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E-01

SHIPBOARD ELECTRIC WIRES AND CABLES

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Foreword:

CCS Product Inspection and Testing Guideline (hereinafter referred to as this Guideline) contains the technical requirements, inspection and testing criteria related to classification and statutory survey of marine products to be applied for CCS approval/inspection.

This Guideline frees the users to adopt other test methods and requirements which are equivalent to or are stricter than this Guideline.

This Guideline is published and updated by CCS, and is released at http://www.ccs.org.cn. Your comments or suggestions are welcomed and may be sent to our email addressed mp@ccs.org.cn.

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Main changes:

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

~~a) Editorial change.~~

~~b) Correct errors in printing.~~

~~c)~~a) This Guidance references and quotes standards as IEC60092-3560 ~~and IEC60092-354~~, etc. By now they have been updated to version 20201.

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SHIPBOARD ELECTRIC WIRES AND CABLES

1 Scope

1.1 This 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.

1.2 Shipboard electric cables are to include:

(1) Power cables;

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

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).

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 and its amendments
IEC60092-350:2020	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
IEC60092-354:2020	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)
IEC60092-376:2017	Electrical installations in ships - Part 376: Cables for control and instrumentation circuits 150/250 V (300 V)
IEC60228	Conductors of insulated cables
IEC60092-~~360:2014~~360:2021	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 ℃ 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 ℃ 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 ℃
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

3 Terms and Definitions

3.1 Terms and definitions in this Chapter are the same as those of IEC60050-461 and IEC60092-350:2020.

4 Plans and documents

4.1 The following plans and documents are to be submitted for review:

(1) Structural drawing of cables;

(2) Technical specifications of cables or equivalent documents.

(3) Designation of cable types and specifications;

(4) Table of cable construction data or equivalent documents;

(5) Production process flow chart indicating quality control points;

(6) List of production technology;

(7) List of production equipment;

(8) List of test equipment;

(9) List of trademarks and suppliers of main raw materials;

(10) Specimen of quality certificate;

(11) Asbestos free statement;

(12) Routine inspection programmer or equivalent documents;

(13) Format of routine inspection report;

(14) Operation instructions for the products;

(15) Other documents to be submitted as required for approval.

5 Technical requirements

5.1 Shipboard electric cables shall be in accordance with the following standards:

5.1.1 Shipboard electric cables shall be in accordance with the requirements of IEC60092-350:2020.

5.1.2Power cables for rated voltages 1 kV and 3 kV shall be in accordance with the requirements of IEC60092-353:2016.

5.1.3Power cables for rated voltages 6 kV up to 30 kV shall be in accordance with the requirements of IEC 60092-354:2020.

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

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

5.3 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.

5.4 The screen shall be in accordance with the requirements of Clause 4.4 of IEC60092-350:2020. 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.

5.5 The inner covering of 2-core, 3-core or multi-core cables shall be extruded in case of a braid armour of galvanized steel wires.

5.6 The insulating compounds and their designation for shipboard cables shall be in accordance with the Table 2 of IEC60092-~~360:2014~~360:2021. 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.

5.7 The inner, outer sheathing compounds shall be in accordance with the Table 5 and 7 of IEC60092-~~360:2014~~360:2021. 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).

5.8 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 IEC60092-354:2020.

6 Material and parts

Nil

7 Type tests

7.1 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.

7.2 Shipboard electric cables shall be subjected to type test according to Clause this Guidance 7.2.1 to 7.2.4.

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

(1) Ambient temperature: 15℃ to 35℃;

(2) Relative humidity: 30%RH to 90%RH;

(3) Atmospheric pressure: 86 to 106 kPa.

7.2.2 Power cables for rated voltages 1 kV and 3 kV shall be type tested according to Table 7.2.2.

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

7.2.3.

