

# TECHNICAL REPORT



**Electrical installations in ships –  
Part 370: Guidance on the selection of cables for telecommunication and data  
transfer including radio-frequency cables**



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INTERNATIONAL  
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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

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### ELECTRICAL INSTALLATIONS IN SHIPS –

#### **Part 370: Guidance on the selection of cables for telecommunication and data transfer including radio-frequency cables**

#### FOREWORD

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The main task of IEC technical committees is to prepare International Standards. However, a technical committee may propose the publication of a Technical Report when it has collected data of a different kind from that which is normally published as an International Standard, for example "state of the art".

IEC TR 60092-370, which is a Technical Report, has been prepared by subcommittee 18A: Electric cables for ships and mobile and fixed offshore units, of IEC technical committee 18: Electrical installations of ships and of mobile and fixed offshore units.

This second edition cancels and replaces the first edition published in 2009. This edition constitutes a technical revision.

This edition includes the following significant technical change with respect to the previous edition: 30 V AC was added in voltage rating for data cables.

The text of this Technical Report is based on the following documents:

|             |                  |
|-------------|------------------|
| Draft TR    | Report on voting |
| 18A/421/DTR | 18A/422/RVDTR    |

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

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

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

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

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- withdrawn,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

**IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.**

## INTRODUCTION

IEC 60092 (all parts) concerns electrical installations in sea-going ships, and fixed and mobile offshore units, 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, mobile and fixed offshore units owners and builders and appropriate organisations.

~~This IEC/TR 60092-370 has been prepared by the maintenance team MT2 of the IEC subcommittee 18A.~~

Cables selected for installation on board ships and on offshore installations are usually installed and are expected to operate in much harsher environments than equivalent land based types. The risk of mechanical abuse during installation, physical dislocation due to tension and bending allied with extremes of temperature are examples of the conditions to which these cables may be subject. If faults occur unlike onshore installations, trained experienced technicians may not always be readily available to affect a repair or replacement.

## ELECTRICAL INSTALLATIONS IN SHIPS –

### Part 370: Guidance on the selection of cables for telecommunication and data transfer including radio-frequency cables

#### 1 Scope

This part of IEC 60092, which is a Technical Report, gives guidance and lays down the basic recommendations for the selection and installation of shipboard and offshore unit cables intended for electrical systems used in both essential and non-essential analogue or digital signal communication, transmission and control networks, including types suitable for high-frequency signals (i.e. signals with a frequency of more than  $10^5$  Hz). These cables are not suitable for direct connection to low impedance supplies. Where such cables are required, attention is drawn to IEC 60092-353.

Cables intended to have limited circuit integrity (fire resistance) when affected by fire are not covered by this document.

Fibre optical cables are not included.

Sub-sea or umbilical cables are not included.

#### 2 Normative references

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

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

#### 3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60092-350 apply.

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

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

#### 4 Selection of cables

Cables with physical and electrical characteristics in accordance with IEC 60092 (all parts) are recommended for use in the marine environment.

Cables constructed in accordance with the following standards are acceptable provided that due consideration has been given to their use in a marine environment: IEC 60189-1, IEC 60189-2, IEC 60189-3, and IEC 60096-0-1.

## 5 Fundamental considerations

The choice of materials and cable construction should be suitable for the intended application and installation of the cable.

The high level of electrical performance associated with many modern cables is only achieved by the accurate, consistent positioning of the various components within the cable. Careless or excess tension, compression or bending can alter this relationship. This may then have significant detrimental effects upon the fundamental performance of the cable at high data rates.

Similarly, these high levels of electrical performance can usually only be achieved by the use of polymers and insulation systems that may not have the same reaction to fire characteristics as the more traditional materials used in other marine cables. In recognition of this, careful consideration should be given to the method of installation to select that most appropriate to the particular application (see also Clause 8).

