



Guidance No.: E-01(201705)

E-01 SHIPBOARD ELECTRIC WIRES AND CABLES

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Foreword:

This Guidance is a part of CCS Rules, which contains technical requirements, inspection and testing criteria related to classification and statutory survey of marine products.

This Guidance is published and updated by CCS and can be found through <http://www.ccs.org.cn> . Comments or suggestions can be sent by email to ps@ccs.org.cn .

This Guidance references and quotes rules and standards as "Rules for Classification of Sea-going Steel Ships" and IEC60092-350 (2008-02), IEC60092-351 (2004-04), IEC60092-354 (2003), IEC60092-359 (1999-08), etc. By now in addition to the relevant sections of " Rules for Classification of Sea-going Steel Ships ", IEC60092-350 has been updated to version 4.0(2014-08), IEC60092-351 and IEC60092-359 has merged into the new standard IEC60092-360 (2014-04), IEC60092- 2014-08 354 has been updated to version 3.0(2014-08).

As CCS has not yet put the latest version of IEC standards into " Rules for Classification of Sea-going Steel Ships " and its amendments, so the relevant contents of this Guidance have not been updated, and still can be used as the technical basis of CCS factory approval, CCS also accept the latest version of the above IEC standard as the approval basis.

Historical versions and release date: E-01(201510), October 20, 2015

Main changes and effective date: E-01(201704), April , 2017

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

- a) Updated references to IEC60092-350:2014 for general construction and test methods and IEC60092-360:2014 for insulating and sheathing materials.
- b) Updated references to IEC60092-353:2016 and IEC60092-354:2014 for test requirements.
- c) Deleted the normatively referenced standards not be used in the text.
- d) Interpreted the normatively referenced standard names into Chinese.
- e) Editorial change.
- f) Correct errors in printing.

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SHIPBOARD ELECTRIC WIRES AND CABLES

1 General provisions

1.1 Application

1.1.1 This ~~Guideline~~Guidance applies to approval and inspection of cables ~~(rated voltage 18/30/36 kV and below)~~ which are permanently ~~unfixed~~, fixed and used on ships and offshore installations.

1.1.2 Shipboard electric cables are to include:

(1) Power cables;

(2) Cables for control and instrumentation circuits, etc.

1.1.3 This Guidance does not cover:

~~(1) optical~~Optical fibre

~~(2) sub-sea~~Sub-sea and umbilical cables

~~(3) coaxial~~Coaxial cables

~~(4) data~~Data and communication cables

~~(5) Cables suitable for frequent or continual flexing-use (See IEC60227 and IEC60245)~~

1.2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.~~1.2.1 The approval and inspection of shipboard cables in this Chapter are to be based on the following documents:~~

~~1.2.2 Products and performance standards~~

~~Section 5, Chapter 3 of PART FOUR of CCS Rules for~~
Classification of Sea-going Steel Ships ~~Part 4, Chapter 3,~~

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带格式表格

	<u>Section 5</u> Section 5, Chapter 3, Part 4	
IEC-60092-350(2008-02)-2014	Electrical installations in ships - Part 350: <u>General construction and test methods of power, control and instrumentation cables for shipboard and offshore applications</u> Shipboard power cables—General construction and test requirements—	带格式的 带格式的：字体：五号，字体颜色：黑色
IEC 60092-351(2004-04)-	Electrical installations in ships—Part 351: Insulating materials for shipboard and offshore units, power, control, instrumentation, telecommunication and data cables	带格式的
IEC-60092-353(2011-08)-2016	Electrical installations in ships - Part 353: Power cables for rated voltages 1 kV and 3 kV	
IEC-60092-354(2003-06)-2014	Electrical installations in ships - Part 354: Single- and three-core power cables with extruded solid insulation for rated voltages 6 kV (Um = 7,2 kV) up to 30 kV (Um = 36 kV)	
IEC60092-376:2003IEC-60092-359(1999-08)-	Electrical installations in ships - Part 376: Cables for control and instrumentation circuits 150/250 V (300 V) Electrical installations in ships—Part 359: Sheathing materials for shipboard power and telecommunication cables—	
IEC60228IEC-60092-376(2003-05)-	Conductors of insulated cables Electrical installations in ships—Part 376: Cables for control and instrumentation circuits 150/250 V (300 V)—	
IEC60092-360:2014IEC-60228(2004-11)-	<u>Electrical installations in ships – Part 360: Insulating and sheathing materials for shipboard and offshore units, power, control, instrumentation, telecommunication and data cables</u> Conductors of insulated cables—	带格式的：字体：五号 带格式的：字体：五号，字体颜色：黑色
<u>IEC60331-1</u>	<u>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</u>	带格式的：字体：（默认）宋体

	<u>exceeding 20 mm</u>	
<u>IEC60331-2</u>	<u>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</u>	带格式的: 字体: (默认) 宋体
<u>IEC60331-11</u>	<u>Tests for electric cables under fire conditions - Circuit integrity - Part 11: Apparatus - Fire alone at a flame temperature of at least 750 °C</u>	带格式的: 字体: (默认) 宋体
<u>IEC60331-21</u>	<u>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</u>	
<u>IEC60332-1-2</u>	<u>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</u>	
<u>IEC60332-3-22</u>	<u>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</u>	
<u>IEC60754-1</u>	<u>Test on gases evolved during combustion of materials from cables - Part 1: Determination of the halogen acid gas content</u>	
<u>IEC60754-2</u>	<u>Test on gases evolved during combustion of materials from cables - Part 2: Determination of acidity (by pH measurement) and conductivity</u>	
<u>IEC61034-1</u>	<u>Measurement of smoke density of cables burning under defined conditions - Part 1: Test apparatus</u>	
<u>IEC61034-2</u>	<u>Measurement of smoke density of cables burning under defined conditions - Part 2: Test procedure and</u>	

	<u>requirements</u>	
<u>IEC60811-201</u>	<u>Electric and optical fibre cables – Test methods for non-metallic materials – Part 201: General tests – Measurement of insulation thickness</u>	带格式的: 字体: Times New Roman
<u>IEC60811-202</u>	<u>Electric and optical fibre cables – Test methods for non-metallic materials – Part 202: General tests – Measurement of thickness of non-metallic sheath</u>	带格式的: 字体: Times New Roman
<u>IEC60811-203</u>	<u>Electric and optical fibre cables – Test methods for non-metallic materials – Part 203: General tests – Measurement of overall dimensions</u>	
<u>IEC60811-401</u>	<u>Electric and optical fibre cables – Test methods for non-metallic materials – Part 401: Miscellaneous tests – Thermal ageing methods – Ageing in an air oven</u>	带格式的: 字体: Times New Roman
<u>IEC60811-403</u>	<u>Electric and optical fibre cables – Test methods for non-metallic materials – Part 403: Miscellaneous tests – Ozone resistance test on cross-linked compounds</u>	带格式的: 字体: Times New Roman
<u>IEC60811-404</u>	<u>Electric and optical fibre cables – Test methods for non-metallic materials – Part 404: Miscellaneous tests – Mineral oil immersion tests for sheaths</u>	带格式的: 字体: Times New Roman
<u>IEC60811-409</u>	<u>Electric and optical fibre cables – Test methods for non-metallic materials – Part 409: Miscellaneous tests – Loss of mass test for thermoplastic insulations and sheaths</u>	带格式的: 字体: Times New Roman
<u>IEC60811-501</u>	<u>Electric and optical fibre cables – Test methods for non-metallic materials – Part 501: Mechanical tests – Tests for determining the mechanical properties of insulating and sheathing compounds</u>	带格式的: 字体: Times New Roman
<u>IEC60811-505</u>	<u>Electric and optical fibre cables – Test methods for non-metallic materials – Part 505: Mechanical tests – Elongation at low temperature for insulations and sheaths</u>	带格式的: 字体: Times New Roman 带格式的: 字体: Times New Roman

IEC60811-507	Electric and optical fibre cables – Test methods for non-metallic materials – Part 507: Mechanical tests – Hot set test for cross-linked materials	
IEC60811-508	Electric and optical fibre cables – Test methods for non-metallic materials – Part 508: Mechanical tests – Pressure test at high temperature for insulation and sheaths	带格式的: 字体: Times New Roman
IEC60811-509	Electric and optical fibre cables – Test methods for non-metallic materials – Part 509: Mechanical tests – Test for resistance of insulations and sheaths to cracking (heat shock test)	带格式的: 字体: Times New Roman
ISO7989-2:2007	Steel wire and wire products – Non-ferrous metallic coating on steel wire – Part 2: Zinc or zinc-alloy coating	带格式的: 字体: Times New Roman 带格式的: 字体: Times New Roman
IEC60684-2	Flexible insulating sleeving - Part 2: Methods of test	带格式的: 字体: Times New Roman
IEC60885-2	Electrical test methods for electric cables. Part 2: Partial discharge tests	带格式的: 字体: Times New Roman
IEC60050-461	International Electrotechnical Vocabulary - Part 461: Electric cables	带格式的: 字体: Times New Roman
1.2.3 Test methods and standards		
IEC 60331-1(2009-05)-	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	带格式表格 带格式的: 字体: (默认) 宋体
IEC 60331-2(2009-05)-	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	带格式的: 字体: (默认) 宋体