7.2.4 Cables for control and instrumentation circuits shall be type tested according to Table 7.2.4.

Type test of power cables for rated voltages 1 kV and 3 kV **Table 7.2.2**

No.	Test	Requirement	Testing method
1	Electrical		
1.1	Insulation resistance measurement at ambient temperature	IEC60092-~~360:2014~~360:2021 Table 3	IEC60092-350:2020 para.7.2.1
1.2	Insulation resistance measurement at maximum rated temperature	IEC60092-~~360:2014~~360:2021 Table 3	IEC60092-350:2020 para.7.2.2
1.3	Increase of the a.c. capacitance after immersion in water when required	IEC60092-~~360:2014~~360:2021 Table 3	IEC60092-350:2020 para.7.3
1.4	High-voltage test for 4 h	IEC60092-350:2020 para.7.4	IEC60092-350:2020 para.7.4
2	Non-electrical		
2.1	Conductor examination	IEC60092-353:2016 para.5.2 IEC60228 Table II and III	IEC60092-350:2020 para.6.4
2.2	Measurement of thickness of insulation	IEC60092-353:2016 para.5.3.3	IEC60092-350:2020 para.8.2IEC60811-201
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	IEC60092-350:2020 para.8.3 IEC60811-202
2.4	Coverage density of braid (Braid armoured Cables)	IEC60092-353:2016 para.5.8	IEC60092-350:2020 para.4.8.2
2.5	Test for determining the mechanical properties of insulation before and after ageing	IEC60092-~~360:2014~~360:2021 Table 4	IEC60092-350:2020 para.8.4 IEC60811-501 IEC60811-401
2.6	Test for determining the mechanical properties of sheath before and after ageing	IEC60092-~~360:2014~~360:2021 Table 6 and 8	IEC60092-350:2020 para.8.5 IEC60811-501 IEC60811-401
2.7	Additional ageing test on pieces of completed cables (compatibility test)	IEC60092-~~360:2014~~360:2021 Table 4 and 6 and 8	IEC60092-350:2020 para.8.6 IEC60811-501 IEC60811-401
2.8	Loss of mass test on PVC ST2 sheath	IEC60092-~~360:2014~~360:2021 Table 8	IEC60092-350:2020 para.8.7 IEC60811-409

Continued table 7.2.2

No.	Test	Requirement	Testing method
2.9	Test for the behavior of PVC ST2 and halogen-free SHF1 Sheaths at high temperature (hot pressure test)	IEC60092-~~360:2014~~360:2021 Table 8	IEC60092-350:2020 para.8.8 IEC60811-508
2.10	Test for the behavior of PVC sheath ST2 and halogen-free SHF1 and SHF2 sheaths at low temperatures	IEC60092-~~360:2014~~360:2021 Table 6 and 8	IEC60092-350:2020 para.8.9 IEC60811-505
2.11	Test of the metal coating of copper wires	IEC60092-350:2020 para.8.11	IEC60092-350:2020 para.8.11
2.12	Galvanizing test	IEC60092-350:2020 para.8.12 ISO 7989-2:2007 para.5.3	IEC60092-350:2020 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~~360:2021 Table 8	IEC60092-350:2020 para.8.13 IEC60811-509
2.14	Ozone resistance for insulations and sheaths	IEC60092-~~360:2014~~360:2021 Table 4 and 6	IEC60092-350:2020 para.8.14 IEC60811-403
2.15	Hot oil immersion test for sheaths (SE1, SH and SHF2 sheaths)	IEC60092-~~360:2014~~360:2021 Table 6	IEC60092-350:2020 para.8.15.1 IEC60811-404
2.16	Fire-retardant tests: IEC 60332-1-2 and IEC 60332-3-22	IEC60092-350:2020 para.8.17.1 IEC60332-1-2 IEC60092-350:2020 para.8.17.2 IEC60332-3-22	IEC60092-350:2020 para.8.17.1 IEC60332-1-2 IEC60092-350:2020 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~~360:2021 Table 4	IEC60092-350:2020 para.8.18
2.18	Determination of modulus of elasticity (HEPR insulation)	IEC60092-~~360:2014~~360:2021 Table 4	IEC60092-350:2020 para.8.19
2.19	Durability of marking	IEC60092-350:2020 para.8.20	IEC60092-350:2020 para.8.20

Continued table 7.2.2

No.	Test	Requirement	Testing method
3	Additional tests required for halogen-free cables		
3.1	Acid gas emission	IEC60092-350:2020 Table 7	IEC60092-350:2020 para.8.17.4 IEC60754-1
3.2	pH and conductivity	IEC60092-350:2020 Table 7	IEC60092-350:2020 para.8.17.5 IEC60754-2
3.3	Fluorine content test	IEC60092-350:2020 Table 7	IEC60092-350:2020 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 halogen free materials. When tested according to IEC 61034-2	IEC60092-350:2020 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	IEC60092-350:2020 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	IEC60092-350:2020 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 behavior (when required)	IEC60092-350:2020Annex E	IEC60092-350:2020 para.8.10
6.2	Enhanced hot oil immersion	IEC60092-~~360:2014~~360:2021 Table 9	IEC60092-350:2020 para.8.15.2
6.3	Drill fluid test	IEC60092-~~360:2014~~360:2021 Table10	IEC60092-350:2020 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 7.2.3**

