

Electrical installations in ships —

Part 401: Installation and test of completed installation

ICS 47.020.60

National foreword

This British Standard reproduces verbatim IEC 60092-401:1980 including Amd 1:1987 and Amd 2:1997 and implements it as the UK national standard. The UK participation in its preparation was entrusted to Technical Committee JP/EL/18, Electrical installations of ships and of mobile and fixed offshore units, which has the responsibility to:

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Installations électriques à bord des navires
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Electrical installations in ships
Part 401: Installation and test of completed installation



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INTERNATIONAL ELECTROTECHNICAL COMMISSION

ELECTRICAL INSTALLATIONS IN SHIPS

Part 401 : Installation and test of completed installation

FOREWORD

- 1) The formal decisions or agreements of the IEC on technical matters, prepared by Technical Committees on which all the National Committees having a special interest therein are represented, express, as nearly as possible, an international consensus of opinion on the subjects dealt with.
- 2) They have the form of recommendations for international use and they are accepted by the National Committees in that sense.
- 3) In order to promote international unification, the IEC expresses the wish that all National Committees should adopt the text of the IEC recommendation for their national rules in so far as national conditions will permit. Any divergence between the IEC recommendation and the corresponding national rules should, as far as possible, be clearly indicated in the latter.

PREFACE

This standard has been prepared by IEC Technical Committee No. 18: Electrical Installations in Ships.

It forms a part of IEC Publication 92, which deals with electrical installations in ships.

The first edition of this publication was published in 1957.

A second edition consisted of six parts and was published in 1964 (Publication 92-1) and in 1965 (Publications 92-2, 92-3, 92-4, 92-5 and 92-6).

This third edition supersedes the second edition with the exception of Chapter X of Publication 92-3: Part 3: Cables (construction, testing and installation), which is under consideration. (Please see therefore the latest edition of the Catalogue of Publications.)

The series consists of the following publications:

- Publications Nos. 92-101: Electrical Installations in Ships,
Part 101: Definitions and General Requirements.
- 92-201: Part 201: System Design — General.
- 92-202: Part 202: System Design — Protection.
- 92-301: Part 301: Equipment — Generators and Motors.
- 92-302: Part 302: Equipment — Switchgear and Controlgear Assemblies.
- 92-303: Part 303: Equipment — Transformers for Power and Lighting.
- 92-304: Part 304: Equipment — Semiconductor Convertors.
- 92-305: Part 305: Equipment — Accumulator (storage) Batteries.
- 92-306: Part 306: Equipment — Luminaires and Accessories.
- 92-307: Part 307: Equipment — Heating and Cooking Appliances.
- 92-352: Part 352: Choice and Installation of Cables for Low-voltage Power Systems.
- 92-373: Part 373: Shipboard Telecommunication Cables and Radio-frequency Cables — Shipboard Flexible Coaxial Cables.
- 92-374: Part 374: Shipboard Telecommunication Cables and Radio-frequency Cables — Telephone Cables for Non-essential Communication Services.
- 92-375: Part 375: Shipboard Telecommunication Cables and Radio-frequency Cables — General Instrumentation, Control and Communication Cables.
- 92-401: Part 401: Installation and Test of Completed Installation.
- 92-501: Part 501: Special Features — Electric Propulsion Plant.
- 92-502: Part 502: Special Features — Tankers.

- 92-503: Part 503: Special Features — A.C. Supply Systems with Voltages in the Range Above 1 kV up to and Including 11 kV.
 92-504: Part 504: Special Features — Control and Instrumentation.
 92-504A: First Supplement to Publication 92-504 (1974)
 Special Features — Control and Instrumentation
 Appendices — Specific Control and Instrumentation Installations.
 92-505: Part 505: Special Features — Mobile Offshore Drilling Units.

Drafts for Part 401 were discussed at the meeting held in Moscow in 1977 and completed at the meeting held in Florence in 1978. As a result of the latter meeting, the draft, Document 18(Central Office)475, was submitted to the National Committees for approval under the Six Months' Rule in July 1979.

