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Introduction

Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international and European standards, comments will be reviewed by the relevant UK national committee before submitting the consensus UK vote and comments. If the draft standard is approved, it is usual for the resulting published standard to be adopted as a British Standard.

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UK Vote

Please indicate whether you consider the UK should submit a negative (with supporting technical reasons) or positive vote on this draft. Please indicate if you are aware of any reason why this draft standard should not be published as a British Standard.

Submission of Comments

Annotated drafts are not acceptable and will be rejected.

All comments should be submitted online at <http://standardsdevelopment.bsigroup.com>. You will need to register in order to comment.

BS 8450:2025

Installation of electrical and electronic equipment in ships – Code of practice

DRAFT

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Foreword

Publishing information

This British Standard is published by BSI Standards Limited, under licence from The British Standards Institution, and came into effect on XX Month 202X. It was prepared by 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 the committee manager.

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Supersession

This British Standard supersedes BS 8450:2006, which is withdrawn.

Relationship with other publications

The development and publication of BS 8450 superseded all editions of the *Regulations for the Electrical and Electronic Equipment of Ships* (the IEE “Blue Book”), which were withdrawn.

This British Standard gives additional recommendations for the UK industry that the BS IEC 60092 series either lacks entirely or, in the opinion of JPEL/18, does not cover adequately, although frequent reference is made to other relevant standards and publications. References to the applicable parts of the BS IEC 60092 series are given at the beginning of most clauses.

Information about this document

This is a full revision of the document, and introduces the following principal changes:

- updated references; and
- acknowledgement of developments in technology.

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Use of this document

As a code of practice, this British Standard takes the form of recommendations and guidance. It is not to be quoted as if it were a specification. Users are expected to ensure that claims of compliance are not misleading.

Users may substitute any of the recommendations in this British Standard with practices of equivalent or better outcome. Any user claiming compliance with this British Standard is expected to be able to justify any course of action that deviates from its recommendations.

It has been assumed in the preparation of this British Standard that the execution of its provisions will be entrusted to appropriately qualified and experienced people, for whose use it has been produced.

Presentational conventions

The provisions of this document are presented in roman (i.e. upright) type. Its recommendations are expressed in sentences in which the principal auxiliary verb is “should”.

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

The word “should” is used to express recommendations of this document. The word “may” is used in the text to express permissibility, e.g. as an alternative to the primary recommendation of the clause. The word “can” is used to express possibility, e.g. a consequence of an action or an event.

Notes and commentaries are provided throughout the text of this document. Notes give references and additional information that are important but do not form part of the recommendations. Commentaries give background information.

Where words have alternative spellings, the preferred spelling of the *Shorter Oxford English Dictionary* is used (e.g. “organization” rather than “organisation”).

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The recipient is advised to consider seeking professional guidance with respect to its use of this publication.

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Compliance with a British Standard cannot confer immunity from legal obligations.

In particular, attention is drawn to the following specific acts and regulations:

- the International Convention for the Safety of Life at Sea (SOLAS), 1974, as amended [1];
- the Merchant Shipping Act 1995 [2];
- the Merchant Shipping (Dangerous or Noxious Liquid Substances in Bulk) Regulations 1996 [3];
- the Merchant Shipping (Passenger Ship Construction: Ships of Classes I, II and II(A)) Regulations 1998 [4];
- the Merchant Shipping (Passenger Ship Construction: Ships of Classes III to VI(A)) Regulations 1998 [5];
- the Merchant Shipping (Cargo Ship Construction) Regulations 1997 [6];
- the Merchant Shipping (Survey and Certification) Regulations 1995 [7];
- the Merchant Shipping (Gas Carriers) Regulations 1994, as amended [8];
- the Merchant Shipping (Fire Protection) Regulations 2003, as amended [9];
- the Merchant Shipping (Life-Saving Appliances for Ships other than Ships of Classes III to VI(A)) Regulations 1999, as amended [10];
- the Merchant Shipping (Life-Saving Appliances for Passenger Ships of Classes III to VI(A)) Regulations 1999, as amended [11];
- the Merchant Shipping (Radio) (Fishing Vessels) Regulations 1999 [12];
- the Merchant Shipping (Radio Installations) 1998 [13];