No.	Test	Requirement	Testing method
1	Electrical		
1.1	Insulation resistance measurement	IEC60092-~~360:2014~~360:2021Table 3	IEC60092-350:2020 para.7.2.1
1.2	High voltage sequence test	IEC60092-350:2020 para.7.7	IEC60092-350:2020 para.7.7
1.3	Insulation resistance measurement at maximum rated temperature	IEC60092-~~360:2014~~360:2021 Table 3	IEC60092-350:2020 para.7.2.2
1.4	Increase in a.c. capacitance after immersion in water	IEC60092-~~360:2014~~360:2021 Table 3	IEC60092-350:2020 para.7.3
1.5	High-voltage test for 4h	IEC60092-350:2020 para.7.7.9	IEC60092-350:2020 para.7.7.9
2	Non-electrical		
2.1	Conductor examination	IEC60092-354:2020 para. 5.2 IEC60228 Table Ⅱ、Ⅲ	IEC60092-350:2020 para.6.4
2.2	Check of cable dimensions Thickness of insulation Thickness of non-metallic sheaths Dimensions of braid armour External diameter	 IEC60092-354:2020 para.5.3.3 IEC60092-354:2020 para.5.7.2, 5.8.3 and 5.10.3 IEC60092-354:2020 para. 5.9.2, 5.9.3	 IEC60092-350:2020 para.8.2 IEC60811-201 IEC60092-350:2020 para.8.3 IEC60811-202 IEC60092-350:2020 para.6.7 IEC60811-203
2.3	Coverage density of braid (Braid armoured Cables)	IEC60092-354:2020 para. 5.9	IEC60092-350:2020 para. 4.8.2
2.4	Mechanical properties of insulation before and after ageing	IEC60092-~~360:2014~~360:2021 Table 4	IEC60092-350:2020 para.8.4 IEC60811-501 IEC60811-401
2.5	Mechanical properties of sheaths before and after ageing	IEC60092-~~360:2014~~360:2021 Table 6 and 8	IEC60092-350:2020 para.8.5 IEC60811-501 IEC60811-401
2.6	Additional ageing compatibility test	IEC60092-~~360:2014~~360:2021 Table 4 and 6	IEC60092-350:2020 para.8.6 IEC60811-501 IEC60811-401
2.7	Loss of mass test (PVC ST2 sheaths)	IEC60092-~~360:2014~~360:2021 Table 8	IEC60092-350:2020 para.8.7 IEC60811-409

Continued table 7.2.3

No.	Test	Requirement	Testing method
2.8	Behavior at high temperature (ST2 and SHF1 sheaths hot pressure test)	IEC60092-~~360:2014~~360:2021 Table 8	IEC60092-350:2020 para.8.8 IEC60811-508
2.9	Behavior at low temperature(ST2, SHF1 and SHF2 sheaths	IEC60092-~~360:2014~~360:2021 Table 6 and 8	IEC60092-350:2020 para.8.9 IEC60811-505
2.10	Test of the metal coating of copper wires	IEC60092-350:2020 para.8.11	IEC60092-350:2020 para.8.11
2.11	Galvanizing test	IEC60092-350:2020 para.8.12 ISO 7989-2:2007 para. 5.3	IEC60092-350:2020 para.8.12 ISO 7989-2:2007 para. 5.3
2.12	Resistance to cracking heat shock(ST2 and SHF1 sheaths)	IEC60092-~~360:2014~~360:2021 Table 8	IEC60092-350:2020 para.8.13 IEC60811-509
2.13	Ozone resistance (insulation and sheaths)	IEC60092-~~360:2014~~360:2021 Table 4 and 6	IEC60092-350:2020 para.8.14 IEC60811-403
2.14	Hot oil immersion (SE1, SH and SHF2 sheaths)	IEC60092-~~360:2014~~360:2021 Table 6	IEC60092-350:2020 para.8.15 IEC60811-404
2.15	Flame-retardant	IEC60092-350:2020 para.8.17.1 IEC60332-1-2 IEC60092-350:2020 para.8.17.2 IEC60332-3-22	IEC60092-350:2020 para.8.17.1 IEC60332-1-2 IEC60092-350:2020 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~~360:2021 Table 4	IEC60092-350:2020 para.8.18
2.17	Determination of modulus of elasticity (HEPR insulation)	IEC60092-~~360: 2014~~360:2021 Table 4	IEC60092-350:2020 para.8.19
2.18	Durability of marking	IEC60092-350:2020 para.8.20	IEC60092-350:2020 para.8.20
3	Additional tests required for halogen-free cables		
3.1	Acid gas emission	IEC60092-350:2020 Table 7	IEC60092-350:2020 para. 8.17.4 IEC60754-1
3.2	pH and conductivity	IEC60092-350:2020 Table 7	IEC60092-350:2020 para. 8.17.5 IEC60754-2
3.3	Fluorine content test	IEC60092-350:2020 Table 7	IEC60092-350:2020 para. 8.17.6 IEC60684-2

