

Guidance No.: E-01(201705)



E-01 SHIPBOARD ELECTRIC WIRES AND CABLES

Issued date: May 9, 2017

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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 Guidance applies to approval and inspection of cables (rated voltage 18/30(36) kV and below) which are permanently unfixd, 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 fibre
- (2) Sub-sea and umbilical cables
- (3) Coaxial cables
- (4) Data and communication cables
- (5) Cables suitable for frequent or continual flexing (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.

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

IEC60092-350:2014

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

	applications
IEC60092-353:2016	Electrical installations in ships - Part 353: Power cables for rated voltages 1 kV and 3 kV
IEC60092-354:2014	Electrical installations in ships - Part 354: Single- and three-core power cables with extruded solid insulation for rated voltages 6 kV ($U_m = 7,2$ kV) up to 30 kV ($U_m = 36$ kV)
IEC60228	Conductors of insulated cables
IEC60092-360:2014	Electrical installations in ships – Part 360: Insulating and sheathing materials for shipboard and offshore units, power, control, instrumentation, telecommunication and data cables
IEC60331-1	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
IEC60331-2	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
IEC60331-11	Tests for electric cables under fire conditions - Circuit integrity - Part 11: Apparatus - Fire alone at a flame temperature of at least 750 °C
IEC60331-21	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
IEC60332-1-2	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
IEC60332-3-22	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
IEC60754-1	Test on gases evolved during combustion of materials from cables - Part 1: Determination of the halogen acid gas content
IEC60754-2	Test on gases evolved during combustion of materials from cables - Part 2: Determination of acidity (by pH measurement) and conductivity
IEC61034-1	Measurement of smoke density of cables burning under defined conditions - Part 1: Test apparatus
IEC61034-2	Measurement of smoke density of cables burning under defined conditions - Part 2: Test procedure and requirements
IEC60811-201	Electric and optical fibre cables – Test methods for non-metallic materials – Part 201: General tests – Measurement of insulation thickness
IEC60811-202	Electric and optical fibre cables – Test methods for non-metallic materials – Part 202: General tests – Measurement of thickness of non-metallic sheath
IEC60811-203	Electric and optical fibre cables – Test methods for non-metallic materials – Part 203 : General tests – Measurement of overall dimensions
IEC60811-401	Electric and optical fibre cables – Test methods for non-metallic materials – Part 401: Miscellaneous tests – Thermal ageing methods – Ageing in an air oven

IEC60811-403	Electric and optical fibre cables – Test methods for non-metallic materials – Part 403: Miscellaneous tests – Ozone resistance test on cross-linked compounds
IEC60811-404	Electric and optical fibre cables – Test methods for non-metallic materials – Part 404: Miscellaneous tests – Mineral oil immersion tests for sheaths
IEC60811-409	Electric and optical fibre cables – Test methods for non-metallic materials – Part 409: Miscellaneous tests – Loss of mass test for thermoplastic insulations and sheaths
IEC60811-501	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
IEC60811-505	Electric and optical fibre cables – Test methods for non-metallic materials – Part 505: Mechanical tests – Elongation at low temperature for insulations and sheaths
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
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)
ISO7989-2:2007	Steel wire and wire products – Non-ferrous metallic coating on steel wire – Part 2: Zinc or zinc-alloy coating
IEC60684-2	Flexible insulating sleeving - Part 2: Methods of test

IEC60885-2 Electrical test methods for electric cables. Part 2: Partial discharge tests

IEC60050-461 International Electrotechnical Vocabulary - Part 461: Electric cables

1.3 Definitions

1.3.1 Terms and definitions in this Chapter are the same as those of IEC60050-461 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 Guidance.

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 shall be in accordance with the following standards:

3.1.1 Shipboard electric cables shall be in accordance with the requirements of IEC60092-350:2014.

3.1.2 Power cables for rated voltages 1 kV and 3 kV shall be in accordance with the requirements of IEC60092-353:2016.

3.1.3 Power cables for rated voltages 6 kV up to 30 kV shall be in accordance with the requirements of IEC 60092-354:2014.

3.1.4 Cables for control and instrumentation circuits shall be in accordance with the requirements of IEC 60092-376:2003.

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 single core cables for circuit rated in excess of 20A should either be non-armoured or they should be armoured with non-magnetic material.

3.4 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 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 cables shall be in accordance with the Tabel 2 of IEC60092-360:2014. For cables for rated voltage of 0.6/1(1.2)kV and below, Ethylene Propylene Rubber(EPR)、Hard grade Ethylene Propylene Rubber (HEPR)、Cross-linked PolyEthylene (XLPE)、Cross-linked Polyolefin halogen-free (HF90) or Cross-linked Silicone rubber (S95) are to be used. For cables for rated voltage of 1.8/3(3.6)kV and below, EPR、 HEPR、 XLPE are to be used.

3.7 The inner, outer sheathing compounds shall be in accordance with the Tabel 5 and 7 of IEC60092-360:2014. 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 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 shall be subjected to type test according to Clause 4.2.1 to 4.2.4.