IEC 60331-11(2009-07)	Tests for electric cables under fire conditions—Circuit integrity—Part 11: Apparatus—Fire alone at a flame temperature of at least 750 °C
IEC 60331-21(1999-04)	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 60331-23(1999-04)	Tests for electric cables under fire conditions—Circuit integrity—Part 23: Procedures and requirements—Electric data cables
IEC 60331-25(1999-04)	Tests for electric cables under fire conditions—Circuit integrity—Part 25: Procedures and requirements—Optical fibre cables
IEC 60332-1-1(2004-07)	Tests on electric and optical fibre cables under fire conditions—Part 1-1: Test for vertical flame propagation for a single insulated wire or cable—Apparatus
IEC 60332-1-2(2004-07)	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 60332-1-3(2004-07)	Tests on electric and optical fibre cables under fire conditions—Part 1-3: Test for vertical flame propagation for a single insulated wire or cable—Procedure for determination of flaming droplets/particles
IEC 60332-3-10(2009-02)	Tests on electric and optical fibre cables under fire conditions—Part 3-10: Test for vertical flame spread of vertically mounted bunched wires or cables—Apparatus
IEC 60332-3-21(2000-10)	Tests on electric cables under fire conditions—Part 3-21: Test for vertical flame spread of vertically mounted bunched wires or cables—Category A F/R

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IEC 60332-3-22(2009-02)	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 60754-1(2011-11)	Test on gases evolved during combustion of materials from cables—Part 1: Determination of the halogen acid gas content	
IEC 60754-2(2011-11)	Test on gases evolved during combustion of materials from cables—Part 2: Determination of acidity (by pH measurement) and conductivity	
IEC 61034-1(2005-04)	Measurement of smoke density of cables burning under defined conditions—Part 1: Test apparatus	
IEC 61034-2(2005-04)	Measurement of smoke density of cables burning under defined conditions—Part 2: Test procedure and requirements	
IEC60811-201ed1.0(2012-03)	Electric and optical fibre cables—Test methods for non-metallic materials—Part 201: General tests—Measurement of insulation thickness	带格式的：缩进：首行缩进： 0 字符
IEC60811-202ed1.0(2012-03)	Electric and optical fibre cables—Test methods for non-metallic materials—Part 202: General tests—Measurement of thickness of non-metallic sheath	带格式的：缩进：首行缩进： 0 字符
IEC60811-203ed1.0(2012-03)	Electric and optical fibre cables—Test methods for non-metallic materials—Part 203: General tests—Measurement of overall dimensions	带格式的：缩进：首行缩进： 0 字符
IEC60811-401ed1.0(2012-03)	Electric and optical fibre cables—Test methods for non-metallic materials—Part 401: Miscellaneous tests—Thermal ageing methods—Ageing in an air oven	带格式的：缩进：首行缩进： 0 字符
IEC60811-40212ed1.0(2012-03)	Electric and optical fibre cables—Test methods for non-metallic materials—Part 412403: Miscellaneous tests—Ozone resistance test on cross-linked compounds—Thermal ageing methods	带格式的：缩进：首行缩进： 0 厘米

—Ageing in an air bomb

~~IEC60811-404~~ed1.0(2012-03)~~Electric and optical fibre cables—Test methods for non-metallic materials—Part 402404: Miscellaneous tests—Mineral oil immersion tests for sheaths Water absorption tests~~

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~~IEC60811-409~~IEC60811-502ed1.0(2012-03)~~Electric and optical fibre cables—Test methods for non-metallic materials—Part 409: Miscellaneous tests—Loss of mass test for thermoplastic insulations and sheathsElectric and optical fire cables—Test methods for non-metallic materials—Part 502: Mechanical tests—Shrinkage test for insulations~~

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~~IEC60811-501~~IEC60811-503ed1.0(2012-03)~~Electric and optical fibre cables—Test methods for non-metallic materials—Part 501: Mechanical tests—Tests for determining the mechanical properties of insulating and sheathing compoundsElectric and optical fire cables—Test methods for non-metallic materials—Part 503: Mechanical tests—Shrinkage test for sheaths~~

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IEC60811-606ed1.0(2012-03)

Electric and optical fire cables—Test methods for non-metallic materials—Part 606: Physical tests—Methods for determining the density

~~IEC60811-505~~IEC60811-403ed1.0(2012-03)~~Electric and optical fibre cables—Test methods for non-metallic materials—Part 505: Mechanical tests—Elongation at low temperature for insulations and sheathsElectric and optical fire cables—Test methods for non-metallic materials—Part 403: Miscellaneous tests—Ozone resistance test on cross-linked compounds~~

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IEC60811-507404ed1.0(2012-03)

Electric and optical fibre cables—Test methods for non-metallic materials—Part 507: Mechanical tests—Hot set test for cross-linked materials

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~~IEC60811-508ed1.0(2012-03)~~ Electric and optical fibre cables—Test methods for non-metallic materials—Part 508: Mechanical tests—Pressure test at high temperature for insulation and sheaths

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~~IEC60811-509ed1.0(2012-03)~~ Electric and optical fibre cables—Test methods for non-metallic materials—Part 509: Mechanical tests—Test for resistance of insulations and sheaths to cracking (heat shock test)

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~~IEC60811-405ed1.0(2012-03)~~ Electric and optical fire cables—Test methods for non-metallic materials—Part 405: Miscellaneous tests—Thermal stability test for PVC insulation and PVC sheaths

~~IEC60811-409ed1.0(2012-03)~~ Electric and optical fire cables—Test methods for non-metallic materials—Part 409: Miscellaneous tests—Loss of mass test for thermoplastic insulations and sheaths

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~~IEC60811-406ed1.0(2012-03)~~ Electric and optical fire cables—Test methods for non-metallic materials—Part 406: Miscellaneous tests—Resistance to stress cracking of polyethylene and polypropylene compounds

~~IEC60811-511ed1.0(2012-03)~~ Electric and optical fire cables—Test methods for non-metallic materials—Part 511: Mechanical tests—Measurement of the melt flow index of polyethylene compounds

~~IEC60811-605ed1.0(2012-03)~~ Electric and optical fire cables—Test methods for non-metallic materials—Part 605: Physical tests—Measurement of carbon black and/or mineral filler in polyethylene compounds

~~IEC60811-607ed1.0(2012-03)~~ Electric and optical fire cables—Test methods for non-metallic materials—Part 605: Physical tests—Measurement of carbon black and/or mineral filler

	in polyethylene compounds
— IEC60811-607ed1.0(2012-03)	Electric and optical fire cables—Test methods for non-metallic materials—Part 607: Physical tests—Test for the assessment of carbon black dispersion in polyethylene and polypropylene
— IEC60811-407ed1.0(2012-03)	Electric and optical fire cables—Test methods for non-metallic materials—Part 407: Miscellaneous tests—Measurement of mass increase of polyethylene and polypropylene compounds
— IEC60811-408ed1.0(2012-03)	Electric and optical fire cables—Test methods for non-metallic materials—Part 408: Miscellaneous tests—Long-term stability test of polyethylene and polypropylene compounds
IEC60811-410ed1.0(2012-03)	Electric and optical fire cables—Test methods for non-metallic materials—Part 410: Miscellaneous tests—Test method for copper-catalyzed oxidative degradation of polyolefin insulated conductors
IEC60811-510ed1.0(2012-03)	Electric and optical fire cables—Test method for non-metallic materials—Part 510: Mechanical tests—Methods specific to polyethylene and polypropylene compounds—Wrapping test after thermal ageing in air
IEC60811-512ed1.0(2012-03)	Electric and optical fire cables—Test methods for non-metallic materials—Part 512: Mechanical tests—Methods specific to polyethylene and polypropylene compounds—Tensile strength and elongation at break after conditioning at elevated temperature
IEC60811-513ed1.0(2012-03)	Electric and optical fire cables—Test methods for non-metallic materials—Part 513: Mechanical tests—Methods specific to polyethylene and polypropylene compounds—Wrapping test after

	conditioning	
IEC60811-501ed1.0(2012-03)	Electric and optical fire cables—Test methods for non-metallic materials—Part 501: Mechanical tests—Tests for determining the mechanical properties of insulating and sheathing compounds	带格式的：缩进：首行缩进： 0 厘米
IEC 60189-1(2007-05)	Low frequency cables and wires with PVC insulation and PVC sheath—Part 1: General test and measuring methods	
IEC 60189-2(2007-05)	Low frequency cables and wires with PVC insulation and PVC sheath—Part 2: Cables in pairs, triples, quads and quintuples for inside installations	
ISO7989-2:2007IEC-60189-3(2007-05)	Steel wire and wire products—Non-ferrous metallic coating on steel wire—Part 2: Zinc or zinc alloy coating Low frequency cables and wires with PVC insulation and PVC sheath—Part 3: Equipment wires with solid or stranded conductor wires, PVC insulated, in singles, pairs and triples	带格式的：字体：Times New Roman 带格式的：缩进：首行缩进： 0 厘米
IEC 60684-2(2011-08)	Flexible insulating sleeving—Part 2: Methods of test	带格式的：缩进：首行缩进： 0 厘米
IEC 60885-2(1987-03)	Electrical test methods for electric cables. Part 2: Partial discharge tests	带格式的：缩进：首行缩进： 0 厘米
1.2.4 Other standards		
IEC 60050-461(2008-06)	International Electrotechnical Vocabulary—Part 461: Electric cables—	带格式表格

1.3 Definitions

1.3.1 Terms and definitions in this Chapter are the same as those of IEC-60050-461(2008-06) and IEC60092-350:2014.

2 Plans and documents

2.1 General requirements for plans and documents to be submitted to CCS for examination and approval are specified in PART ONE of the [GuidelineGuidances](#).