## 6 Constructional considerations

### 6.1 Selection of conductor

Only circular copper conductors, either plain or metal coated, or copper covered steel, are recommended for use in a marine environment. Stranded conductors are recommended for general use. Where the applicable product standard specifies solid conductors, consideration should be given to the possible effects of vibration (due to the movement of the ship or installation) or movement (due to motion of the ship or installation).

The properties of copper conductors should be in accordance with IEC 60228. Joints in solid conductors or complete stranded conductors are not permitted; however, joints in individual strands are allowed.

**NOTE** When cables are subject to continuous flexing, the advice of the manufacture should be sought.

### 6.2 Selection of insulation

The range of materials for use as conductor insulation should, where possible, be selected from those listed in ~~IEC 60092-351~~ IEC 60092-360 or as given in IEC 60096-0-1 and IEC 61156-5-1. For cables operating at the higher frequencies, the insulation may be solid, cellular or a foam skin composite. The rated operating temperature of the insulating material should be at least 10 °C higher than the maximum ambient temperature likely to exist, or to be produced, in the space where the cable is installed.

The insulation should be continuous, having a thickness as uniform as possible. The insulation should be applied to fit closely to the conductor.

~~**NOTE**—The user should carefully select the insulation material regarding its electrical characteristics and intended use in the marine environment.~~

### 6.3 Cable elements

The cores within each pair, triple, or quad should be clearly identified by colour or number as given in the applicable cable standard. The identification used should be durable and legible.

The choice of the maximum average length of lay in the finished cable should be selected with respect to the specified crosstalk requirements, handling performance and the pair or quad integrity.

#### 6.4 Selection of screen, core screen or shield

If a screen is required, it may consist of the following:

- a) a metallic laminated tape bonded to polyester and a drain wire in direct contact with the metallic side of the tape;
- b) plain or metal coated copper braid;
- c) a metallic laminated tape bonded to polyester and a drain wire in direct contact with the metallic side of the tape with a plain or metal coated copper braid.

The construction of the screen, core screen or shield should be as listed in IEC 60092-350 or the applicable cable standard. Care should be taken when putting dissimilar metals in contact with each other. Coatings or other methods of protection may be necessary to prevent galvanic interaction often encountered in the ~~saliferous~~ marine environment.

~~NOTE—The type of screening should be carefully selected by the user in respect of not only the type of disturbance, electrostatic or electro-magnetic, but also the mechanical hazards, and potential for corrosion, encountered in the marine environment.~~

#### 6.5 Selection of outer ~~protection~~ sheath

The range of materials for use as protective sheath should, where possible, be selected from those listed in ~~IEC 60092-359~~ IEC 60092-360, which have been proven by experience to be suitable for use in the marine environment. Materials listed in IEC 60096-0-1 and IEC 61156-1 may also be considered; the material chosen should meet the requirements of this document.

The material selected should be compatible with the cable components with which it is in contact and compatible with the intended environment and operating temperature of the cable.

In instances where the construction of a cable does not conform with a standard from IEC 60092 (all parts), it should be ensured that the material used as the protective sheath has adequate mechanical strength in respect of the mechanical hazards to which it may be subjected during installation and service. The potential for corrosion, of underlying layers, encountered in the marine environment should also be considered. Attention is drawn to the list of permitted protective coverings given in IEC 60092-350.

Due consideration should be given to fluid resistance for cables installed where water condensation or harmful vapours (including oil vapour) may be present. In this instance, the cables should meet the appropriate fluid resistance requirements of ~~Annex D of IEC 61892-4~~ IEC 60092-360.

~~NOTE—Not all materials in IEC 60092-359 meet the fluid resistance requirement.~~

Also, consideration should be given to the fire performance characteristics given in Clause 10.

The minimum thickness of sheath considered as being acceptable for cables for installation on board a ship or offshore installation is 0,7 mm.

#### 6.6 Selection of metallic sheath (covering), braid or armour

The construction of the metal braid armour should be in accordance with IEC 60092-350. The type of metal braid armour should be carefully selected by the user in respect of not only the mechanical hazards but also the potential for corrosion encountered in the marine environment. Care should be taken when putting dissimilar metals in contact with each other. Coatings or other methods of protection may be necessary to prevent galvanic interaction often encountered in the ~~saliferous~~ marine environment.