- the Merchant Shipping (Safety of Navigation) Regulations 2002 [14];
- the Merchant Shipping (Crew Accommodation) Regulations 1997, Parts 1 and 2, as amended [15];
- the Fishing Vessels (Safety Provisions) Regulations 1975, as amended [16];
- the Merchant Shipping (Submersible Craft Construction and Survey) Regulations 1981, as amended [17];
- the Merchant Shipping (Dangerous Goods and Marine Pollutants) Regulations 1997 [18];
- the Merchant Shipping and Fishing Vessels (Health and Safety at Work) Regulations 1997 [19];
- the Merchant Shipping (Guarding of Machinery and Safety of Electrical Equipment) Regulations 1988, as amended [20];
- the Health and Safety at Work etc. Act 1974 [21]; and
- the Convention on the International Regulations for Preventing Collisions at Sea, 1972 [22].

1 Scope

This British Standard gives recommendations for the design, installation and maintenance of electrical equipment for the generation, storage, conversion, distribution and utilization of electrical energy for all purposes in ships of all descriptions, including, where relevant, inland and harbour craft.

NOTE For vessels smaller than 500 grt (gross registered tonnage) or with a length less than 50 m, BS EN 60092-507 provides a basic standard for small vessel electrical installations, including direct current (DC) systems not exceeding 50 V and alternating current (AC) systems not exceeding 250 V single phase or 500 V three phase.

These recommendations are intended to provide satisfactory operation and safety, especially from fire and electrical shock, of installed equipment and portable and transportable equipment which is intended to be connected to the ship's electrical distribution system. They relate principally to installation, utilization, inspection and testing, but certain recommendations for the construction of electrical and electronic equipment are included.

This British Standard is not applicable to the internal wiring of manufactured apparatus that is not wired on board. It is not intended to provide for every circumstance – in some cases, specialist advice is required.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes provisions, or limits the application, of this document¹⁾. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS 1363 (all parts), *13 A plugs, socket-outlets, adaptors and connection units*

BS 1363-2, *13 A plugs, socket-outlets, adaptors and connection units – 13 A switched and unswitched socket-outlets – Specification*

BS 3456 (all parts), *Safety of household and similar electrical appliances*

BS 4999 (all parts), *General requirements for rotating electrical machines*

BS 5655 (all parts), *Lifts and service lifts*

BS 6231, *Electric cables – Single core PVC insulated flexible cables of rated voltage 600/1 000 V for switchgear and controlgear wiring*

BS 6626, *Maintenance of electrical switchgear and controlgear for voltages above 1 kV and up to and including 36 kV – Code of practice*

BS 6883, *Elastomer insulated cables for fixed wiring in ships and on mobile and fixed offshore units – Requirements and test methods*

BS 7655-2.3, *Specification for insulating and sheathing materials for cables – Part 2: Cross-linked elastomeric sheathing compounds – Section 2.3: General application*

BS 7671, *Requirements for electrical installations – IEE Wiring Regulations*

BS EN 10226-1, *Pipe threads where pressure tight joints are made on the threads – Part 1: Taper external threads and parallel internal threads – Dimensions, tolerances and designation*

BS EN 10255, *Non-alloy steel tubes suitable for welding and threading – Technical delivery conditions*

¹⁾ Documents that are referred to solely in an informative manner are listed in the Bibliography.