2.2 The following plans and documents are to be submitted to CCS for approval:

2.2.1 Structural drawing of cables;

2.2.2 Technical specifications of cables or equivalent documents.

2.3 The following plans and documents are to be submitted to CCS for information:

2.3.1 Designation of cable types and specifications;

2.3.2 Table of cable construction data or equivalent documents;

2.3.3 Production process flow chart indicating quality control points;

2.3.4 List of production technology;

2.3.5 List of production equipment;

2.3.6 List of test equipment;

2.3.7 List of trademarks and suppliers of main raw materials;

2.3.8 Specimen of quality certificate;

2.3.9 Asbestos free statement;

2.3.10 Routine inspection programmer or equivalent documents;

2.3.11 Format of routine inspection report;

2.3.12 Operation instructions for the products;

2.3.13 Other documents to be submitted as required for approval.

3 Technical requirements

3.1 Shipboard electric cables ~~are to comply~~ shall be in accordance with the following standards:

3.1.1 Shipboard electric cables ~~shall be in accordance~~ are to comply with the requirements of IEC60092-350 ~~(2008-02);2014.~~

3.1.2 Power cables for rated voltages 1 kV and 3 kV ~~shall be in accordance~~ are to comply with the requirements of IEC60092-353 ~~(2011-08);2016.~~

3.1.3 Power cables for rated voltages 6 kV up to 30 kV ~~shall be in accordance~~ are to comply with the requirements of IEC 60092-354 ~~(2014(2003-06).~~

3.1.4 Cables for control and instrumentation circuits ~~shall be in accordance~~ are to comply with the requirements of IEC 60092-376 ~~(2003-05).~~

3.2 Non-metallic compounds such as insulation, non-metallic coverings and sheaths, fillers and binders of cables are not to contain asbestos.

3.3 ~~Each core of the multi-core cable and s~~Single-core cables ~~or cores for circuit~~ rated in excess of 20A ~~are to should be~~ either be non-armoured or they should be armoured ~~and covered~~ with non-magnetic material.

~~3.4 Screens for power cables are to comply with the requirements in paragraph 5.5 of IEC60092-353. The metallic screen is to cover outside the cores at least consisting of two cores laid up. The individual insulating core of pair unit, triple unit and multi unit shipboard power cables is to be without metallic screen or cover (i.e. sub-screened cable is not permitted). The screen shall be in accordance with the requirements of Clause 4.4 of IEC60092-350:2014. The screen of the power cables for rated voltage 0.6/1.0(1.2) kV and 1.8/3(3.6) kV, if any, shall be a collective metallic screen (i.e. the collective screen shall be applied over 2 twisted cores at least. The individually braided screen applying over a single core is forbidden) and shall be in accordance with the requirements of Clause 5.6 of IEC60092-353:2016.~~

~~3.5 In case of a braid armour of galvanized steel wires in which case the inner covering is to be extruded for pair unit, triple unit and multi unit shipboard power cables. The inner covering of 2-core, 3-core or multi-core cables shall be extruded in case of a braid armour of galvanised steel wires.~~

3.6 The insulating compounds and their designation for shipboard ~~power~~ cables shall be in accordance with the ~~are to be as given in Tabel 2 of IEC60092-360:2014~~ 51. For cables ~~having for~~

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rated voltage of 0.6/1(1.2)kV and below, Ethylene Propylene Rubber(~~types~~-EPR)、Hard grade Ethylene Propylene Rubber (HEPR)、Cross-linked PolyEthylene (XLPE)、Cross-linked Polyolefin halogen-free (HF-90) or Cross-linked Silicone rubber (S-95) are to be used. For cables ~~having-for~~ rated voltage of 1.8/3(3.6)kV and below, ~~types~~-EPR、HEPR、XLPE are to be used.

3.7 The inner, outer sheathing compounds ~~shall be in accordance with the~~are to be one of those given in Tabel 5 and 7 of IEC60092-360:201459 except that PVC type ST1 is not permitted. ~~The types of cross-linked sheathing compound are Polychloroprene rubber(SE), Chlorosulphonated polyethylene or chlorinated polyethylene rubber(SH) and Halogen-free rubber(SHF2). The types of thermoplastic sheathing compounds are Polyvinyl chloride thermoplastic(ST2, is permitted even though it releases harmful fumes under fire conditions) and Halogen-free thermoplastic(SHF1).~~

3.8 The construction of the shipboard power cables for rated voltage 1kV and 3kV ~~shall be in accordance with the requirements of Clause 5 of IEC60092-353:2016.~~ The construction of the shipboard power cables for rated voltage 6kV and 30kV shall be in accordance with the requirements of Clause 5 of IEC60092-354:2014.

4 Approval and tests

4.1 Cables used in ships classed with CCS ~~are to~~shall be subjected to CCS works approval, covering examination and approval of plans and technical documents, type approval tests and on-site audit.

4.2 Shipboard electric cables ~~are to~~shall be subjected to type test according to ~~4-4.2.1~~Clause 4.2.1 to 4.2.4.

4.2.1 Unless otherwise specified, all tests ~~are to~~shall be carried out in the following atmospheric conditions:

- (1) Ambient temperature: 15℃ to 35℃;
- (2) ~~relative~~Relative humidity: 30%RH to 90%RH;
- (3) ~~atmospheric~~Atmospheric pressure: 86 to 106 kPa.

4.2.2 Power cables for rated voltages 1 kV and 3 kV ~~are shall to~~ be type tested according to Table 4.2.2.

4.2.3 Power cables for rated voltages 6 kV up to 30 kV ~~are to~~shall be type tested according to

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Table 4.2.3.

4.2.4 Cables for control and instrumentation circuits ~~are to~~shall be type tested according to Table 4.2.4.

Type test of power cables for rated voltages 1 kV and 3 kV

Table 4.2.2

No.	Test	Requirement	Testing method
1	Electrical		
1.1	Insulation resistance measurement at ambient temperature test at 20°C	IEC60092-360:2014 5.1:2004 Table 23	IEC60092-350:2008-2014 para.7.2.1
1.2	Insulation resistance measurement at maximum rated temperature (90°C)	IEC60092-360:2014 5.1:2004 Table 23	IEC60092-350:2008-2014 para.7.2.2
1.3	Increase in of the a.c. capacitance after immersion in water when required	IEC60092-360:2014 Table 350:2008 para.7.3	IEC60092-350:2008-2014 para.7.3
1.4	High-voltage test for 4 h	IEC60092-350:2014 para.7.4	IEC60092-350:2014 para.7.4
2	Non-electrical		
2.1	Conductor examination	IEC60092-353:2016 para.5.2 IEC60228 Table II and III	IEC60092-350:2014 para.6.4
2.2	Measurement of thickness of insulation	IEC60092-353:2016 para.5.3.3	IEC60092-350:2014 para.8.2 IEC60811-201
2.3	Measurement of thickness of non-metallic sheaths (excluding inner coverings)	IEC60092-353:2016 para.5.5.2、5.7.3、5.9.3	IEC60092-350:2014 para.8.3 IEC60811-202
2.4	Coverage density of braid (Braid armoured Cables)	IEC60092-353:2016 para.5.8	IEC60092-350:2014 para.4.8.2
2.5	Test for determining the mechanical properties of insulation before and after ageing	IEC60092-360:2014 Table 4	IEC60092-350:2014 para.8.4 IEC60811-501 IEC60811-401
2.6	Test for determining the mechanical properties of sheath before and after ageing	IEC60092-360:2014 Table 6 and 8	IEC60092-350:2014 para.8.5 IEC60811-501 IEC60811-401

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2.7	Additional ageing test on pieces of completed cables (compatibility test)	IEC60092-360:2014 Table 4 and 6 and 8	IEC60092-350:2014 para.8.6 IEC60811-501 IEC60811-401
2.8	Loss of mass test on PVC ST2 sheath	IEC60092-360:2014 Table 8	IEC60092-350:2014 para.8.7 IEC60811-409