## 7 Marking

Cables should be provided with a continuous indication of origin (manufacturers name or trade mark), by one of the following methods:

- a) printing, indenting or embossing on the outer sheath;
- b) a printed tape within the cable;
- c) the inclusion of identification threads within the cable;
- d) printing on the insulation of at least one core.

The marking should be durable and legible.

The spacings and dimensions of the indication of origin should be as given in the applicable product standard.

## 8 Guidance on the selection of appropriate tests

Unless otherwise specified in the applicable product standard, tests should be made at an ambient temperature of  $(20 \pm 15) ^\circ\text{C}$ .

This document defines, by the frequency range in the intended application, seven classes of cable (Table 1) and, in Annex A, gives guidance in the selection of the appropriate tests to be applied, related to each class.

**Table 1 – Classification of cables by frequency range**

| Cable type                                | Frequency range                           |
|-------------------------------------------|-------------------------------------------|
| 1                                         | $f_{\text{max}} < 100 \text{ kHz}$        |
| 2                                         | $100 \text{ kHz} < f < 1 \text{ MHz}$     |
| 3                                         | $1 \text{ MHz} < f < 16 \text{ MHz}$      |
| 4                                         | $16 \text{ MHz} < f < 125 \text{ MHz}$    |
| 5                                         | $125 \text{ MHz} < f < 250 \text{ MHz}$   |
| 6                                         | $250 \text{ MHz} < f < 600 \text{ MHz}$   |
| 7                                         | $250 \text{ Hz} < f < 1\,000 \text{ MHz}$ |
| NOTE All cables are backwards compatible. |                                           |

## 9 Guide to use

### 9.1 ~~Introduction~~ Purpose

The aim of Clause 9 is to inform users of characteristics and limitations of electric cables and thereby to minimise misuse.

It is assumed that the design of installation and the specification, purchase and installation of cables in accordance with this document is entrusted to suitable skilled and competent people.

In case of doubt as to the suitability of cables covered by this document for a particular use, further specific information should be obtained from the manufacturer.

## 9.2 General

All cables should be stored in a suitable place until required. Consideration should be given to security and environmental conditions.

Any protective packaging should not be removed until the cable is to be installed.

The ends of cables should always remain sealed during storage and installation to prevent the ingress of water and other contaminants.

## 9.3 Voltage rating

### 9.3.1 Data and telecommunication cables

All cables covered by this document should be subject to electrical tests applicable to their maximum rated voltage. Recommended maximum rated voltages for data and ~~instrumentation~~ telecommunication cables are:

- 30 V AC;
- 60 V AC;
- 250 V AC.

The rated voltage of any cable should not be lower than the nominal voltage of the circuit for which it is used.

NOTE These cables are not intended to be used for power supply.

### 9.3.2 High-frequency radio communications cables

The voltage rating of the cable should not be lower than the nominal voltage of the radio communication system in which it will be used.

## 9.4 Current ratings

The cables covered by this document are only recommended for use in circuits carrying analogue and digital signals.

Where high power co-axial feeder cables are to be used, advice from the cable manufacturer should be sought.

~~NOTE These cables are not intended to be used for power supply.~~

## 9.5 Thermal considerations

It is recommended that the rated operating temperature of the cable selected shall be at least 10 °C higher than the maximum ambient temperature likely to exist, or to be produced, in the space where the cable is installed.

These cables should not normally be run in groups or bundles containing power cables operating at or near their maximum operating temperature. Where this is unavoidable, then the operating temperature should be based upon the lowest maximum operating temperature of any cable in the group or bundle.

All insulation and sheathing materials used for cables become progressively stiffer as their temperature is lowered below the normal ambient temperature to the point where they become brittle. This should be carefully considered when comparing the minimum operating temperature of the cable with the intended environment and application.