BS EN 50085-1, *Cable trunking systems and cable ducting systems for electrical installations – Part 1: General requirements*

BS EN 50117 (all parts), *Coaxial cables*

BS EN 50525-1, *Electric cables – Low voltage energy cables of rated voltages up to and including 450/750 V – Part 1: General requirements*

BS EN 60034-1, *Rotating electrical machines – Part 1: Rating and performance*

BS EN 60034-15, *Rotating electrical machines – Part 15: Impulse voltage withstand levels of form-wound stator coils for rotating a.c. machines*

BS EN 60079 (all parts), *Explosive atmospheres*

BS EN 60079-14, *Explosive atmospheres – Part 14: Electrical installations design, selection and erection*

BS EN 60228, *Conductors of insulated cables*

BS EN 60309-2, *Plugs, socket-outlets and couplers for industrial purposes – Part 2: Dimensional interchangeability requirements for pin and contact-tube accessories*

BS EN 60335-1, *Household and similar electrical appliances – Safety – Part 1: General requirements*

BS EN 60335-2-36, *Household and similar electrical appliances – Safety – Part 2-36: Particular requirements for commercial electric cooking ranges, ovens, hobs and hob elements*

BS EN 60335-2-37, *Household and similar electrical appliances – Safety – Part 2-37: Particular requirements for commercial electric deep fat fryers*

BS EN 60335-2-38, *Household and similar electrical appliances – Safety – Part 2-38: Particular requirements for commercial electric griddles and griddle grills*

BS EN 60335-2-39, *Household and similar electrical appliances – Safety – Part 2-39: Particular requirements for commercial electric multi-purpose cooking pans*

BS EN 60622, *Secondary cells and batteries containing alkaline or other non-acid electrolytes – Sealed nickel-cadmium prismatic rechargeable single cells*

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

BS EN 60669 (all parts), *Switches for household and similar fixed electrical installations*

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

BS EN 60896-21, *Stationary lead-acid batteries – Part 21: Valve regulated types – Methods of test*

BS EN 60896-22, *Stationary lead-acid batteries – Part 22: Valve regulated types – Requirements*

BS EN 60945, *Maritime navigation and radiocommunication equipment and systems – General requirements – Methods of testing and required test results*

BS EN 60953-1, *Rules for steam turbine thermal acceptance tests – Part 1: High accuracy for large condensing steam turbines*

BS EN 61008-1, *Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCBs) – Part 1: General rules*

BS EN 61056-1, *General purpose lead-acid batteries (valve-regulated types) – Part 1: General requirements, functional characteristics – Methods of test*

BS EN 61386-1, *Conduit systems for cable management – Part 1: General requirements*

BS EN 61558-2-5, *Safety of transformers, reactors, power supply units and combinations thereof – Part 2-5: Particular requirements and tests for transformer for shavers, power supply units for shavers and shaver supply units*

BS EN 62395, *Electrical resistance trace heating systems for industrial and commercial applications – Part 2: Application guide for system design, installation and maintenance*

BS EN IEC 60045-1, *Steam turbines – Part 1: Specifications*

BS EN IEC 60079-10 (all parts), *Explosive atmospheres – Classification of areas*²⁾

BS EN IEC 60079-31, *Explosive atmospheres – Part 31: Equipment dust ignition protection by enclosure “t”*

BS EN IEC 60947-4-1, *Low-voltage switchgear and controlgear – Part 4-1: Contactors and motor-starters – Electromechanical contactors and motor-starters*

BS EN IEC 60953-0, *Rules for steam turbine thermal acceptance tests – Part 0: Wide range of accuracy for various types and sizes of turbines*

BS EN IEC 61386-21, *Conduit systems for cable management – Part 21: Particular requirements – Rigid conduit systems*

BS EN IEC 61386-22, *Conduit systems for cable management – Part 22: Particular requirements – Pliable conduit systems*

BS EN IEC 61386-23, *Conduit systems for cable management – Part 23: Particular requirements – Flexible conduit systems*

BS EN IEC 61951-1, *Secondary cells and batteries containing alkaline or other non-acid electrolytes – Secondary sealed cells and batteries for portable applications – Part 1: Nickel-cadmium*

BS EN IEC 62271-106, *High-voltage switchgear and controlgear – Part 106: Alternating current contactors, contactor-based controllers and motor-starters*

BS EN IEC 62271-200, *High-voltage switchgear and controlgear – Part 200: AC metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV*

BS IEC 60092-302-2, *Electrical installations in ships – Part 302-2: Low voltage switchgear and controlgear assemblies – Marine power*