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2.9	Test for the behaviour of PVC ST2 and halogen-free SHF1 Sheaths at high temperature (hot pressure test)	IEC60092-360:2014 Table 8	IEC60092-350:2014 para.8.8 IEC60811-508
2.10	Test for the behaviour of PVC sheath ST2 and halogen-free SHF1 and SHF2 sheaths at low temperatures	IEC60092-360:2014 Table 6 and 8	IEC60092-350:2014 para.8.9 IEC60811-505
2.11	Test of the metal coating of copper wires	IEC60092-350:2014 para.8.11	IEC60092-350:2014 para.8.11
2.12	Galvanizing test	IEC60092-350:2014 para.8.12 ISO 7989-2:2007 para.5.3	IEC60092-350:2014 para.8.12 ISO 7989-2:2007 para.5.3
2.13	Test for resistance of PVC ST2 and halogen-free SHF1 sheaths to cracking (heat shock)	IEC60092-360:2014 Table 8	IEC60092-350:2014 para.8.13 IEC60811-509
2.14	Ozone resistance for insulations and sheaths	IEC60092-360:2014 Table 4 and 6	IEC60092-350:2014 para.8.14 IEC60811-403
2.15	Hot oil immersion test for sheaths (SE1, SH and SHF2 sheaths)	IEC60092-360:2014 Table 6	IEC60092-350:2014 para.8.15.1 IEC60811-404
2.16	Fire-retardant tests: IEC 60332-1-2 and IEC 60332-3-22	IEC60092-350:2014 para.8.17.1 IEC60332-1-2 IEC60092-350:2014 para.8.17.2 IEC60332-3-22	IEC60092-350:2014 para.8.17.1 IEC60332-1-2 IEC60092-350:2014 para.8.17.2 IEC60332-3-22 in which case cables are to be installed in touching configuration on the front of the ladder

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2.17	<u>Determination of hardness (HEPR insulation)</u>	<u>IEC60092-360:2014 Table 4</u>	<u>IEC60092-350:2014 para.8.18</u>
2.18	<u>Determination of modulus of elasticity (HEPR insulation)</u>	<u>IEC60092-360:2014 Table 4</u>	<u>IEC60092-350:2014 para.8.19</u>
2.19	<u>Durability of marking</u>	<u>IEC60092-350:2014 para.8.20</u>	<u>IEC60092-350:2014 para.8.20</u>
3	<u>Additional tests required for halogen-free cables</u>		
3.1	<u>Acid gas emission</u>	<u>IEC60092-350:2014 Table 7</u>	<u>IEC60092-350:2014 para.8.17.4</u> <u>IEC60754-1</u>

Continued table 4.2.2

3.2	<u>pH and conductivity</u>	<u>IEC60092-350:2014 Table 7</u>	<u>IEC60092-350:2014 para.8.17.5</u> <u>IEC60754-2</u>
3.3	<u>Fluorine content test</u>	<u>IEC60092-350:2014 Table 7</u>	<u>IEC60092-350:2014 para.8.17.6</u> <u>IEC60684-2</u>
4	<u>Additional test required for low smoke cables</u>		
4.1	<u>Smoke emission test for cables insulated and sheathed with halogenfree materials. When tested according to IEC 61034-2</u>	<u>IEC60092-350:2014 para.8.17.3</u> <u>IEC61034-1</u> <u>IEC61034-2</u> <u>The test is satisfactory for the finished cables if the levels of light transmittance exceeds 60% throughout the test</u>	<u>IEC60092-350:2014 para.8.17.3</u> <u>IEC61034-1</u> <u>IEC61034-2</u>
5	<u>Additional tests required for fire resistant cables</u>		
5.1	<u>Test for fire resistance (limited circuit integrity)</u>	<u>The test is to be carried out in accordance with IEC 60331-21 or IEC 60331-1 or IEC 60331-2 and the minimum time to failure is to be 90 min</u>	<u>IEC60092-350:2014 para.8.17.7</u> <u>IEC60331-1 (Overall diameter exceeding 20mm)</u> <u>IEC60331-2 (Overall diameter not exceeding 20mm)</u> <u>IEC60331-21</u>
6	<u>Additional tests required for specific performances</u>		
6.1	<u>Special test for low temperature behaviour (when required)</u>	<u>IEC60092-350:2014 Annex E</u>	<u>IEC60092-350:2014 para.8.10</u>
6.2	<u>Enhanced hot oil immersion</u>	<u>IEC60092-360:2014 Table 9</u>	<u>IEC60092-350:2014 para.8.15.2</u>
6.3	<u>Drill fluid test</u>	<u>IEC60092-360:2014 Table 10</u>	<u>IEC60092-350:2014 para.8.16</u>

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1.4	High-voltage test for 4 h	IEC60092-350:2008 2014 para.7.4	IEC60092-350:2008 2014 para.7.4
2	Non-electrical		
2.1	Conductor examination	IEC60092-353:20161 para.5.2	IEC60092-350:2008 2014 para.6.4
2.2	Check of cable dimensions		
	Measurement of		
	(Thickness of insulation	IEC60092-353:20161 para.5.3.3	IEC60092-350:20141 para.8.21
	Thickness of non-metallic sheaths (excluding inner coverings)	IEC60092-353:2011 para.5.5.2	IEC60811-201
	External diameter	IEC60092-353:2011 para.5.7.3	IEC60092-353:2011 para.8.2
2.3	Measurement of thickness of non-metallic sheaths (excluding inner coverings) Hot set test (HEPR, EPR, XLPE, HF 90, S-95 insulations and SE1, SHF2 sheaths)	IEC60092-353:201604 para.5.5.2, 5.7.3, 5.9.3 Table 4	IEC60092-350:201408 para.8.26.8
		IEC60092-359:1999 Table II	IEC60811-202
2.4	Coverage density of braid (Braid armoured Cables)	IEC60092-353:20161 para.5.8	IEC60092-350:201408 para.4.8.2
2.5	Test for determining the mechanical properties of insulation before and after ageing	IEC60092-360:201451:2004 Table 43	IEC60092-350:201408 para.8.43
			IEC60811-501
			IEC60811-401
2.6	Test for determining the mechanical properties of sheath before and after ageing	IEC60092-360:201459:1999 Table 6 and 8II	IEC60092-350:201408 para.8.54
			IEC60811-501
			IEC60811-401

Continued table 4.2.2

2.7	Additional ageing test on pieces of completed cables (compatibility test)	IEC60092-360:201451:2004 Table 4 and 6 and 83	IEC60092-350:201408 para.8.65
			IEC60811-501
			IEC60811-401
2.8	Loss of mass test (on PVC ST2 sheath)	IEC60092-360:201459:1999 Table 8III	IEC60092-350:201408 para.8.67
			IEC60811-409
2.9	Test for the behaviour of PVC-ST2 and halogen-free SHF1 Sheaths at high temperature (hot pressure test) (ST2 and SHF1 Sheaths)	IEC60092-360:201459:1999 Table 8 III	IEC60092-350:201408 para.8.87
			IEC60811-508

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2.10	Test for the behaviour of PVC sheath ST2 and halogen free SHF1 and SHF2 sheaths at low temperatures (ST2, SHF1 and SHF2 sheaths)	IEC60092-360:201459:1999 Table 6 and 8III	IEC60092-350:201408 para.8.98 IEC60811-505
2.11	Test of the metal for coating of copper wires	IEC60092-350:201408 para.8.110	IEC60092-350:201408 para.8.110
2.12	Galvanizing test	IEC60092-350:201408 para.8.121 ISO 7989 2:2007 para.5.3	IEC60092-350:201408 para.8.121 ISO 7989 2:2007 para.5.3
2.13	Test for resistance of PVC ST2 and halogen free SHF1 sheaths to cracking (heat shock) (ST2 and SHF1 sheaths)	IEC60092-360:201459:1999 Table 8 III	IEC60092-350:201408 para.8.122 IEC60811-509
2.14	Ozone resistance for (insulations and sheaths)	IEC60092-360:201451:2004 Table 4 and 6 IEC60092-359:1999 Table III	IEC60092-350:201408 para.8.142 IEC60811-403
2.15	Hot oil immersion test for sheaths (SE1, SH and SHF2 sheaths)	IEC60092-360:201459:1999 Table 6II	IEC60092-350:201408 para.8.154.1 IEC60811-404

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2.16	Flame spread Fire retardant tests: IEC 60332-1-2 and IEC 60332-3-22	IEC60092-350:201408 para.8.1617.1 IEC60332-1-2:2004 IEC60092-350:201408 para.8.1617.2 IEC60332-3-22:2009	IEC60092-350:201408 para.8.1617.1 IEC60332-1-2:2004 IEC60092-350:201408 para.8.1617.2 IEC60332-3-22:2009 -in which case cables are to be installed in touching configuration on the front of the ladder
2.17	Determination of hardness (HEPR insulation)	IEC60092-360:201451:2004 Table 4	IEC60092-350:201408 para.8.1718
2.18	Determination of modulus	IEC60092-360:201451:2004 Table 4	IEC60092-350:201408

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	(when required)		
6.2	Enhanced hot oil immersion	IEC60092-360:201459:1999 Table 9H	IEC60092-350:201408-para.8.1415.2
6.3	Mud Drill fluid drilling test	IEC60092-350360:201408-Tablepara.8.1510	IEC60092-350:201408-para.8.1516