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

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

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

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

4.2.4 Cables for control and instrumentation circuits 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	IEC60092-360:2014 Table 3	IEC60092-350:2014 para.7.2.1
1.2	Insulation resistance measurement at maximum rated temperature	IEC60092-360:2014 Table 3	IEC60092-350:2014 para.7.2.2
1.3	Increase of the a.c. capacitance after immersion in water when required	IEC60092-360:2014 Table 3	IEC60092-350:2014 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
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

Continued table 4.2.2

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
2.17	Determination of hardness (HEPR insulation)	IEC60092-360:2014 Table 4	IEC60092-350:2014 para.8.18
2.18	Determination of modulus of elasticity (HEPR insulation)	IEC60092-360:2014 Table 4	IEC60092-350:2014 para.8.19
2.19	Durability of marking	IEC60092-350:2014 para.8.20	IEC60092-350:2014 para.8.20
3	Additional tests required for halogen-free cables		

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3.1	Acid gas emission	IEC60092-350:2014 Table 7	IEC60092-350:2014 para.8.17.4 IEC60754-1
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Continued table 4.2.2

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		
4.1	Smoke emission test for cables insulated and sheathed with halogenfree materials. When tested according to 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		
5.1	Test for fire resistance (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	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 required for specific performances		
6.1	Special test for low temperature behaviour (when required)	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
6.3	Drill fluid test	IEC60092-360:2014 Table 10	IEC60092-350:2014 para.8.16

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	Requirement	Testing method
1	Electrical		
1.1	Insulation resistance measurement	IEC60092-360:2014 Table 3	IEC60092-350:2014 para.7.2.1
1.2	High voltage sequence test	IEC60092-350:2014 para.7.7	IEC60092-350:2014 para.7.7
1.3	Insulation resistance measurement at maximum rated temperature	IEC60092-360:2014 Table 3	IEC60092-350:2014 para.7.2.2
1.4	Increase in a.c. capacitance after immersion in water	IEC60092-360:2014 Table 3	IEC60092-350:2014 para.7.3
1.5	High-voltage test for 4h	IEC60092-350:2014 para.7.7.9	IEC60092-350:2014 para.7.7.9
2	Non-electrical		
2.1	Conductor examination	IEC60092-354:2014 para. 5.2 IEC60228 Table II、III	IEC60092-350:2014 para.6.4
2.2	Check of cable dimensions Thickness of insulation Thickness of non-metallic sheaths Dimensions of braid armour External diameter	IEC60092-354:2014 para.5.3.3 IEC60092-354:2014 para.5.7.2, 5.8.3 and 5.10.3 IEC60092-354:2014 para. 5.9.2, 5.9.3	IEC60092-350:2014 para.8.2 IEC60811-201 IEC60092-350:2014 para.8.3 IEC60811-202 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
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
6.3	Drill fluid test	IEC60092-360: 2014 Table 10	IEC60092-350:2014 para. 8.16

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
2.7	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
2.10	Ozone resistance (Insulations and sheaths)	IEC60092-360:2014 Table 4 and 6	IEC60092-350:2014 para.8.14 IEC60811-403
2.11	Hot oil immersion (SE1, SH and SHF2 sheaths)	IEC60092-360:2014 Table 6	IEC60092-350:2014 para.8.15.1 IEC60811-404

Continued table 4.2.4

2.12	Flame-spread 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
2.13	Determination of hardness (HEPR insulation)	IEC60092-360:2014 Table 4	IEC60092-350:2014 para.8.18
2.14	Determination of modulus of elasticity (HEPR insulation)	IEC60092-360:2014 Table 4	IEC60092-350:2014 para.8.19
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		
4.1	Smoke emission test for cables insulated and sheathed with halogenfree materials. When tested according to 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		
5.1	Test for fire resistance (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	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	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 required for specific performances
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Continued table 4.2.4

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
6.3	Mud fluid drilling test	IEC60092-360:2014 Table 10	IEC60092-350:2014 para.8.16

4.4 Principles for selection of samples

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

4.4.2 Types and specifications of the test samples 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 shall meet related standards.

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

4.5 Test organization

4.5.1 For initial works approval, tests 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.

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 shall at least to be subjected to the 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 Table 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
2	Sample Tests		
2.1	Conductor examination	IEC60092-353:2016 para.5.2 IEC60228 Table II and III	IEC60092-350:2014 para.6.4
2.2	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.6.6 IEC60811-202
	External diameter	IEC60092-353:2016 para.5.7.3	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	Insulation resistance test	IEC60092-360:2014 Table 3	IEC60092-350:2014 para.7.2.1

5.2 The power cables for rated voltages 6 kV and 30 kV are at least to be subjected to (all of) the 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 test (IEC60092-350:2014 para. 5.2.3);

5.2.3 Partial discharge test (IEC60092-350:2014 para. 5.2.4);

5.2.4 Conductor examination (IEC60092-350:2014 para. 6.4);

5.2.5 Construction examination (IEC60092-350:2014 para. 6.5 to 6.7);

5.2.6 Hot-set test for insulations and sheaths (IEC60092-350:2014 para. 6.8).

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	IEC60228 Table 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	Partial discharge test	IEC60092-350:2014 para. 5.2.4	IEC60092-350:2014 para.5.2.4 IEC60885-2
2	Sample Tests		
2.1	Conductor examination	IEC60092-354:2014 para. 5.2 IEC60228 Table II and III	IEC60092-350:2014 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

5.3 The cables for control and instrumentation circuits are at least to be subjected to the 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		

Continued table 5.3

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
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

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

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 ≤ 10	4 < L ≤ 20	1
10 < L ≤ 20	20 < L ≤ 40	2
20 < L ≤ 30	40 < L ≤ 60	3
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 *****