BS IEC 60092-303, *Electrical installations in ships – Part 303: Equipment – Power transformers and reactors*

BS IEC 60092-304, *Electrical installation in ships – Part 304: Equipment – Semiconductor converters*

BS IEC 60092-401, *Electrical installation in ships – Part 401: Installation and test of completed installation*³⁾

BS IEC 60092-504:2001, *Electrical installations in ships – Part 504: Special features – Control and instrumentation*

BS IEC 60533, *Electrical and electronic installations in ships – Electromagnetic compatibility (EMC) – Ships with a metallic hull*⁴⁾

²⁾ This document gives an informative reference to BS EN IEC 60079-10-1 and BS EN IEC 60079-10-2.

³⁾ This document gives an informative reference to BS IEC 60092-401:1980.

⁴⁾ This document gives informative references to BS IEC 60533:2015.

BS ISO 2314, *Gas turbines – Acceptance tests*

BS ISO 3046 (all parts), *Reciprocating internal combustion engines*

BS ISO 3046-4, *Reciprocating internal combustion engines – Performance – Part 4: Speed governing*

BS ISO 3977-1, *Gas turbines – Procurement – Part 1: General introduction and definitions*

BS ISO 3977-2, *Gas turbines – Procurement – Part 2: Standard reference conditions and ratings*

BS ISO 8528-5, *Reciprocating internal combustion engine driven alternating current generating sets – Part 5: Generating sets*

IEC 60092-352, *Electrical installations in ships – Part 352: Choice and installation of electrical cables*

IEC 60092-360, *Electrical installations in ships – Part 360: Insulating and sheathing materials for shipboard and offshore units, power, control, instrumentation and telecommunication cables*

IEC 63462-1, *Maritime battery system – Part 1: Secondary lithium cells and batteries – Safety requirements*

3 Terms and definitions

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

3.1 appropriate authority

governmental body, or classification society, or both, to whose rules and regulations ships are expected to conform

3.2 computer-based system

system that consists of one or more programmable electronic devices with their connections, peripherals and software necessary to carry out automatically specified functions

3.3 DP (dynamic position) control system

control computer(s), input sensors (including manual control of set points) and output actuators, together with associated cabling and power supplies

3.4 hazardous area

area in which an explosive atmosphere is present, or might be expected to be present, in quantities such as to require special precautions for the construction, installation and use of equipment

3.5 high voltage

voltage normally exceeding low voltage

3.6 low voltage

voltage not exceeding 1 000 V AC or 1 500 V DC between conductors or 600 V AC or 900 V DC between any conductor and earth

3.7 non-hazardous area

area in which an explosive atmosphere is not present, or might not be expected to be present, in quantities such as to require special precautions for the construction, installation and use of equipment

3.8 valve-regulated battery

secondary battery in which cells are closed but have an arrangement (valve) which allows the escape of gas if the internal pressure exceeds a predetermined value

NOTE The cell or battery cannot normally receive additions to the electrolyte.

4 General recommendations

COMMENTARY ON CLAUSE 4

This clause supplements the provisions of BS IEC 60092-101.

4.1 Voltage and frequency

NOTE Voltage and frequency variations within electrical systems are prescribed in BS IEC 60092-101.

4.1.1 In circuits supplied by batteries (given that the voltage variations in BS IEC 60092-101 are likely to be exceeded, particularly where the battery is normally on floating service) the apparatus supplied should function satisfactorily within the maximum voltage variations in all operating conditions.

4.1.2 Batteries supplying the emergency services should be capable of carrying the emergency electrical load without recharging, whilst maintaining the voltage of the battery throughout the discharge period within 12% above or below the rated voltage.

NOTE Attention is drawn to SOLAS [1], which gives further information about the emergency services required.

4.1.3 The supply system should be designed such that if the defined transient limits are exceeded this does not cause maloperation or damage to other equipment.