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Type test of single and three-core power cables with extruded

solid insulation for rated voltages 6 kV up to 30 kV

Table 4.2.3

No.	Test item	Technical requirement	Testing method
1	Electrical		
1.1	Insulation resistance measurement Partial discharge test	IEC60092-360:201454:2003 para.18.3.3 Table 3	IEC60092-350:20144:2003 para.18.3.37.2.1 IEC60885-2:1987
1.2	High voltage sequence test Bending test	IEC60092-350:20144:2003 para.18.3.47.7	IEC60092-350:20144:2003 para.18.3.47.7
1.3	Insulation resistance measurement at maximum rated temperature Tan δ measurement as a function of voltage	IEC60092-360:2014 Table 354:2003 para.18.3.5	IEC60092-350:2014:2003 para.18.3.57.2.2
1.4	Increase in a.c. capacitance after immersion in water Tan δ measurement as a function of temperature	IEC60092-360:2014 Table 354:2003 para.18.3.6	IEC60092-350:2014:2003 para.18.3.67.3
1.5	Heating cycle plus partial discharge test	IEC60092-354:2003 para.18.3.7	IEC60092-354:2003 para.18.3.7
1.6	Impulse withstand test, followed by a power frequency voltage test	IEC60092-354:2003 para.18.3.8	IEC60092-354:2003 para.18.3.8
1.7.5	High voltage test for 4h	IEC60092-350:2014 para.7.7.9:2003 Table 5	IEC60092-350:2014 para.7.7.9:2003 para.18.2.9
2	Non-electrical		
2.1	Conductor examination Measurement of thickness of insulation	IEC60092-354:2014 para.5.2 93 Table 4 IEC60228 表 Table II、III 992-350:2008 para.4.3.3	IEC60092-350:201498 para.6.48.1

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2.2	Check of cable dimensions		
	Thickness of insulation	IEC60092-354:2014 1493	IEC60092-350:2014 1498 para.8.2
	Measurement of thickness of non-metallic sheaths	para. 14.25.3.3 and 15.2 IEC60092-354:2014 1493 para. 45.7.3.2 5.8.3 and 4.95.10.3	IEC60811-201 IEC60092-350:2014 para.8.3 IEC60811-202
	Dimensions of braid armour	IEC60092-354:2014 para. 5.9.2, 5.9.3	
	External diameter		IEC60092-350:2014 para.6.7 IEC60811-203
2.3	Coverage density of braid (Braid armoured Cables)	IEC60092-354:2014 para. 5.9	IEC60092-350:2014 para. 4.8.2
2.4	Mechanical properties of insulation before and after ageing	IEC60092-360:2014 Table 4	IEC60092-350:2014 para.8.4 IEC60811-501 IEC60811-401
2.5	Mechanical properties of sheaths before and after ageing	IEC60092-360:2014 Table 6 and 8	IEC60092-350:2014 para.8.5 IEC60811-501 IEC60811-401
2.6	Additional ageing compatibility test	IEC60092-360:2014 Table 4 and 6	IEC60092-350:2014 para.8.6 IEC60811-501 IEC60811-401
2.7	Loss of mass test (PVC, ST2 sheaths)	IEC60092-360:2014 Table 8	IEC60092-350:2014 para.8.7 IEC60811-409
Continued table 4.2.3			
2.8	Behavior at high temperature (ST2 and SHF1 sheaths hot pressure test)	IEC60092-360:2014 Table 8	IEC60092-350:2014 para.8.8 IEC60811-508
2.9	Behavior at low temperature(ST2, SHF1 and SHF2 sheaths)	IEC60092-360:2014 Table 6 and 8	IEC60092-350:2014 para.8.9 IEC60811-505
2.10	Test of the metal coating of copper wires	IEC60092-350:2014 para.8.11	IEC60092-350:2014 para.8.11
2.11	Galvanizing test	IEC60092-350:2014 para.8.12 ISO 7989-2:2007 para. 5.3	IEC60092-350:2014 para.8.12 ISO 7989-2:2007 para. 5.3
2.12	Resistance to cracking heat shock(ST2 and SHF1 sheaths)	IEC60092-360:2014 Table 8	IEC60092-350:2014 para.8.13 IEC60811-509
2.13	Ozone resistance (insulation and sheaths)	IEC60092-360:2014 Table 4 and 6	IEC60092-350:2014 para.8.14 IEC60811-403
2.14	Hot oil immersion (SE1, SH and SHF2 sheaths)	IEC60092-360:2014 Table 6	IEC60092-350:2014 para.8.15 IEC60811-404

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2.15	Flame-retardant	IEC60092-350:2014 para.8.17.1 IEC60332-1-2 IEC60092-350:2014 para.8.17.2 IEC60332-3-22	IEC60092-350:2014 para.8.17.1 IEC60332-1-2 IEC60092-350:2014 para.8.17.2 IEC60332-3-22 in which case cables shall be installed in touching configuration on the front of the ladder
2.16	Determination of hardness (HEPR insulation)	IEC60092-360: 2014 Table 4	IEC60092-350:2014 para.8.18
2.17	Determination of modulus of elasticity (HEPR insulation)	IEC60092-360: 2014 Table 4	IEC60092-350:2014 para.8.19
2.18	Durability of marking	IEC60092-350:2014 para.8.20	IEC60092-350:2014 para.8.20
3	Additional tests required for halogen-free cables		
3.1	Acid gas emission	IEC60092-350:2014 Table 7	IEC60092-350:2014 para. 8.17.4 IEC60754-1
3.2	pH and conductivity	IEC60092-350:2014 Table 7	IEC60092-350:2014 para. 8.17.5 IEC60754-2
3.3	Fluorine content test	IEC60092-350:2014 Table 7	IEC60092-350:2014 para. 8.17.6 IEC60684-2
4	Additional test required for low smoke cables		

Continued table 4.2.3

4.1	Smoke density test for cables insulated and sheathed with halogen-free materials, when tested according to IEC 61034-1 and IEC 61034-2	IEC60092-350:2014 para.8.17.3 IEC61034-1 IEC61034-2 The test is satisfactory for the finished cables if the levels of light transmittance exceeds 60% throughout the test	IEC60092-350:2014 para.8.17.3 IEC61034-1 IEC61034-2
5	Additional tests required for fire resistant cables (if any)		
5.1	Test for fire resistance (limited circuit integrity)	The test shall be carried out in accordance with IEC 60331-21 or IEC 60331-1 or IEC 60331-2 and the minimum time to failure shall be 90 min	IEC60092-350:2014 para. 8.17.7 IEC60331-1 (Overall diameter exceeding 20mm) IEC60331-2 (Overall diameter not exceeding 20mm) IEC60331-21
6	Additional tests when required		
6.1	Special test for low temperature behaviour	IEC60092-350:2014 Annex E	IEC60092-350:2014 para. 8.10
6.2	Enhanced hot oil immersion	IEC60092-360: 2014 Table 9	IEC60092-350:2014 para. 8.15.2

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6.3	Drill fluid test	IEC60092-360:2014 Table 10	IEC60092-350:2014 para. 8.16
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Continued table 4.2.3

2.3	Coverage density of braid (Braid armoured Cables)	IEC60092-354:2014 para. 5.9	IEC60092-350:2014 para. 4.8.2
2.34	Test for determining the mechanical properties of insulation before and after ageing in air bomb	IEC60092-360:2014 51:2004 Table 34	IEC60092-350:2014 408 para. 8.43 IEC60811-501 IEC60811-401
2.45	Test for determining the mechanical properties of sheaths before and after ageing in air bomb	IEC60092-360:2014 59:1999 Table H6 and 8	IEC60092-350:2014 408 para. 8.45 IEC60811-501 IEC60811-401
2.56	Additional ageing test on pieces of completed cables (compatibility test)	IEC60092-360:2014 51:2004 Table 34 and 6	IEC60092-350:2014 408 para. 8.56 IEC60811-501 IEC60811-401
2.67	Loss of mass test on (PVC insulation and ST1 and ST2 sheaths)	IEC60092-360:2014 51:2004 Table 48 IEC60092-359:1999 Table III	IEC60092-350:2014 408 para. 8.76 IEC60811-409
2.78	Test for behavior at high temperature of PVC insulation and PVC and ST1, (ST2 and SHF1 sheaths (hot pressure test)	IEC60092-360:2014 51:2004 Table 84 IEC60092-359:1999 Table III	IEC60092-350:2014 408 para. 8.78 IEC60811-508
2.89	Test for behavior at low temperature of PVC insulation and PVC and ST1, (ST2, SHF1 and SHF2 sheaths	IEC60092-360:2014 51:2004 Table 6 and 84 IEC60092-359:1999 Table III	IEC60092-350:2014 408 para. 8.89 IEC60811-505
2.9	Special test for low temperature behaviour	IEC60092-350:2008 para. 8.9	IEC60092-350:2008 para. 8.9
2.10	Test of the metal coating of copper wires	IEC60092-350:2014 para. 8.11 IEC60228:2004 Tables H, III	IEC60092-350:2014 408 para. 8.110
2.11	Galvanizing test	IEC60092-350:2014 408 para. 8.121 ISO 7989-2:2007 para. 5.3	IEC60092-350:2014 408 para. 8.121 ISO 7989-2:2007 para. 5.3

