18 Test of completed installation

18.1 Inspections and tests

18.1.1 Commissioning procedures and a record of the commissioning shall be documented and carried out in accordance with an established programme. Guidance for performance tests is given in Annex A.

18.1.2 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.

18.1.3 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.

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.

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.

Test methods and their results shall be recorded.

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

If test on completed cables operating at or above 1 kV is considered necessary, test voltage and duration of the test shall be in accordance with advice from the cable manufacturer.

18.2 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.

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.

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.

Unless specific instructions are given by the equipment manufacturer regarding test voltages, the values in Table 5 should be used as a guideline.

Table 5 – Test voltages

Nominal voltages DC or AC r.m.s. V	**Test voltages DC** V
≤500	500
500 to 1 000	1 000
1 000 to 6 000	2 500
6 000 to 15 000	5 000

18.3 Insulation resistance

18.3.1 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.

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.

For nominal voltages above 400 V the minimum insulation resistance should be not less than

$$\frac{\text{Nominal voltage}}{1000} + 1{,}0 \quad \text{MΩ}$$

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

18.3.2 Generators and motors

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

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

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.

18.3.3 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).

The installation may be subdivided to any desired extent and appliances may be disconnected if tests give results lower than those given in 18.3.1.

18.4 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 according to the requirements of IEC 61892-3.

18.5 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.

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

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.

18.6 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.

18.7 Communication systems

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

18.8 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.

18.9 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 the earthing terminals of socket outlets with earthing contacts are connected to the hull or structure.

18.10 Voltage drop

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

18.11 Requirements of international conventions and regulations

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.

19 Documentation

19.1 General

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.

19.2 Equipment

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

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.

19.3 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.

19.4 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.

NOTE Guidance regarding maintenance for equipment in hazardous area can be found in IEC 60079-17.

Annex A
(informative)

Performance test

A.1 Switchgear

All switchgear should be loaded as near as is practicable to its working load in order to demonstrate that no overheating takes place due to faulty connections or incorrect rating.

Thermographic surveys may be employed to assist with this assessment. The measurement of the resistance of joints and contacts by volt drop methods with the injection of high current from a low voltage source is also recommended. Records should be taken of the readings for subsequent reference.

These techniques may be used at the initial examination and for periodic inspections.

Switches and circuit-breakers should be operated on load and the satisfactory operation of all interlocks should be demonstrated.

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 by the use of suitable injection testing 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.

A.2 Generator

All generator sets should be run over a sufficient range of load, including full rated load, or as near as is practicable to full rated load, and for a duration sufficient to demonstrate that commutation, electrical characteristics, governing, range of excitation control, phase rotation, lubrication and absence of excessive vibration are satisfactory.

If sets are intended to operate in parallel, they should be tested over a range of loads to demonstrate their compliance with the requirements of IEC 61892-3.

The voltage and speed regulation when a specified load is suddenly thrown on and off should be satisfactory to previously defined limits.

Overspeed trips together with all other devices relative to the protection of the generator sets should be demonstrated to show that they are satisfactory.

Synchronizing equipment and any associated protective devices should be demonstrated to verify correct functioning between each generating set and all other generating sets intended to operate in parallel. Reverse current, reverse power and overcurrent trips and any other safety devices should be satisfactorily demonstrated.

A.3 Motor

Each motor, together with its controlgear, should be tested to prove the wiring and direction of rotation and then run as near as is practicable to service conditions for a sufficient length of time to demonstrate that alignment, speed range, commutation, rated output and operating characteristics are satisfactory.

A.4 Circuits

All electrical devices and circuits, including lighting, heating and galley equipment, should be tested under operating conditions to verify that they are suitable and satisfactory for their purposes.

A.5 Communication, control and alarm systems

Each communications system and alarm system should be thoroughly tested to determine its suitability and to verify its specified functioning.