NOTE For example:

- a) where pole changing deck machinery is involved, a voltage dip of 15% and a recovery time of less than 0.2 s might be suitable; and
- b) where pole changing deck machinery is not involved, a voltage dip of 15% and a recovery time of less than 1 s might be suitable.

4.2 Design of equipment

COMMENTARY ON 4.2

Attention is drawn to SOLAS [1], in relation to the cooling of air and water temperatures and the inclination of ships.

4.2.1 All apparatus should be of a design appropriate to the situation in which it is likely to be used and its mode of installation should take account of the conditions likely to be encountered in service.

NOTE Examples of such conditions include exposure to:

- a) moisture and salt-laden atmosphere, sea spray, high wind velocity or ice formation;
- b) abnormal vibration or shock;
- c) excessively high or low temperatures; and
- d) explosive mixtures of gases, dusts and circumstances where there is an abnormal risk of fire or explosion.

4.2.2 The design of equipment should provide accessibility to all parts requiring inspection or replacement in service.

4.2.3 Electrical and electronic equipment that operates under automatic or remote control should do so such that the risk of damage to plant or injury to personnel is judged to be as low as reasonably practicable.

4.2.4 Equipment should be designed, constructed and installed in accordance with BS IEC 60533 and BS EN 60945, as appropriate, with respect to the electromagnetic compatibility (EMC) of the electrical equipment and systems of the installation.

4.2.5 Materials used for items associated with systems which are required to operate as long as possible in a fire (e.g. cables for certain alarms and shutdown systems, navigation lights, communication systems, emergency lighting) should be selected with this in mind.

4.2.6 Where liquid coolants are used, the detection of liquids in an equipment enclosure and provision of an alarm indication should be taken into account. For semiconductor converters,

the flow of coolant should be monitored to operate an alarm in the event of significant reduction of flow.

NOTE Attention is drawn to the need to guard against the leakage of coolant into the cooling liquid, e.g. where liquid-to-liquid heat exchangers are fitted.

4.2.7 Apparatus should be provided with suitable cable glands, bushings or conduit entries. All entries should maintain the degree of protection provided by the enclosure of the associated apparatus (see **8.2.1.8**).

4.2.8 The means of fixing current-carrying parts should be independent of the means of making electrical connection thereto.

4.2.9 Apparatus should be provided with suitable terminals, clearly marked, placed in an accessible position convenient for external connections. The terminals should be effectively secured and should be so spaced and/or shielded as to minimize the risk of accidental earthing or short-circuiting. Sufficient clearance should be allowed between the cable entries and terminals so that cables can be drawn in and connected without damage.

Enclosures containing delicate apparatus should be provided with means to allow easy termination of cables without exposing such apparatus to the possibility of damage.

4.2.10 Enclosures of fixed apparatus which are liable to exceed a temperature of 80 °C should be so located or guarded as to prevent persons coming accidentally into contact with such equipment.

4.3 Installation, location and protection of equipment

4.3.1 Electrical equipment should, as far as practicable, be so placed that it is not exposed to risk of mechanical damage or excessive vibration. If equipment is installed in locations subject to vibration, e.g. steering compartments, it should be secured using anti-vibration mountings, and placed in a metal enclosure with flexible arrangements for earthing.

4.3.2 Electrical equipment should be so selected and located or protected that the effects of exposure to sea air, water, steam, oil or oil fumes, spray, ice formation, etc., are minimized. Electrical equipment should be located well clear of boilers, steam, oil or water pipes, and engine exhaust pipes or manifolds, unless specifically designed for such locations. If pipes are run adjacent to electrical equipment, there should be no joints in the immediate vicinity of the equipment.

4.3.3 Where sprinkler heads or water spraying devices are fitted for fire-fighting, the siting of electrical equipment should be such that it is not likely to be seriously affected by the inadvertent operation of the extinguishing arrangement. For switchgear and switch rooms, a suitable alternative method of extinguishing should be used.

4.3.4 Horizontal rotating machines should, where practicable, be installed fore-and-aft to minimize the effects of rolling. Where a machine is installed athwartships or vertically, the design of bearings and the arrangement for their lubrication should be adequate to withstand the rolling encountered in heavy weather and operation for prolonged periods under the conditions specified by the appropriate authority.