Continued table 4.2.3

2.12	Test for resistance to	IEC60092-360:2014 51:2004	IEC60092-350:2014 408
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	cracking heat shock of PVC insulation, ST1, (ST2 and SHF1 sheaths (heat shock test)	Table 84 IEC60092-359:1999 Table III	para.8.1213 IEC60811-509
2.13	Hot set test for insulations and for sheaths	IEC60092-351:2004 Table 4 IEC60092-359:1999 Table II	IEC60092-350:2008 para.6.8
2.1413	Ozone resistance (test for EPR, HEPR, HF EPR, HFHEPR, HF 90 insulation and for SE1, SH and SHF2 sheaths)	IEC60092-360:201451:2004 Table 4 and 6 IEC60092-359:1999 Table III	IEC60092-350:201408 para.8.143 IEC60811-403
2.1514	Hot Oil immersion (SE1, SH and SHF2 sheaths) test for elastomeric oversheaths	IEC60092-360:201459:1999 Table 6H	IEC60092-350:201408 para.8.154 IEC60811-404
2.1615	Flame retardant test of a single wire or cable	IEC60092-350:201408 para.8.1617.1 IEC60332-1-2:2004 IEC60092-350:2014 para.8.17.2 IEC60332-3-22	IEC60092-350:201408 para.8.1617.1 IEC60332-1-2:2004 IEC60092-350:2014 para.8.17.2 IEC60332-3-22 in which case cables shall be installed in touching configuration on the front of the ladder
2.1716	Determination of hardness (HEPR insulation) Flame retardant test of bunched wires or cables	IEC60092-360:2014 Table 4 IEC60092-350:2008 para.8.16.2 IEC60332-3-22:2000	IEC60092-350:2014 para.8.18 IEC60092-350:2008 para.8.16.2 IEC60332-3-22:2009
2.1817	Determination of modulus of elasticity (HEPR insulation) Fire test of cables	IEC60092-360:2014 Table 4 IEC60092-350:2008 para.8.16.7 IEC60331-1:2009 IEC60331-21:1999	IEC60092-350:2014 para.8.19 IEC60092-350:2008 para.8.16.7 IEC60331-1:2009 IEC60331-21:1999
2.18	Durability of marking	IEC60092-350:2014 para.8.20	IEC60092-350:2014 para.8.20
2	Additional tests required for halogen free cables		
3.1	Acid gas emission	IEC60092-350:2014 Table 7	IEC60092-350:2014 para.8.17.4 IEC60754-1
3.2	pH and conductivity	IEC60092-350:2014 Table 7	IEC60092-350:2014 para.8.17.5 IEC60754-2

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Type test of cables for control and instrumentation circuits Table 4.2.4

No.	Test	Requirement	Testing Method
1	Electrical		
1.1	Mutual capacitance	NIL	IEC60092-350:2014 para.7.5 IEC60092-376:2003 para.17.4 a)
1.2	Inductance to resistance ratio (L/R ratio)	NIL	IEC60092-350:2014 para.7.6 IEC60092-376:2003 para.17.4 b)
2	Non-electrical		
2.1	Measurement of thickness of insulation	IEC60092-376:2003 para.10.4	IEC60092-350:2014 para.8.2 IEC60811-201
2.2	Measurement of thickness of sheaths	IEC60092-376:2003 para.13.2	IEC60092-350:2014 para.8.3
2.3	Mechanical properties of insulation before and after ageing	IEC60092-360:2014 Table 4	IEC60092-350:2014 para.8.4 IEC60811-501 IEC60811-401
2.4	Mechanical properties of sheath before and after ageing	IEC60092-360:2014 Table 6 and 8	IEC60092-350:2014 para.8.5 IEC60811-501 IEC60811-401
2.5	Additional ageing compatibility test	IEC60092-360:2014 Table 4, 6 and 8	IEC60092-350:2014 para.8.6 IEC60811-501 IEC60811-401
2.6	Loss of mass test (ST2 sheath)	IEC60092-360:2014 Table 8	IEC60092-350:2014 para.8.7 IEC60811-409
2.5+1	Additional ageing compatibility test	IEC60092-360:2014 Table 4, 6 and 8	IEC60092-350:2014 para.8.6 IEC60811-501
2.6+1	Insulation resistance test at 20°C	IEC60092-351:2004 Table 2	IEC60811-401 IEC60092-350:2008 para.7.2.1
2.6+2	Loss of mass test (ST2 sheath)	IEC60092-360:2014 Table 8	IEC60092-350:2014 para.8.7 IEC60811-409 IEC60092-350:2008 para.7.2.2
2.7	Behaviour at high temperature (ST2 and SHF1 Sheaths)	IEC60092-360:2014 Table 8	IEC60092-350:2014 para.8.8 IEC60811-508
2.8	Behaviour at low temperatures (ST2, SHF1 and SHF2 sheaths)	IEC60092-360:2014 Table 6 and 8	IEC60092-350:2014 para.8.9 IEC60811-505
2.9	Resistance to cracking heat shock (ST2 and SHF1 sheaths)	IEC60092-360:2014 Table 8	IEC60092-350:2014 para.8.13 IEC60811-509

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<u>2.10</u>	<u>Ozone resistance</u> <u>(Insulations and sheaths)</u>	<u>IEC60092-360:2014 Table 4 and</u> <u>6</u>	<u>IEC60092-350:2014 para.8.14</u> <u>IEC60811-403</u>
<u>2.11</u>	<u>Hot oil immersion (SE1,</u> <u>SH and SHF2 sheaths)</u>	<u>IEC60092-360:2014 Table 6</u>	<u>IEC60092-350:2014 para.8.15.1</u> <u>IEC60811-404</u>

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<u>2.12</u>	<u>Flame-spread tests:</u> <u>IEC 60332-1-2 and</u> <u>IEC 60332-3-22</u>	<u>IEC60092-350:2014 para.8.17.1</u> <u>IEC60332-1-2</u> <u>IEC60092-350:2014 para.8.17.2</u> <u>IEC60332-3-22</u>	<u>IEC60092-350:2014</u> <u>para.8.17.1</u> <u>IEC60332-1-2</u> <u>IEC60092-350:2014</u> <u>para.8.17.2</u> <u>IEC60332-3-22 in which case</u> <u>cables are to be installed in</u> <u>touching configuration on the</u> <u>front of the ladder</u>
<u>2.13</u>	<u>Determination of hardness</u> <u>(HEPR insulation)</u>	<u>IEC60092-360:2014 Table 4</u>	<u>IEC60092-350:2014 para.8.18</u>
<u>2.14</u>	<u>Determination of modulus</u> <u>of elasticity (HEPR</u> <u>insulation)</u>	<u>IEC60092-360:2014 Table 4</u>	<u>IEC60092-350:2014 para.8.19</u>
<u>3</u>	<u>Additional tests required for halogen-free cables</u>		
<u>3.1</u>	<u>Acid gas emission</u>	<u>IEC60092-350:2014 Table 7</u>	<u>IEC60092-350:2014</u> <u>para.8.17.4</u> <u>IEC60754-1</u>
<u>3.2</u>	<u>pH and conductivity</u>	<u>IEC60092-350:2014 Table 7</u>	<u>IEC60092-350:2014</u> <u>para.8.17.5</u> <u>IEC60754-2</u>
<u>3.3</u>	<u>Fluorine content test</u>	<u>IEC60092-350:2014 Table 7</u>	<u>IEC60092-350:2014</u> <u>para.8.17.6</u> <u>IEC60684-2</u>
<u>4</u>	<u>Additional test required for low smoke cables</u>		
<u>4.1</u>	<u>Smoke emission test for</u> <u>cables insulated and</u> <u>sheathed with halogenfree</u> <u>materials. When tested</u> <u>according to IEC 61034-2</u>	<u>IEC60092-350:2014 para.8.17.3</u> <u>IEC61034-1</u> <u>IEC61034-2</u> <u>The test is satisfactory for the</u> <u>finished cables if the levels of</u> <u>light transmittance exceeds 60%</u> <u>throughout the test</u>	<u>IEC60092-350:2014</u> <u>para.8.17.3</u> <u>IEC61034-1</u> <u>IEC61034-2</u>
<u>5</u>	<u>Additional tests required for fire resistant cables</u>		

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5.1	<u>Test for fire resistance (limited circuit integrity).</u> <u>The test is to be carried out in accordance with IEC 60331-21 or IEC 60331-2 and the minimum time to failure is to be 90 min</u>	<u>The test is to be carried out in accordance with IEC 60331-21 or IEC 60331-2 and the minimum time to failure is to be 90 min</u>	<u>IEC60092-350:2014 para.8.17.7</u> <u>IEC60331-1 (Overall diameter exceeding 20mm)</u> <u>IEC60331-2 (Overall diameter not exceeding 20mm)</u> <u>IEC60331-21</u>
6	<u>Additional tests required for specific performances</u>		

Continued table 4.2.4

6.1	<u>Special test for low temperature behaviour</u>	<u>IEC60092-350:2014 Annex E</u>	<u>IEC60092-350:2014 para.8.10</u>
6.2	<u>Enhanced hot oil immersion</u>	<u>IEC60092-360:2014 Table 9</u>	<u>IEC60092-350:2014 para.8.15.2</u>
6.3	<u>Mud fluid drilling test</u>	<u>IEC60092-360:2014 Table 10</u>	<u>IEC60092-350:2014 para.8.16</u>

