



Edition 5.0 2024-06 REDLINE VERSION

# INTERNATIONAL STANDARD



Electrical installations in ships – Part 353: Power cables for rated voltages 1 kV and 3 kV

INTERNATIONAL ELECTROTECHNICAL COMMISSION

ICS 29.060.20; 47.020.60

ISBN 9782-832-2911-84

Warning! Make sure that you obtained this publication from an authorized distributor.

## CONTENTS

	FOREWORD		
	1 Scop	pe- <mark>and-object</mark>	6
	2 Norr	native references	6
	3 Tern	is and definitions	7
	4 Gen	eral requirements	7
	4.1	Rated voltage	7
	4.2	Markings	
	4.2.2	Indication of origin and voltage identification	8
	4.2.2	2 Continuity of marking	8
	4.2.3	Core identification	8
ļ	5 Con	structional requirements	8
	5.1	General description	8
	5.1.1	Overview	8
	5.1.2	2 Unarmoured cables (excluding 1,8/3 kV)	9
	5.1.3	Armoured cables	9
	5.2	Conductors	. 10
	5.3	Insulation	. 10
	5.3.2	Material	. 10
	5.3.2	2 Application	. 10
	5.3.3	B Thickness of insulation	.10
	5.4	Cabling (including fillers and binders)	
	5.5	Inner covering	
	5.5.7	-	
	5.5.2	5	
	5.6	Screen	
	5.6.		
	5.6.2		
	5.7	Inner sheath	
	5.7.		
	5.7.2		
	5.7.3		
	5.8 5.8.2	Braid armour	
	5.8.2		
	5.8.3		
	5.8.4	5 ,	
	5.9	Outer sheath	
	5.9. <sup>2</sup>		
	5.9.2		
	5.9.3		
	5.9.4		
	5.10	Construction for special applications	
	5.10		
	5.10		
(	6 Test	s – Methods and requirements	
		(informative) Alternative enhanced insulation thickness for 0,6/1 kV	
		· · · · · · · · · · · · · · · · · · ·	

Annex <mark>B</mark> A	(informative) Identification of cores of multicore cables	.20
<mark>B</mark> A.1	Inscription	.20
BA.2	Arrangement of the marks	.20
BA.3	Spacing and dimensions of the marks	.20
BA.4	Appearance of inscription	.21
Bibliograp	hy	. 22
Figure BA	.1 – Arrangement of the marks	.20
5		
Table 1 –	Insulation thickness	.11
Table 2 –	Thickness of extruded inner covering and fictitious diameters	.12
Table 3 –	Requirements of drain wire	. 12
Table 4 –	Tests applicable to all cables	.15
Table 5 –	Additional tests required for halogen-free cables	.17
Table 6 –	Additional test required for low smoke cables	.17
Table 7 –	Additional test required for fire resistant cables	. 17
Table 8 –	Additional tests required for specific performances	.17
	Additional test for cables for installation between areas with and without atmospheres	. 18
Table <mark>B</mark> A.	1 – Dimensions of the marks	.21

### INTERNATIONAL ELECTROTECHNICAL COMMISSION

## ELECTRICAL INSTALLATIONS IN SHIPS -

### Part 353: Power cables for rated voltages 1 kV and 3 kV

### 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.
- The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) IEC draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). IEC takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, IEC had not received notice of (a) patent(s), which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at https://patents.iec.ch. IEC shall not be held responsible for identifying any or all such patent rights.

This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition IEC 60092-353:2016. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

IEC 60092-353 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. It is an International Standard.

This fifth edition cancels and replaces the fourth edition published in 2016. This edition constitutes a technical revision.

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

- a) Updated references to IEC 60092-350 for general construction and test methods and IEC 60092-360 for insulating and sheathing materials.
- b) Added subclause 5.10: Construction for special applications.
- c) Added Table 9: Additional test for cables for installation between areas with and without explosive atmospheres.
- d) Deleted the test requirement IEC 60331-21 from Table 7.
- e) Deleted the former Annex A (Alternative enhanced insulation thickness for 0,6/1 kV).

The text of this International Standard is based on the following documents:

Draft	Report on voting
18A/476/CDV	18A/482/RVC

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members\_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all the parts of the IEC 60092 series, 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 webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn, or
- revised.

IMPORTANT – The "colour inside" logo on the cover page of this document 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.

## ELECTRICAL INSTALLATIONS IN SHIPS –

### Part 353: Power cables for rated voltages 1 kV and 3 kV

### 1 Scope and object

This part of IEC 60092 is applicable to shipboard and offshore non radial field power cables with extruded solid insulation, having a voltage rating of 0,6/1 (1,2) kV or 1,8/3 (3,6) kV intended for fixed installations.