Continued table 7.2.3

No.	Test	Requirement	Testing method
4	Additional test required for low smoke cables		
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	IEC60092-350:2020 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	IEC60092-350:2020 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	IEC60092-350:2020 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 behavior	IEC60092-350:2020 Annex E	IEC60092-350:2020 para. 8.10
6.2	Enhanced hot oil immersion	IEC60092-~~360: 2014~~360:2021 Table 9	IEC60092-350:2020 para. 8.15.2
6.3	Drill fluid test	IEC60092-~~360: 2014~~360:2021 Table 10	IEC60092-350:2020 para. 8.16

Type test of cables for control and instrumentation circuits Table 7.2.4

No.	Test	Requirement	Testing method
1	Electrical		
1.1	Insulation resistance constant test	IEC60092-~~360: 2014~~360:2021 Table 3	IEC60092-350:2020, 7.2.1
1.2	Insulation resistance measurement at maximum rated temperature	IEC60092-~~360: 2014~~360:2021 Table 3	IEC60092-350:2020, 7.2.2
1.3	Mutual capacitance	——	IEC60092-350:2020, 7.5
1.4	Inductance to resistance ratio	——	IEC60092-350:2020, 7.6
2	Non-electrical		
2.1	Conductor examination	IEC60092-376:2017, 5.2	IEC60092-350:2020, 6.4
2.2	Check of cable dimensions – Thickness of insulation – Thickness of nonmetallic Sheaths (excluding inner coverings) – External diameter	——	 IEC 60092-350:2020, 6.5 and 8.2 IEC 60092-350:2020, 6.6 and 8.3 IEC 60092-350:2020, 6.7
2.3	Coverage density of braid (Braid armoured cables and/or braid screened cable)	IEC60092-376:2017, 5.6 and 5.8	IEC60092-350:2020, 4.8.2
2.4	Mechanical properties of insulation before and after ageing	IEC60092-~~360: 2014~~360:2021 Table 4	IEC60092-350:2020, 8.4 IEC60811-501 IEC60811-401
2.5	Mechanical properties of sheath before and after ageing	IEC60092-~~360: 2014~~360:2021 Table 6, 8	IEC60092-350:2020, 8.5 IEC60811-501 IEC60811-401
2.6	Additional ageing compatibility test	IEC60092-~~360: 2014~~360:2021 Table 4, 6, 8	IEC60092-350:2020, 8.6 IEC60811-501 IEC60811-401
2.7	Loss of mass test (PVC ST2 sheath)	IEC60092-~~360: 2014~~360:2021 Table 8	IEC60092-350:2020, 8.7 IEC60811-409
2.8	Behavior at high temperature (PVC ST2 and SHF1 sheaths)	IEC60092-~~360: 2014~~360:2021 Table 8	IEC60092-350:2020, 8.8 IEC60811-508
2.9	Behavior at low temperatures (PVC ST2, SHF1 and SHF2 sheaths)	IEC60092-~~360: 2014~~360:2021 Table 6, 8	IEC60092-350:2020, 8.9 IEC60811-505