Continued table 4.2.4

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2.7.4	Mechanical properties of sheath before and after ageing	IEC60092-360:201459:1999 Table 6 and 8H	IEC60092-350:201408 para.8.54 IEC60811-501 IEC60811-401
2.8.5	Additional ageing compatibility test	IEC60092-360:201451:2004 Table 4, 6 and 83	IEC60092-350:201408 para.8.65 IEC60811-501 IEC60811-401
2.9.6	Loss of mass test (ST2 sheath)	IEC60092-360:201459:1999 Table 8III	IEC60092-350:201408 para.8.76 IEC60811-409
2.10	Behaviour at high temperature (ST2 and SHF1 Sheaths)	IEC60092-360:201459:1999 Table 8III	IEC60092-350:201408 para.8.87 IEC60811-508
2.11	Behaviour at low temperatures (ST2, SHF1 and SHF2 sheaths)	IEC60092-360:201459:1999 Table 6 and 8III	IEC60092-350:201408 para.8.98 IEC60811-505
2.12	Test for coating of copper wires	IEC60092-350:2008 para.8.10	IEC60092-350:2008 para.8.10
2.13	Galvanizing test	IEC60092-350:2008 para.8.11 ISO 7989-2:2007 para.5.3	IEC60092-350:2008 para.8.11 ISO 7989-2:2007 para.5.3
2.14	Resistance to cracking heat shock (ST2 and SHF1 sheaths)	IEC60092-360:201459:1999 Table 8III	IEC60092-350:201408 para.8.132 IEC60811-509
2.15	Ozone resistance (Insulations and sheaths)	IEC60092-360:201451:2004 Table 4 and 6	IEC60092-350:201408 para.8.143

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		IEC60092-359:1999 Table III	IEC60811-403
2.16-11	Hot oil immersion (SE1, SH and SHF2 sheaths)	IEC60092-350:201459:1999 Table 6H	IEC60092-350:201408-para.8.154.1 IEC60811-404
2.17-12	Flame spread tests: IEC 60332-1-2 and IEC 60332-3-22	IEC60092-350:201408 para.8.176.1 IEC60332-1-2:2004 IEC60092-350:201408-para.8.1617.2 IEC60332-3-22:2009	IEC60092-350:201408-para.8.176.1 IEC60332-1-2:2004 IEC60092-350:201408-para.8.176.2 IEC60332-3-22:2009 in which case cables are to be installed in touching configuration on the front of the ladder
2.18-12	Determination of hardness (HEPR insulation)	IEC60092-350:201451:2004 Table 4	IEC60092-350:201408-para.8.187

[Continued table 4.2.4](#)

2.19-14	Determination of modulus of elasticity (HEPR insulation)	IEC60092-350:201451:2004 Table 4	IEC60092-350:201408-para.8.198
2.20	Durability of marking	IEC60092-350:2008 para.8.19 IEC60092-376:2003 para.7.3	IEC60092-350:2008 para.8.19 IEC60092-376:2003 para.16.2
2	Additional tests required for halogen-free cables		
2.1	Acid gas emission	IEC60092-350:201408 para.4.1.4 Table 7	IEC60092-350:201408-para.8.176.4 IEC60754-1:2011
3.2	pH and conductivity	IEC60092-350:201408 para.4.1.4 Table 7	IEC60092-350:201408-para.8.176.5 IEC60754-2:2011
3.3	Fluorine content test	IEC60092-350:201408 para.4.1.4 Table 7	IEC60092-350:201408-para.8.176.6 IEC60684-2:2011
4	Additional test required for low smoke cables		
4.1	Smoke emission test for cables insulated and sheathed with halogenfree materials. When tested according to IEC 61034-1 and IEC 61034-2	IEC60092-350:201408 para.8.176.3 IEC61034-1:2005 IEC61034-2:2005 The test is satisfactory for the finished cables if the levels of light transmittance exceeds 60% throughout the test	IEC60092-350:201408-para.8.176.3 IEC61034-1:2005 IEC61034-2:2005
5	Additional tests required for fire-resistant cables		
5.1	Test for fire resistance	The test is to be carried out in	IEC60092-350:201408-

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	(limited circuit integrity), The test is to be carried out in accordance with IEC 60331-21 or IEC 60331-1 or IEC 60331-2 and the minimum time to failure is to be 90 min	accordance with IEC 60331-21 or IEC 60331-1 or IEC 60331-2 and the minimum time to failure is to be 90 min IEC60092-350:2008 para.8.16.7 IEC60331-1:2009(Overall diameter exceeding 20mm) IEC60331-2:2009(Overall diameter not exceeding 20mm) IEC60331-21:1999	para.8.176.7 IEC60331-1:2009(Overall diameter exceeding 20mm) IEC60331-2:2009(Overall diameter not exceeding 20mm) IEC60331-21:1999
6	Additional tests required for specific performances		

Continued table 4.2.4

6.1	Special test for low temperature behaviour	IEC60092-350:201408 para.8.9 Annex E	IEC60092-350:201408- para.8.109
6.2	Enhanced hot oil immersion	IEC60092-360:201459:1999 Table QH	IEC60092-350:201408- para.8.154.2
6.3	Mud fluid drilling test	IEC60092-360:201450:2008- para.8.15 Table 10	IEC60092-350:201408- para.8.165

4.4 Principles for selection of samples

4.4.1 Types and specifications of the test samples are to shall cover the products for which works approval is sought. Generally samples are to should be taken from each series of cable products.

4.4.2 Types and specifications of the test samples are to shall be technically representative. In other words, it is difficult for test samples to pass approval type test.

4.4.3 Quantity (length) of the test samples is to shall meet related standards.

4.4.4 Test samples are to shall be taken by CCS Surveyor at the applicant's factory.

4.5 Test organization

4.5.1 For initial works approval, tests are to shall be carried out by a test organization approved by CCS.

4.5.2 For renewal of works approval certificate, works approval type test may be carried out at the manufacturer's laboratory in the presence of CCS Surveyor, subject to agreement of CCS and provided that the manufacturer has required test environment and equipment as well as competent inspection and test personnel.

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4.6 Approval certificate

4.6.1 The works approval certificate is to be issued, maintained, modified, renewed or cancelled according to Chapter 3 of PART ONE of Rules for Classification of Sea-going Ships.

5 Unit/batch inspection

5.1 The power cables for rated voltages 1 kV and 3 kV ~~are~~ shall at least to be subjected to the ~~following~~ inspections and tests at the manufacturer according to Table 5.1:

Test programme for unit/batch inspection of power cables

for rated voltages 1 kV and 3 kV

Table 5.1

No.	Test	Requirement	Testing method
1	Routine Tests		
1.1	Measurement of electrical resistance of conductors	IEC60228:2004 Tables II and III	IEC60092-350:2014 para.5.2.2
1.2	Voltage test	IEC60092-350:2014 para.5.2.3	IEC60092-350:2014 para.5.2.3
1.3	Voltage test on sheath (Armoured cables)	IEC60092-350:2014 para.5.2.3.4	IEC60092-350:2014 para.5.2.3.4
1.4	Insulation resistance test	IEC60092-351:2004 Table 2	IEC60092-350:2008 para.5.2.4
2	Sample Tests		
2.1	Insulation resistance test	IEC60092-350:2008 para.7.2.4	IEC60092-350:2008 para.5.2.4
2.2	Conductor examination	IEC60092-353:2016 para.5.2 IEC60228:2004 Tables II and III	IEC60092-350:2014 para.6.4
2.3	Check of cable dimensions		
	Measurement of thickness of insulation	IEC60092-353:2016 para.5.3.3	IEC60092-350:2014 para.6.5 IEC60811-201
	Measurement of thickness of non metallic sheaths (excluding inner coverings)	IEC60092-353:2016 para.5.5.2	IEC60092-350:2014 para.6.5.6 IEC60811-202
	External diameter	IEC60092-353:2016 para.5.7.3	IEC60092-350:2014 para.6.7 IEC60811-203
2.4	Hot-set test for insulations and sheaths (HEPR, EPR, XLPE, HF 90, S 95 insulations and SE1, SHF2 sheaths)	IEC60092-360:2014 Table 4 and 6 IEC60092-359:1999 Table II	IEC60092-350:2014 para.6.8 IEC60811-507
2.4	Insulation resistance test	IEC60092-360:2014 Table 3	IEC60092-350:2014 para.7.2.1

Note: Routine tests are to be carried out in the full length for delivery. For frequency of sample tests and number of samples, see paragraph 6.2 of IEC60092-350:2008 for detail.