A.6 Statutory requirements

Equipment installed to implement relevant statutory requirements should be tested to ensure that all such requirements have been met. Where operation is required to be maintained from emergency sources of power, including automatic transfer of circuits to such emergency sources, correct functioning from and by such emergency supplies should be tested and the duration of the emergency supplies, where specified, should also be verified.

A.7 Interference

All equipment, including radio communication equipment, radio navigation aids, depth-sounding and broad-casting apparatus, should be tested for the purpose of detecting harmful interference. If objectionable interference is found, it should be reduced by suitable means to the level prescribed in IEC 60533 and IEC 60945.

A.8 Batteries

Batteries should be subjected to an initial test to demonstrate their ability to supply their design loads for the duration required.

Regular testing to demonstrate this capability should be carried out in accordance with the manufacturer's recommended procedures.

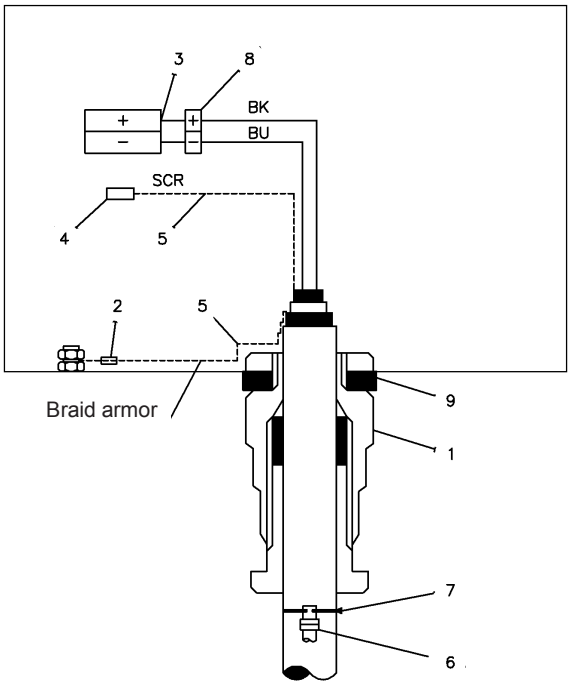
A.9 Ventilation of battery installations

The ventilation arrangement of battery installations should be inspected to ensure that they are in accordance with IEC 61892-7. Ventilation air flow should be tested to confirm that at least the minimum quantity is obtained.

Annex B
(informative)

Examples of cable termination

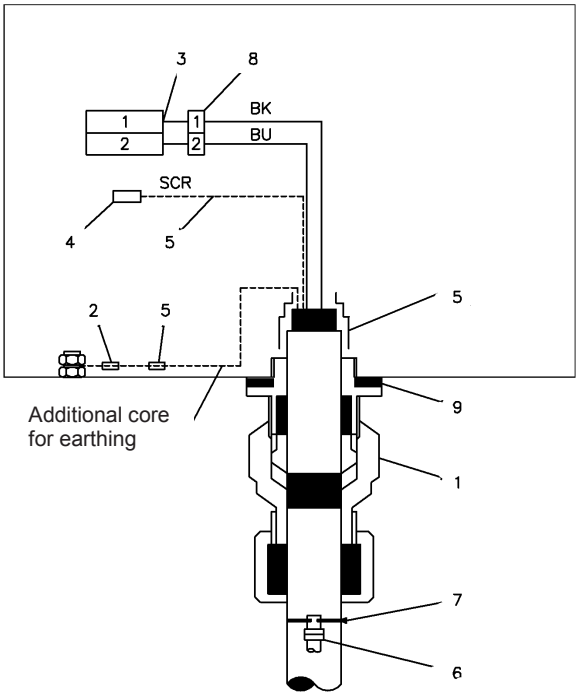
This annex gives examples of cable termination as described in 6.7



Key

1	Cable gland	2	Crimp lug
3	Crimp pin	4	Isolating cap/terminal
5	Heat shrink	6	Cable number
7	Cable tie	8	Terminal number
9	Sealing washer	BU	Blue conductor
BK	Black conductor		