Continued table 7.2.4

No.	Test	Requirement	Testing method
2.10	Test for coating of copper wires	IEC60092-350:2020, 8.11	IEC60092-350:2020, 8.11
2.11	Galvanizing test	IEC60092-350:2020, 8.12 ISO 7989-2:2007, 5.3	IEC60092-350:2020, 8.12 ISO 7989-2:2007, 5.3
2.12	Resistance to cracking heat shock (PVC ST2 and SHF1 sheaths)	IEC60092-~~360: 2014~~360:2021 Table 8	IEC60092-350:2020, 8.13 IEC60811-509
2.13	Ozone resistance (HEPR, EPR, HF90 insulations and SH, SE, SHF2 sheaths)	IEC60092-~~360: 2014~~360:2021 Table 4, 6	IEC60092-350:2020 ,8.14 IEC60811-403
2.14	Hot oil immersion (SE, SH and SHF2 sheaths)	IEC60092-~~360: 2014~~360:2021 Table 6	IEC60092-350:2020, 8.15.1 IEC60811-404
2.15	Fire-retardant tests: IEC 60332-1-2 and IEC 60332-3-22	IEC60092-350:2020, 8.17.1 IEC60332-1-2 IEC60092-350:2020, 8.17.2 IEC60332-3-22	IEC60092-350:2020, 8.17.1 IEC60332-1-2 IEC60092-350:2020, 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~~360:2021 Table 4	IEC60092-350:2020, 8.18
2.17	Determination of modulus of elasticity (HEPR insulation)	IEC60092-~~360: 2014~~360:2021 Table 4	IEC60092-350:2020, 8.19
2.18	Durability of marking	IEC60092-350:2020, 8.20	IEC60092-350:2020, 8.20
3	Additional tests required for halogen-free cables		
3.1	Acid gas emission	IEC60092-350:2020 Table7	IEC60092-350:2020， 8.17.4 IEC60754-1
3.2	pH and conductivity	IEC60092-350:2020 Table 7	IEC60092-350:2020， 8.17.5 IEC60754-2
3.3	Fluorine content test	IEC60092-350:2020 Table 7	IEC60092-350:2020， 8.17.6 IEC60684-2
4	Additional test required for low smoke cables (NOTE The smoke emission test is in general applicable to halogen-free cables. See also above test item No.3.)		
4.1	Smoke emission test for cables insulated and sheathed with halogen-free materials. When tested according to IEC 61034-2	IEC60092-350:2020， 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	IEC60092-350:2020， 8.17.3 IEC61034-1 IEC61034-2

Continued table 7.2.4

No.	Test	Requirement	Testing method
5	Additional tests required for fire resistant cables (NOTE The test apparatus for the test procedure defined in IEC 60331-21 is detailed in IEC 60331-11.)		
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	IEC60092-350:2020， 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 behavior	IEC60092-350:2020 Annex E	IEC60092-350:2020 ,8.10
6.2	Enhanced hot oil immersion	IEC60092-~~360: 2014~~360:2021 Table 9	IEC60092-350:2020, 8.15.2
6.3	Drilling fluid test	IEC60092-~~360: 2014~~360:2021 Table 10	IEC60092-350:2020, 8.16

7.4 Principles for selection of samples

7.4.1 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.

7.4.2 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.

7.4.3 Quantity (length) of the test samples shall meet related standards.

7.4.4 Test samples shall be taken by CCS Surveyor at the applicant’s factory.

7.5 Test organization

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

7.5.2 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.

7.6 Approval certificate

7.6.1 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.

8 Unit/batch inspection

8.1 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 8.1:

Test program for unit/batch inspection of power cables for rated voltages 1 kV and 3 kV **Table 8.1**

No.	Test	Requirement	Testing method
1	Routine Tests		
1.1	Measurement of electrical resistance of conductors	IEC60228 Table II and III	IEC60092-350:2020 para.5.2.2
1.2	Voltage test	IEC60092-350:2020 para.5.2.3	IEC60092-350:2020 para.5.2.3
1.3	Voltage test on sheath (Armoured cables)	IEC60092-350:2020 para.5.2.3.4	IEC60092-350:2020 para.5.2.3.4
2	Sample Tests		
2.1	Conductor examination	IEC60092-353:2016 para.5.2 IEC60228 Table II and III	IEC60092-350:2020 para.6.4
2.2	Check of cable dimensions Measurement of thickness of insulation Measurement of thickness of non metallic sheaths (excluding inner coverings) External diameter	 IEC60092-353:2016 para.5.3.3 IEC60092-353:2016 para.5.5.2 IEC60092-353:2016 para.5.7.3	 IEC60092-350:2020 para.6.5 IEC60811-201 IEC60092-350:2020 para.6.6 IEC60811-202 IEC60092-350:2020 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~~360:2021 Table 4 and 6	IEC60092-350:2020 para.6.8 IEC60811-507
2.4	Insulation resistance test	IEC60092-~~360:2014~~360:2021Table 3	IEC60092-350:2020 para.7.2.1