The National Committees of the following countries voted explicitly in favour of publication:

Australia	Germany	South Africa (Republic of)
Belgium	Israel	Sweden
Bulgaria	Italy	Turkey
Canada	Japan	United Kingdom
Denmark	Netherlands	United States of America
Egypt	Poland	

Other IEC publications quoted in this standard:

- Publications Nos. 92-101: Definitions and General Requirements.
 92-201: System design — General.
 92-301: Equipment — Generators and Motors.
 533: Electromagnetic Compatibility of Electrical and Electronic Installations in Ships
 (First edition, 1977).

ELECTRICAL INSTALLATIONS IN SHIPS

Part 401 : Installation and test of completed installation

INTRODUCTION

IEC Publication 92: Electrical Installations in Ships, forms a series of international standards for electrical installations in sea-going ships, incorporating good practice and co-ordinating as far as possible existing rules.

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

1. Scope

This standard is applicable to the installation of electrical equipment for use in ships and to the testing of the complete installation.

SECTION ONE — DEFINITIONS

2. Definitions

2.1 *Earth-continuity conductor*

A wire, cable or other conductor connecting to each other or to the earthing-lead those parts which have to be earthed. For example it may be in whole or in part the metal conduit or the metal sheath of the cables, or the special earth continuity conductor of a cable or flexible cord incorporating such a conductor.

2.2 *Earthing-lead*

A conductor by which the connection is made to the metal hull of the ship.

SECTION TWO — EARTHING

3. Parts for which earthing is required

- 3.1 Unless specifically exempted in the following exemptions, all accessible metal parts of the electrical installation, other than current-carrying accessible parts, shall be earthed.

Exemptions:

- lamp caps;
- shades, reflectors and guards, supported on lampholders or luminaires constructed of, or shrouded in, non-conducting material;
- metal parts on, or screws in or through, non-conducting material, which are separated by such material from current-carrying parts, and from earthed non-current-carrying parts;

- portable appliances having double and/or reinforced insulation (see IEC Publication 92-101: Definitions and General Requirements) provided that the appliances conform with recognized safety requirements;
- bearing housings which are insulated in order to prevent circulation of current in the bearings;
- clips for fluorescent lighting tubes;
- apparatus supplied at safety voltage (see Sub-clause 2.19 of IEC Publication 92-101);
- cable clips.

Note. — Consideration shall be given to the earthing of the non-current-carrying parts which are not accessible but which under fault conditions might become live and hence constitute a fire hazard, such as a metal junction-box mounted on a wooden panel.

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

Note. — See IEC Publication 533: Electromagnetic Compatibility of Electrical and Electronic Installations in Ships.

- 3.3 Secondary windings of instrument transformers shall be earthed.

4. Methods of earthing

Accessible non-current-carrying metal parts not exempted under Sub-clause 3.1 shall be earthed as described below.

- 4.1 Metal frames or enclosures of apparatus may be fixed to, and in metallic contact with, the ship's structure, 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 hull by a connection complying with Clauses 5 and 7.

A lead cable sheath shall not be solely relied upon for this purpose.

- 4.2 For requirements concerning earthing of metal coverings of cables and earthing of mechanical protection of cables, see Clause 36.

5. Earthing connections

- 5.1 Every earthing connection shall be of copper or other corrosion-resistant material and shall be securely installed and protected where necessary against damage and also, where necessary, against galvanic corrosion.
- 5.2 The nominal cross-sectional area of every copper earthing connection shall be not less than is required in Table I. Every other earthing connection shall have a conductance not less than that specified for a copper earthing connection.
- 5.3 Metal parts of portable appliances, other than current-carrying parts and parts exempted in Sub-clause 3.1, shall be earthed by means of an earth-continuity conductor in the flexible cable or cord, which complies with Table I and which is earthed for example through the associated plug and socket-outlet.

- 5.4 Under no circumstances shall the lead sheathing of cables be relied upon as the sole means for earthing.