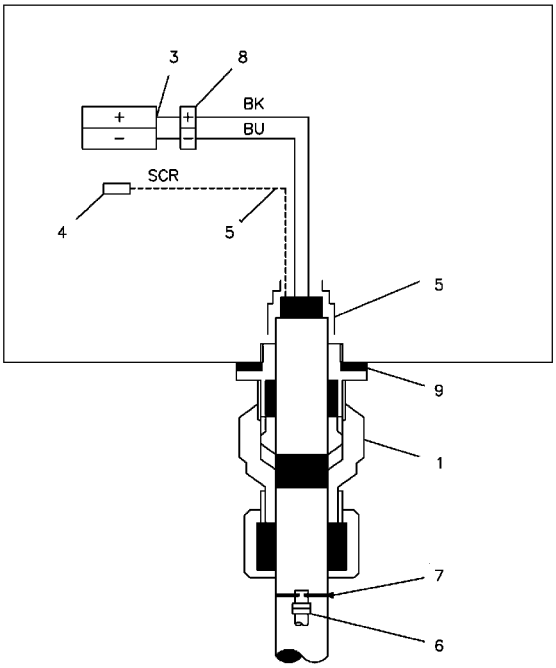
Figure B.1 – Equipment with through gland



Key

1	Cable gland	2	Crimp lug
3	Crimp pin	4	Isolating cap/terminal
5	Heat shrink	6	Cable number
7	Cable tie	8	Terminal number
9	Sealing washer		

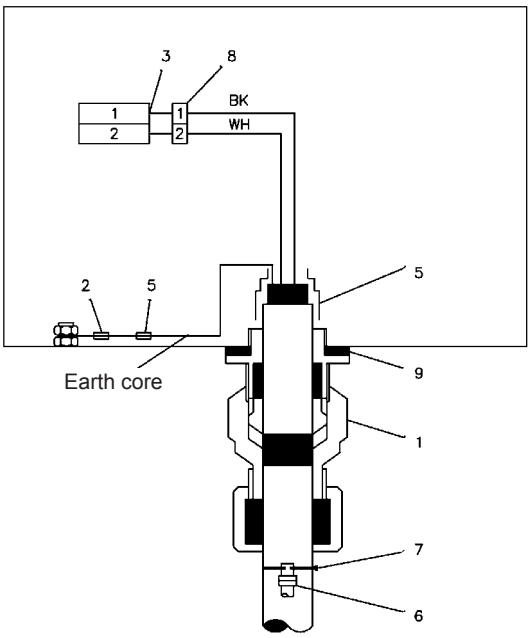
Figure B.2 – Equipment for voltage above 30 V AC or 50 V DC with Ex d armour clamping gland



Key

1	Cable gland	2	Not applicable
3	Crimp pin	4	Isolating cap/terminal
5	Heat shrink	6	Cable number
7	Cable tie	8	Terminal number
9	Sealing washer	BU	Blue conductor
BK	Black conductor		

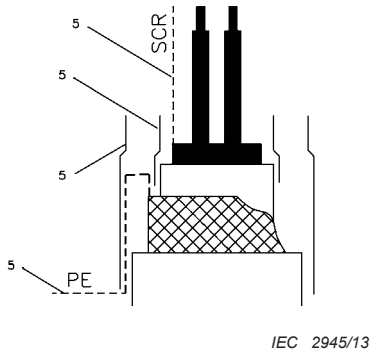
Figure B.3 – Equipment for voltage 30 V AC, 50 V DC and below with Ex d armour clamping gland – termination of instrument cable



Key

1	Cable gland	2	Crimp lug
3	Crimp pin	4	Isolating cap/terminal
5	Heat shrink	6	Cable number
7	Cable tie	8	Terminal number
9	Sealing washer	BU	Blue conductor
BK	Black conductor		

Figure B.4 – Equipment for voltage above 30 V AC or above 50 V DC with Ex d armour clamping gland – termination of power cable



Key

5 Heat shrink

Figure B.5 – Detail of heat shrink isolation between outer braid and screen

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