4.3.5 Where an item of equipment or enclosure contains live parts that are not capable of being isolated by a single device, a warning notice should be placed in such a position that any person gaining access to live parts is warned of the need to use the appropriate isolating devices, unless an interlocking arrangement is provided so that all the circuits concerned are isolated.

4.3.6 In ships where electric power is used for essential services, generators, switchgear, motors and associated control gear for such services should be so situated or protected that they continue to operate satisfactorily in the event of partial flooding by bilge water above the tank top in the space in which they are situated. The design criterion for "partial flooding" should be assumed to be a depth of water 1/12th beam, but not exceeding a depth of 1.5 m.

Where this recommendation is impracticable for horizontally mounted propulsion motors, the motor should be watertight to the underside of the motor shaft.

4.4 Electrical equipment in flammable and/or explosive dust atmospheres

4.4.1 Owing to the potential dangers introduced by electrical equipment and the difficulty in maintaining its safe characteristics in service, such equipment should not be installed where flammable gases/vapours or explosive dusts are liable to accumulate, except where it is essential and it conforms to **4.4.3**.

4.4.2 Where there is a risk of explosion from flammable gases/vapours, equipment should be of a safe type, certified for the gases/vapours involved and should conform to the BS EN 60079 series or an equivalent national or international standard.

4.4.3 Where there is a risk of explosion from combustible dusts, equipment should conform to BS EN IEC 60079-31 and BS EN 60079-14, or an equivalent national or international standard.

NOTE 1 The BS IEC 60092 series gives details of electrical equipment permitted on board tankers intended for the carriage in bulk of oil cargoes and other types of ships where oil or liquids of similar hazards are processed, handled or stored. BS IEC 60092-506 and BS IEC 60092-502 are particularly relevant.

NOTE 2 Clause 13 gives details of electrical equipment permitted in battery compartments.

NOTE 3 Subclause 14.2 details the recommendations for trace heating systems.

NOTE 4 Attention is drawn to the following statutory requirements and regulations: SOLAS [1], the Merchant Shipping (Dangerous or Noxious Liquid Substances in Bulk) Regulations 1996 [3], the Merchant Shipping (Fire Protection) Regulations 2003 [9], the Merchant Shipping (Dangerous Goods and Marine Pollutants) Regulations 1997 [18], the IMSBC code [23], the IGC code [24], the IGF code [25] and the IMDG code [26]. These govern the electrical equipment permitted on board the following types of ships:

- *ships carrying dangerous chemicals in bulk;*
- *ships carrying liquefied gases in bulk;*
- *ships carrying dangerous goods and materials hazardous only in bulk; and*
- *ships with spaces for carrying vehicles with fuel in their tanks for their own propulsion.*

4.4.4 Electrical equipment for use in stores containing paint or other flammable fluids should be of a certified safe type. All switches and protective devices should interrupt all poles or phases and should be located in a non-hazardous area. Such switches and protective devices should be clearly labelled for identification purposes.

4.4.5 Electrical equipment for use in other spaces/areas where flammable gases/vapours and/or explosive dusts are liable to accumulate or where explosive materials are handled or stored should be of a type acceptable to the appropriate authority.

NOTE 1 BS EN IEC 60079-10-1, BS EN IEC 60079-10-2, BS EN IEC 60079-14 and BS EN IEC 60079-17 give guidance on the installation and maintenance of electrical equipment for use in potentially explosive atmospheres.

NOTE 2 Special precautions might be necessary where risk of explosion from combustible dusts and flammable gases/vapours could arise simultaneously.

NOTE 3 Radio/radar transmitters coexist frequently in many shipping operations, particularly where bulk flammable cargoes are being transported. PD CLC/TR 50427:2004, 8.3 and Table 2 and Table 3, give guidance on the precautions to be taken to avoid inadvertent ignition of flammable materials by radio frequency radiation. Radio/radar transmitters coexist frequently in many shipping operations, particularly where bulk flammable cargoes are being transported. BS 6656:2002, 12.3 and Table 9, give guidance on the precautions to be taken to avoid inadvertent ignition of flammable materials by radio frequency radiation.