8.2 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 8.2:

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

8.2.2 Voltage test (IEC60092-350:2020 para. 5.2.3);

8.2.3 Partial discharge test (IEC60092-350:2020 para. 5.2.4);

8.2.4 Conductor examination (IEC60092-350:2020 para. 6.4);

8.2.5 Construction examination (IEC60092-350:2020 para. 6.5 to 6.7);

8.2.6 Hot-set test for insulations and sheaths (IEC60092-350:2020 para. 6.8).

Test program for unit/batch inspection of power cables for rated voltages 6 kV and 30 kV **Table 8.2**

No.	Test	Requirement	Testing method
1	Routine Tests		
1.1	Measurement of electrical resistance of conductors	IEC60228 Table II and III	IEC60092-350:2020 para.5.2.2
1.2	Voltage test	IEC60092-350:2020 para. 5.2.3	IEC60092-350:2020 para.5.2.3
1.3	Partial discharge test	IEC60092-350:2020 para. 5.2.4	IEC60092-350:2020 para.5.2.4 IEC60885-2
2	Sample Tests		
2.1	Conductor examination	IEC60092-354:2020 para. 5.2 IEC60228 Table II and III	IEC60092-350:2020 para.6.4
2.2	Check of cable dimensions Thickness of insulation Thickness of non-metallic sheaths (excluding inner coverings) External diameter	 IEC60092-354:2020 para. 5.5.3 IEC60092-354:2020 para. 14.2 IEC60092-354:2020 para. 15.2	 IEC60092-350:2020 para. 6.5 IEC60811-201 IEC60092-350:2020 para. 6.6 IEC60811-202 IEC60092-350:2020 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~~360:2021 Table 4 and 6	IEC60092-350:2020 para.6.8 IEC60811-507

8.3 The cables for control and instrumentation circuits are at least to be subjected to the inspections and tests at the manufacturer according to Table 8.3:

Test program for unit/batch inspection of cables for control and instrumentation circuits **Table 8.3**

No.	Test	Requirement	Testing method
1	Routine Tests		
1.1	Measurement of electrical resistance of conductors and drain wires	IEC60092-376:2017 Table 1	IEC60092-350:2020, 5.2.2
1.2	Voltage test	IEC60092-350:2020, 5.2.3	IEC60092-350:2020, 5.2.3
1.3	Voltage test on sheath (Armoured cables)	IEC60092-350:2020, 5.2.3.4	IEC60092-350:2020, 5.2.3.4
2	Sample Tests		
2.1	Insulation resistance test	——	IEC60092-350:2020 ,6.9
2.2	Screen insulation resistance, the insulation resistance between individually screened pair triple or quad units and any collective screening	≥ 1 MΩ·km	IEC60092-350:2020, 6.9
2.3	The insulation resistance between any screen and the armour for armoured cables	≥ 0,25 MΩ·km	IEC60092-350:2020, 6.9
2.4	Conductor examination	IEC60092-376:2017, 5.2	IEC60092-350:2020, 6.4
2.5	Check of cable dimensions – Thickness of insulation – Thickness of nonmetallic sheaths (excluding inner coverings) – External diameter		IEC60092-350:2020, 6.5 and 8.2 IEC60811-201 IEC60092-350:2020, 6.6 and 8.3 IEC60811-202 IEC60092-350:2020, 6.7 IEC60811-203
2.3	Hot set test (HEPR, EPR, XLPE, HF 90, S 95 insulations and SH, SE, SHF2 sheaths)	IEC60092-~~360: 2014~~360:2021 Table 4, 6	IEC60092-350:2020, 6.8 IEC60811-507

8.4 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.

8.5 Frequency of sample tests

8.5.1 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.

8.5.2 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 8.5.

Number of samples according to cable length **Table 8.5**

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 *****