Cables designed to maintain circuit integrity during a fire are included.

The various types of power cables are given in 5.1. The constructional requirements and test methods are aligned with those indicated in IEC 60092-350, unless otherwise specified in this document.

The object of this document is:

- to standardize cables whose safety and reliability is ensured when they are installed in accordance with the requirements of IEC 60092-352 or IEC 61892-4,
- to lay down standard manufacturing requirements and characteristics of such cables directly or indirectly bearing on safety, and
- to specify test methods for checking conformity with those requirements.

### 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 60050-461, International Electrotechnical Vocabulary – Part 461: Electric cables

IEC 60079-14:2013 Explosive atmospheres – Part 14: Electrical installations design, selection and erection

IEC 60092-350:<del>2014</del>2020, *Electrical installations in ships – Part 350: General construction and test methods of power, control and instrumentation cables for shipboard and offshore applications* 

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 60228, Conductors of insulated cables

IEC 60331-1, Tests for electric cables under fire conditions – Circuit integrity – Part 1: Test method for fire with shock at a temperature of at least 830 °C for cables of rated voltage up to and including 0,6/1,0 kV and with an overall diameter exceeding 20 mm

IEC 60331-2, Tests for electric cables under fire conditions – Circuit integrity – Part 2: Test method for fire with shock at a temperature of at least 830 °C for cables of rated voltage up to and including 0,6/1,0 kV and with an overall diameter not exceeding 20 mm

IEC 60092-353:2024 RLV © IEC 2024 - 7 -

IEC 60331-21, Tests for electric cables under fire conditions – Circuit integrity – Part 21: Procedures and requirements – Cables of rated voltage up to and including 0,6/1,0 kV

IEC 60332-1-2, Tests on electric and optical fibre cables under fire conditions – Part 1-2: Test for vertical flame propagation for a single insulated wire or cable – Procedure for 1 kW pre-mixed flame

IEC 60332-3-22, Tests on electric-cables and optical fibre cables under fire conditions – Part 3-22: Test for vertical flame spread of vertically-mounted bunched wires or cables – Category A

IEC 60445, Basic and safety principles for man-machine interface, marking and identification – Identification of equipment terminals, conductor terminations and conductors

IEC 60684-2, Flexible insulating sleeving – Part 2: Methods of test

IEC 60754-1, Test on gases evolved during combustion of materials from cables – Part 1: Determination of the halogen acid gas content

IEC 60754-2, Test on gases evolved during combustion of materials from cables – Part 2: Determination of acidity (by pH measurement) and conductivity

IEC 61034-2, Measurement of smoke density of cables burning under defined conditions – Part 2: Test procedure and requirements





Edition 5.0 2024-06

# INTERNATIONAL STANDARD

Electrical installations in ships – Part 353: Power cables for rated voltages 1 kV and 3 kV



## CONTENTS

FOREW	ORD.		4
1 Sco	pe		6
2 Nor	mative	e references	6
3 Ter	ms an	d definitions	7
4 Ger	neral r	equirements	
4.1		ed voltage	
4.2		kings	
4.2		Indication of origin and voltage identification	
4.2		Continuity of marking	
4.2		Core identification	
	-	ional requirements	
5.1		neral description	
5.1 5.1		Overview	
5.1		Unarmoured cables (excluding 1,8/3 kV)	
5.1. 5.1		Armoured cables (excluding 1,8/3 kV)	
5.2		iductors	-
5.2 5.3		Ilation	
5.3		Material	-
5.3		Application	
5.3		Thickness of insulation	
5.4		ling (including fillers and binders)	
5.5		er covering	
5.5		General	
5.5		Thickness of inner covering	
5.6		en	
5.6		Construction	
5.6		Application	
5.7		application	
5.7		Material	
5.7		Application	
5.7		Thickness of inner sheath	
5.8		id armour	
5.8		General	
5.8		Braid wire diameter	-
5.8		Coverage density	
5.8		Application of the armour	
5.9		er sheath	
5.9		Material	
5.9		Application	
5.9		Thickness of outer sheath	
5.9		Colour of outer sheath	
5.10		struction for special applications	
5.1		Cables for installation in areas with explosive atmospheres	
5.1		Cables for installation between areas with and without explosive	. •
		atmospheres	. 15
6 Tes	ts – N	lethods and requirements	15
Annex A	(infor	mative) Identification of cores of multicore cables	19