5 Earthing and bonding

COMMENTARY ON CLAUSE 5

This clause supplements the provisions of BS IEC 60092-401 and BS EN 60092-507. The details given in 5.1 to 5.4 apply directly to ships with metallic hulls. Additional recommendations for ships with non-metallic hulls are detailed in 5.5.

5.1 System earthing

COMMENTARY ON 5.1

This subclause applies to earthed DC systems.

Earthed neutral or insulated systems are acceptable. For earthed systems in tankers and in other ships of similar hazard, see BS IEC 60092-502. For further information, see Annex B.

Guidance for the earthing and bonding of cables for EMC are given in Annex C.

5.1.1 Earthed neutral systems should be so designed that the potential earth fault current:

- a) does not exceed the design capacity of any part of the systems; and
- b) is of sufficient magnitude to operate any protection or indication device.

5.1.2 The earthing system adopted should take account of, and limit to acceptable values, possible harmonic circulating currents.

5.1.3 Low-voltage earthed neutral systems should be achieved by connecting the neutral point directly to earth. The earth loop impedance should be low enough to permit the passage of a current at least three times the fuse rating for fuse protected circuits or 1.5 times the tripping current of any excess current circuit-breaker used to protect the circuit.

5.1.4 High-voltage earthed neutral systems should be achieved by inserting impedance in the neutral connection to earth to limit the earth fault current to an acceptable level. The prospective earth fault current should be at least three times the value of current required to operate any earth fault protection devices. In the case of high impedance earthing, the impedance should be such that the earth fault current is slightly higher than the capacitive current of the system. Solid earthing should not be used for high-voltage systems.

5.1.5 Where an earthed system is divided into two or more sections, means for neutral earthing should be provided for each section.

5.1.6 All earthing resistors/impedances should be connected to the ship's hull. In addition, earthing resistors/impedances should be bonded together on the hull side of the resistance/impedance. The means of bonding should be separate from that provided at the ship's hull for radio, radar and communications circuits in order to minimize possible interference.

5.1.7 Efficient means should be provided for detecting defects in the insulation of the system. For systems where the earth fault current exceeds 5 A, automatic tripping devices should be provided.

NOTE Where the earth fault current does not exceed 5 A, an indicator may be provided as an alternative to an automatic tripping device (see also 5.3 and B.3.2.2).

5.2 Earthing of non-current-carrying parts

5.2.1 Unless specifically included in the exemptions listed in BS IEC 60092-401, all exposed-conductive-parts and extraneous-conductive-parts should be bonded to the ship's hull. The bonding should be such as to give a substantially equal potential and a sufficiently low earth fault loop impedance that protective devices operate correctly. The bonding should be achieved by means of a separate earth conductor.

NOTE Where metal frames or enclosures of apparatus mounted in direct contact with the ship's hull exhibit a low resistance to earth, and if the supplies to the apparatus and their protection arrangements are in accordance with Table 1, no supplementary bonding is needed.

Table 1 – Supply conditions for which supplementary bonding is not required

System voltage	Protection arrangements not requiring supplementary bonding
110 V up to and including 440 V	- Protective device rating 32 A or less; or - residual current circuit-breaker (RCCB) protected.
55-0-55 V	- Fuse rating 16 A or less; or - circuit-breaker or RCCB with overcurrent protection (RCBO) rating 32 A or less; or - RCCB protected.
24 V	- Fuse rating 6 A or less; or - RCBO rating 10 A or less; or - RCCB protected.

5.2.2 Extraneous-conductive parts, which are connected to the ship's hull by permanent and reliable metal-to-metal joints of negligible impedance, should not be bonded by separate earthing conductors. Separate supplementary bonding should be provided in situations where this addition is deemed to be necessary.