TABLE I

Sizes of earth-continuity conductors and earthing connections

Type of earthing connection	Cross-sectional area of associated current-carrying conductor	Minimum cross-sectional area of copper earthing connection						
1. Earth-continuity conductor in flexible cable or flexible cord	Any	Same as current-carrying conductor up to and including 16 mm ² or one-half above 16 mm ² but at least 16 mm ²						
2. Earth-continuity conductor incorporated in fixed cable	Any	2.1 For cables having an insulated earth-continuity conductor: 2.1.1 a cross-section equal to the main conductors up to and including 16 mm² but minimum 1.5 mm² 2.1.2 a cross-section not less than 50% of the cross-section of the main conductor when the latter is more than 16 mm², but at least 16 mm² 2.2 For cables with a bare earth wire in direct contact with the lead sheath: <table><tr><th>Cross-section of main conductor</th><th>Earthing conductor</th></tr><tr><td>1 to 2.5 mm²</td><td>1 mm²</td></tr><tr><td>4 to 6 mm²</td><td>1.5 mm²</td></tr></table>	Cross-section of main conductor	Earthing conductor	1 to 2.5 mm ²	1 mm ²	4 to 6 mm ²	1.5 mm ²
Cross-section of main conductor	Earthing conductor							
1 to 2.5 mm ²	1 mm ²							
4 to 6 mm ²	1.5 mm ²							
3. Separate fixed earthing-conductor	3.1 Not exceeding 3 mm ²	Same as current-carrying conductor subject to minimum of 1.5 mm ² for stranded earthing connection, or 3 mm ² for unstranded earthing connection						
	3.2 Exceeding 3 mm ² but not exceeding 125 mm ²	One-half the cross-sectional area of the current-carrying conductor, subject to a minimum of 3 mm ²						
	3.3 Exceeding 125 mm ²	64 mm ²						

6. Earthed distribution systems

- 6.1 The system earthing connection in an earthed distribution system, in which the earthing connection does not normally carry current, shall conform with the recommendation of Clause 5 except that the upper limit of 64 mm² does not apply (see Table I, Item 3.3).
- 6.2 The system earthing of earthed distribution systems shall be effected by means independent of any earthing arrangements of non-current-carrying parts.

7. Connections to the ship's structure

Every connection of an earth-continuity conductor or earthing lead to the ship's structure shall be made in an accessible position, and shall be secured by a screw of brass or other corrosion-resistant material of diameter not less than 6 mm which shall be used for this purpose only. In all circumstances care shall be taken to ensure bright metallic surfaces at the contact areas immediately before the screw is tightened.

8. Aluminium superstructures

Methods of securing aluminium superstructures to the steel hull of a ship often include insulation to prevent galvanic corrosion between these materials. In such case, a separate bonding connection should be provided between superstructure and hull which should be made in such a manner that galvanic corrosion is avoided and the points of connection may be readily inspected.

Note. — See IEC Publication 533.

9. Single-wire systems with hull return

Where hull return systems are permitted, all final sub-circuits shall consist of two insulated wires, the hull return being achieved by connecting to the hull one of the busbars of the distribution board from which they originate.

Earth wires shall be in accessible locations to permit their ready examination and to enable their disconnection for the testing of insulation.

In d.c. hull return systems, all cables inside the magnetic compass zone shall be arranged in a bipolar manner, i.e. the outgoing and the returning wire shall be arranged in one cable or be directly side by side.

Depending on the current of the respective circuit, this shall apply to the following spherical radii around the magnetic compass, except where a steel bulkhead or deck intervenes.

Current (A)	Spherical radius (m)
Up to 10	5
Over 10 up to 50	7
Over 50	9

For radio telegraph installations or other essential radio apparatus including direction-finders, the manufacturer's data are valid.

SECTION THREE — SWITCHGEAR AND CONTROLGEAR ASSEMBLIES

10. Insulating mats

When the voltage exceeds the safety voltage specified in Sub-clause 2.19 of IEC Publication 92-101 an insulated mat, grating or deck of impregnated wood shall be provided in front of switchgear and controlgear assemblies and also at the rear if access from the rear is required. The insulated mats, grating or deck shall be oil-resistant and non-slip.