A.1	Inscription	19
A.2	Arrangement of the marks	19
A.3	Spacing and dimensions of the marks	19
A.4	Appearance of inscription	20
Bibliograp	hy	21
Figure A.1	– Arrangement of the marks	19
Table 1 –	Insulation thickness	11
Table 2 –	Thickness of extruded inner covering and fictitious diameters	12
Table 3 –	Requirements of drain wire	12
Table 4 –	Tests applicable to all cables	15
Table 5 –	Additional tests required for halogen-free cables	17
Table 6 –	Additional test required for low smoke cables	17
Table 7 –	Additional test required for fire resistant cables	17
Table 8 –	Additional tests required for specific performances	17
	Additional test for cables for installation between areas with and without atmospheres	18
Table A.1	– Dimensions of the marks	20

### INTERNATIONAL ELECTROTECHNICAL COMMISSION

## ELECTRICAL INSTALLATIONS IN SHIPS -

### Part 353: Power cables for rated voltages 1 kV and 3 kV

### 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.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) IEC draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). IEC takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, IEC had not received notice of (a) patent(s), which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at https://patents.iec.ch. IEC shall not be held responsible for identifying any or all such patent rights.

IEC 60092-353 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. It is an International Standard.

This fifth edition cancels and replaces the fourth edition published in 2016. This edition constitutes a technical revision.

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

- a) Updated references to IEC 60092-350 for general construction and test methods and IEC 60092-360 for insulating and sheathing materials.
- b) Added subclause 5.10: Construction for special applications.
- c) Added Table 9: Additional test for cables for installation between areas with and without explosive atmospheres.

- d) Deleted the test requirement IEC 60331-21 from Table 7.
- e) Deleted the former Annex A (Alternative enhanced insulation thickness for 0,6/1 kV).

The text of this International Standard is based on the following documents:

Draft	Report on voting
18A/476/CDV	18A/482/RVC

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members\_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all the parts of the IEC 60092 series, 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 webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn, or
- revised.

## **ELECTRICAL INSTALLATIONS IN SHIPS –**

### Part 353: Power cables for rated voltages 1 kV and 3 kV

### 1 Scope

This part of IEC 60092 is applicable to shipboard and offshore non radial field power cables with extruded solid insulation, having a voltage rating of 0.6/1(1.2) kV or 1.8/3(3.6) kV intended for fixed installations.

Cables designed to maintain circuit integrity during a fire are included.

The various types of power cables are given in 5.1. The constructional requirements and test methods are aligned with those indicated in IEC 60092-350, unless otherwise specified in this document.

The object of this document is:

- to standardize cables whose safety and reliability is ensured when they are installed in accordance with the requirements of IEC 60092-352 or IEC 61892-4,
- to lay down standard manufacturing requirements and characteristics of such cables directly or indirectly bearing on safety, and
- to specify test methods for checking conformity with those requirements.

### 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 60050-461, International Electrotechnical Vocabulary – Part 461: Electric cables

IEC 60079-14:2013 Explosive atmospheres – Part 14: Electrical installations design, selection and erection

IEC 60092-350:2020, Electrical installations in ships – Part 350: General construction and test methods of power, control and instrumentation cables for shipboard and offshore applications

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 60228, Conductors of insulated cables

IEC 60331-1, Tests for electric cables under fire conditions – Circuit integrity – Part 1: Test method for fire with shock at a temperature of at least 830 °C for cables of rated voltage up to and including 0,6/1,0 kV and with an overall diameter exceeding 20 mm

IEC 60331-2, Tests for electric cables under fire conditions – Circuit integrity – Part 2: Test method for fire with shock at a temperature of at least 830 °C for cables of rated voltage up to and including 0,6/1,0 kV and with an overall diameter not exceeding 20 mm

IEC 60092-353:2024 © IEC 2024 - 7 -

IEC 60332-1-2, Tests on electric and optical fibre cables under fire conditions – Part 1-2: Test for vertical flame propagation for a single insulated wire or cable – Procedure for 1 kW pre-mixed flame

IEC 60332-3-22, Tests on electric and optical fibre cables under fire conditions – Part 3-22: Test for vertical flame spread of vertically-mounted bunched wires or cables – Category A

IEC 60445, Basic and safety principles for man-machine interface, marking and identification – Identification of equipment terminals, conductor terminations and conductors

IEC 60684-2, Flexible insulating sleeving – Part 2: Methods of test

IEC 60754-1, Test on gases evolved during combustion of materials from cables – Part 1: Determination of the halogen acid gas content

IEC 60754-2, Test on gases evolved during combustion of materials from cables – Part 2: Determination of acidity (by pH measurement) and conductivity

IEC 61034-2, Measurement of smoke density of cables burning under defined conditions – Part 2: Test procedure and requirements