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5.2 The power cables for rated voltages 6 kV and 30 kV are at least to be subjected to (all of) the following inspections and tests at the manufacturer according to Table 5.2:

5.2.1 Measurement of conductor DC resistance (IEC60092-350:2008 para. 5.5.2);

- 5.2.2 ~~Voltage~~~~Partial-discharge~~ test (IEC60092-350:2014:201403 para. 18.1 b)5.2.3);
- 5.2.3 ~~Patial discharge~~~~High-voltage~~ test (IEC60092-350:201408 para. 5.2.45.3);
- 5.2.4 Conductor examination (IEC60092-350:201408 para. 6.4, ~~for frequency of sample tests, see 60092-350:2008 para. 6.2~~);
- 5.2.5 Construction examination (IEC60092-350:201408 para. 6.5 to 6.7, ~~for frequency of sample tests, see 60092-350:2008 para. 6.2~~);
- 5.2.6 Hot-set test for insulations and ~~for~~ sheaths (IEC60092-350:201408 para. 6.8, ~~for frequency of sample tests, see 60092-350:2008 para. 6.2~~).
-

Test programme for unit/batch inspection of power cables

for rated voltages 6 kV and 30 kV

Table 5.2

No.	Test	Requirement	Testing method
1	Routine Tests		
1.1	Measurement of electrical resistance of conductors	IEC60092-354:2003 para.9 IEC60228:2004 Tables II and III	IEC60092-350:201408 para.5.2.2
1.2	Partial discharge Voltage test	IEC60092-350:201403 para.18.1b) 5.2.3	IEC60092-350:201403 para.18.1b) 5.2.3
1.3	Partial discharge Voltage test	IEC60092-350:201403 para.18.1c) 5.2.4	IEC60092-350:201408 para.5.2.43 IEC60885-2
2	Sample Special Tests		
2.1	Conductor examination	IEC60092-354:201403 para.9 5.2 IEC60228:2004 Tables II and III	IEC60092-350:201408 para.6.4
2.2	Check of cable dimensions		
	Thickness of insulation	IEC60092-354:2014 para. 5.5.3	IEC60092-350:2014 para. 6.5 IEC60811-201
	Thickness of non metallic sheaths (excluding inner coverings)	IEC60092-354:2014 para. 14.2	IEC60092-350:2014 para. 6.6 IEC60811-202
	External diameter	IEC60092-354:2014 para. 15.2	IEC60092-350:2014 para. 6.7 IEC60811-203
2.3	Hot-set test for insulations and sheaths (HEPR, EPR, XLPE, HF 90, S 95 insulations and SE1, SHF2 sheaths)	IEC60092-360:2014 Table 4 and 6	IEC60092-350:2014 para.6.8 IEC60811-507

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2.2	Check of cable dimensions		
	Thickness of insulation	IEC60092-354:201403 para. 105.5.3	IEC60092-350:20141 para. 6.5 IEC60811-201
	Thickness of non metallic sheaths (excluding inner coverings)	IEC60092-354:201403 para. 14.2	IEC60092-350:20141 para. 6.65 IEC60811-202
	External diameter	IEC60092-354:201403 para. 15.2	IEC60092-350:20141 para. 6.7 IEC60811-203
2.3	Hot-set test for insulations and sheaths (HEPR, EPR, XLPE, HF 90, S 95 insulations and SE1, SHF2 sheaths)	IEC60092-360:2014 Table 4 and 6 IEC60092-359:1999 Table II	IEC60092-350:201408 para.6.8 IEC60811-507
2.4	Behaviour at low temperatures (ST2, SHF1 and	IEC60092-359:1999 Table III	IEC60092-350:2008 para.8.8

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	SHF2 sheaths)		
2.5	Coverage density of braid (Braid armoured Cables)	IEC60092-354:2003 para.16	IEC60092-350:2008 para.4.8.2
2.6	Power frequency voltage of 4 U ₀	IEC60092-354:2003 para.18.2f)	IEC60092-354:2003 para.18.2f)

Note: Routine tests are to be carried out in the full length for delivery. For frequency of special tests and number of samples, see paragraph 6.2 of IEC60092-350:2008 for detail.

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5.3 The cables for control and instrumentation circuits are at least to be subjected to the following inspections and tests at the manufacturer according to Table 5.3:

Test programme for unit/batch inspection of cables for

control and instrumentation circuits

Table 5.3

No.	Test	Requirement	Testing method
1	Routine Tests		
1.1	Measurement of electrical resistance of conductors, including drain wires	IEC60092-376:2003 Table 6	IEC60092-350:2014 para.5.2.2
1.2	Voltage test	IEC60092-350:2014 para. 5.2.3	IEC60092-350:2014 para.5.2.3
1.3	Insulation resistance test	IEC60092-376:2003 para.17.1.c)	IEC60092-350:2014 para. 6.9
1.4	Screen insulation resistance	IEC60092-376:2003 para.17.1.d)	IEC60092-350:2014 para. 6.9
1.5	The insulation resistance between any screen and the armour for armoured cables	IEC60092-376:2003 para.17.1.e)	IEC60092-350:2014 para. 6.9
2	Sample Tests		

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2.1	Conductor examination	IEC60092-376:2003 para.9	IEC60092-350:2014 para.6.4
2.2	Check of cable dimensions		
	Thickness of insulation	IEC60092-376:2003 para.10.4	IEC60092-350:2014 para.6.5 IEC60811-201
	Thickness of non metallic sheaths (excluding inner coverings)	IEC60092-376:2003 para.13.2	IEC60092-350:2014 para.6.6 IEC60811-202
	External diameter	IEC60092-376:2003 para.14.1	IEC60092-350:2014 para.6.7 IEC60811-203
2.3	Hot-set test for insulations and sheaths (HEPR, EPR, XLPE, HF 90, S 95 insulations and SE1, SHF2 sheaths)	IEC60092-360:2014 Table 4 and 6	IEC60092-350:2014 para.6.8 IEC60811-507
2.4	Test for the behaviour of PVC sheath ST2 and halogen-free SHF1 and SHF2 sheaths at low temperatures	IEC60092-360:2014 Table 6 and 8	IEC60092-350:2014 para.8.9

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2.5	Electrostatic screen (Screened Cables)	IEC60092-376:2003 para.12	IEC60092-350:2014 para.4.8.2
2.6	Coverage density of braid (Braid armoured Cables)	IEC60092-376:2003 para.15	IEC60092-350:2014 para.4.8.2

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1.1	Measurement of electrical resistance of conductors, including drain wires	IEC60092-376:2003 para.17.1.a)Table 6	IEC60092-350:201408 para.5.2.2
1.2	Voltage test	IEC60092-35076:201403 para.17.1.b)5.2.3	IEC60092-350:201408 para.5.2.3
1.3	Insulation resistance test	IEC60092-376:2003 para.17.1.e)	IEC60092-350:201408 para.5.2.4.6.9
1.4	Screen insulation resistance	IEC60092-376:2003 para.17.1.d)	IEC60092-350:201408 para.5.2.4.6.9
1.5	The insulation resistance between any screen and the armour for armoured cables	IEC60092-376:2003 para.17.1.e)	IEC60092-350:201408 para.5.2.4.6.9
2	Special Sample Tests		
2.1	Conductor examination	IEC60092-376:2003 para.9	IEC60092-350:201408 para.6.4
2.2	Check of cable dimensions - Thickness of insulation - Thickness of non-metallic sheaths (excluding inner coverings) - External diameter	IEC60092-376:2003 para.10.4 IEC60092-376:2003 para.13.2 IEC60092-376:2003 para.14.1	IEC60092-350:20141 para.6.5 IEC60811-201 IEC60092-350:20141 para.6.65 IEC60811-202 IEC60092-350:20141 para.6.7- IEC60811-203
2.3	Hot set test for insulations and sheaths (HEPR, EPR, XLPE, HF 90, S 95 insulations and SE1, SHF2 sheaths)	IEC60092-36051:20104 Table 4 and 6 IEC60092-359:1999 Table II	IEC60092-350:201408 para.6.8- IEC60811-507
2.4	Test for the behaviour of PVC sheath ST2 and halogen-free SHF1 and SHF2 sheaths at low temperatures (ST2, SHF1 and SHF2 sheaths)	IEC60092-36059:20141999 Table 6 and 8H	IEC60092-350:201408 para.8.98
2.5	Electrostatic screen (Screened Cables)	IEC60092-376:2003 para.12	IEC60092-350:201408 para.4.8.2
2.6	Coverage density of braid (Braid armoured Cables)	IEC60092-376:2003 para.15	IEC60092-350:201408 para.4.8.2

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Note: Routine tests are to be carried out in the full length for delivery. For frequency of special tests and number of samples, see paragraph 6.2 of IEC60092-350:2008 for detail.

5.4 The routine tests are normally carried out on each manufactured cable length and may be carried out, at the manufacturer's option, either on delivery lengths

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or on manufactured lengths before they are cut into delivery lengths.

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5.5 Frequency of sample tests

a) Conductor examination and check of dimensions

Conductor examination, measurement of the thickness of insulation and sheath and measurement of the overall diameter, if required by the surveyor, shall be made on one length from each manufactured series of the same type and size of cable, but shall be limited to not more than 10 % of the number of lengths in any one contract.

b) Physical tests

By agreement between the surveyor and manufacturer, the test specified shall be made on samples taken from cables manufactured for the contract, provided that the total length in the contract exceeds 2 km of multi-core cables or 4 km of single-core cables. The number of samples to be tested is given in Table 5.5.

▲ Number of samples according to cable length Table 5.5		
Cable length (L) km		Number of samples
Multi-core cables	Single-core cables	
▲ $2 < L \leq 10$	$4 < L \leq 20$	<u>1</u>
$10 < L \leq 20$	$20 < L \leq 40$	<u>2</u>
$20 < L \leq 30$	$40 < L \leq 60$	<u>3</u>
$L > 30$	$L > 60$	a b
▲ NOTE a For multicore cable lengths >30 km, add one sample for each additional 10 km b For single core cable lengths >60 km, add one sample for each additional 20 km		
▲ ***** End *****		

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