5.2.3 The earthing of installations in hazardous areas should conform to BS EN 60079-14.

5.3 Earth indication

Every insulated distribution system, whether primary or secondary, should be provided with means to give initially audible and visual, then continuous visual, warning of abnormally low levels of insulation.

5.4 Additional recommendations for ships with non-metallic hulls

5.4.1 A main earth conductor bar should be provided at a suitable location (e.g. the main switchboard) to which all non-current-carrying parts not exempted in BS IEC 60092-401 should be connected.

5.4.2 The main earth conductor bar should be connected to the main earthing plate described in BS IEC 60092-401 by a copper conductor having a minimum cross-sectional area of 64 mm², preferably of solid strip construction.

5.4.3 To minimize electromagnetic interference, earthing connections should be run with the associated power cables wherever practicable.

NOTE Three-core cable is preferred for lighting circuits.

5.4.4 Earthing connections of equipment, which are sensitive to electromagnetic interference, should be made directly to the main earth conductor bar of the main earthing plate.

5.4.5 The earthing system and the lightning protective system (see Clause 20) should be run separately down to the pillars at the main earthing plate.

5.4.6 To dissipate possible charge build-up in ships with non-metallic hulls constructed of high resistivity materials (surface and volume resistivities greater than 10⁸ ohms and 10⁶ ohm-metres, respectively), all metallic objects over 0.6 m in length and over 0.4 m² in surface area should be earthed.

NOTE It might be desirable to bond to the main earth system all metal parts which are in direct contact with the sea, in order to minimize the effects of electrolytic corrosion.

6 Application of diversity factors

COMMENTARY ON CLAUSE 6

This clause supplements the provisions of BS IEC 60092-201.

6.1 General

6.1.1 The diversity factor for power circuits should take account of the known and anticipated conditions. The calculations should be based on the full load ratings of motors and the characteristics of the generators.

6.1.2 The diversity factor applied, where justifiable, to the loading calculation of cables, switchgear and generators supplying groups of winch motors or crane motors should be based upon the estimated duty cycle of the motors in the group, taking into account the frequency and duration of motor starting loads.

6.1.3 All diversity factors should be taken as minima, and cables, switchgear and generators supplying winch motors and crane motors should be capable of carrying continuously (subject to voltage drop) the currents calculated by applying an appropriate diversity factor to the total connected load of winch motors and/or crane motors.

6.1.4 Where the cables feeding winch motors and/or crane motors supply other equipment, the current upon which the cross-sectional area of the conductors of the cables is based should allow for the coincidence of the various loads and any calculated voltage drop.

6.2 Refrigerated containers

A diversity factor should be applied for refrigerated containers when deciding the capacity of generators and distribution transformers.

NOTE The final decision can only be reached by taking into account the type of container, the cargo mix between chilled and frozen, and the ratio of hot to pre-cooled containers for the applicable trade.

7 Distribution

COMMENTARY ON CLAUSE 7

This clause supplements the provisions of BS IEC 60092-201 and BS IEC 60092-204.

7.1 General

7.1.1 If a cable is looped from board to board without passing through a protective device, the cable conductors should be of the same cross-section throughout.

7.1.2 Switches in conductors of insulated distribution systems should open all lines simultaneously.

7.2 Final circuits

7.2.1 A final circuit may supply two or more cooking appliance where these are installed in one space; this circuit should have a rating exceeding 16 A, but not exceeding 32 A. In the absence of precise data, the current demand should be assessed as the first 10 A of the total rated current of the connected cooking appliances, plus 30% of the remainder of the total rated current of the connected cooking appliances.

7.2.2 In dry areas of accommodation spaces, and in spaces having similar environmental conditions, where socket-outlets conforming to BS 1363-2 are installed, they should be served by ring final circuits, each protected by a 30 A or 32 A fuse or circuit-breaker, provided that one pole of the supply is earthed. The maximum number of socket-outlets connected to each ring should be in accordance with the estimated maximum demand of apparatus within the 30 A or 32 A rating, but should not exceed 18. The cables used for such ring final circuits should have a minimum current carrying capacity of 20 A.