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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) This Guidance references and quotes standards as IEC60092-3~~60~~53, etc. By now they have been updated to version 202~~1~~4.

b) This Guidance references and quotes standards as IEC60092-376, etc. By now they have been updated to version 2025.

c) Addition of the technical requirements and test for the optical fibre cables.

d) Addition of the technical requirements and test for the data and communication cables(ethernet cables).

e) Addition of the technical requirements and test for the cables used in intrinsically safe

circuits.

f) Supplemented examples of the sampling principles for type testing.

g) Deleted the test requirement IEC60331-21.

~~a)~~h) Editorial modification.

CONTENTS

1 Scope 4

2 Normative references 4

3 Terms and Definitions 9

4 Plans and documents 9

5 Technical requirements 10

6 Material and parts 12

7 Type tests 12

8 Unit/batch inspection 34

SHIPBOARD ELECTRIC WIRES AND CABLES

1 Scope

1.1 This Guidance ~~applies~~is applicable to approval and inspection of shipboard and offshore cables (rated voltage up to 18/30(36) kV~~ and below)~~ and optical fibre cables ~~which are permanently~~intended for ~~unfixed,~~ fixed ~~and used on ships and offshore~~ installations.

1.2 This Guidance~~Shipboard electric cables are to include~~ applies to:

(1) Power cables;

(2) Cables for control and instrumentation circuits~~, etc~~;

(3) Optical fibre cables;

(4) Data and communication cables(ethernet cables).

1.3 This Guidance does not cover:

~~(1) Optical fibre;~~

(1) Coaxial cables;

(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
IEC60092-353:20~~16~~24	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)
IEC60092-376:20~~17~~25	Electrical installations in ships - Part 376: Cables for control and instrumentation circuits 150/250 V (300 V)
IEC60092-378:2024	Electrical installations in ships - Part 378: Optical fiber cables
IEC60092-379:2024	Electrical installations in ships - Part 379: Symmetrical category cables with transmission characteristics up to 1 000 MHz
IEC60228	Conductors of insulated cables
IEC60092-360:2021	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
IEC60331-4	Tests for electric cables under fire conditions – Circuit integrity – Part 4: Test method for fire with shock at a temperature of at least 830 ℃ for cables of rated voltage higher than 1 kV up to and including 30 kV
IEC60332-3-24~~IEC60331-11~~	Tests on electric and optical fibre cables under fire conditions - Part 3-24: Test for vertical flame spread of vertically-mounted bunched wires or cables - Category C~~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
IEC60793-1-40~~IEC60811-201~~	Optical fibres - Part 1-40: Attenuation measurement methods~~Electric and optical fibre cables - Test methods for non-metallic materials - Part 201: General tests - Measurement of insulation thickness~~
IEC60794-1-1:2023~~IEC60811-202~~	Optical fibre cables - Part 1-1: Generic specification - General~~Electric and optical fibre cables - Test methods for non-metallic materials - Part 202: General tests - Measurement of thickness of non-metallic sheath~~
IEC60794-1-21~~IEC60811-203~~	Optical fibre cables - Part 1-21: Generic specification - Basic optical cable test procedures - Mechanical tests methods~~Electric and optical fibre cables - Test methods for non-metallic materials - Part 203 : General tests - Measurement of overall dimensions~~
IEC60794-1-22~~IEC60811-401~~	Optical fibre cables - Part 1-22: Generic specification - Basic optical cable test procedures - Environmental test methods~~Electric and optical fibre cables - Test methods for non-metallic materials - Part 401: Miscellaneous tests - Thermal ageing methods - Ageing in an air oven~~
IEC60794-1-23~~IEC60811-403~~	Optical fibre cables - Part 1-23: Generic specification - Basic optical cable test procedures - Cable element test methods~~Electric and optical fibre cables - Test methods for non-metallic materials - Part 403: Miscellaneous tests - Ozone resistance test on cross-linked compounds~~
IEC60794-1-111~~IEC60811-404~~	Optical fibre cables - Part 1-111: Generic specification - Basic optical cable test procedures - Mechanical tests methods - Bend, method E11~~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~~
IEC60332-3-25~~IEC60811-501~~	Tests on electric and optical fibre cables under fire conditions - Part 3-25: Test for vertical flame spread of vertically-mounted bunched wires or cables - Category D~~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~~
IEC61156-1:2023~~IEC60811-505~~	Multicore and symmetrical pair/quad cables for digital communications - Part 1: Generic specification~~Electric and optical fibre cables – Test methods for non-metallic materials – Part 505: Mechanical tests – Elongation at low temperature for insulations and sheaths~~
IEC61156-5:2020~~IEC60811-507~~	Multicore and symmetrical pair/quad cables for digital communications - Part 5: Symmetrical pair/quad cables with transmission characteristics up to 1 000 MHz - Horizontal floor wiring - Sectional specification~~Electric and optical fibre cables – Test methods for non-metallic materials – Part 507: Mechanical tests – Hot set test for cross-linked materials~~
IEC61156-6:2020~~IEC60811-508~~	Multicore and symmetrical pair/quad cables for digital communications - Part 6: Symmetrical pair/quad cables with transmission characteristics up to 1 000 MHz - Work area wiring - Sectional specification~~Electric and optical fibre cables – Test methods for non-metallic materials – Part 508: Mechanical tests – Pressure test at high temperature for insulation and sheaths~~
IEC60811-506~~IEC60811-509~~	Electric and optical fibre cables - Test methods for non-metallic materials - Part 506: Mechanical tests -

	Impact test at low temperature for insulations and sheathsElectric 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
IEC60885-23	Electrical test methods for electric cables. Part 2: Partial discharge testsElectrical test methods for electric cables - Part 3: Test methods for partial discharge measurements on lengths of extruded power cables
IEC60079-14:2024	Explosive atmospheres - Part 14: Electrical installation design, selection and installation of equipment, including initial inspection
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;~~

(1~~1~~0) Asbestos free statement;

(1~~2~~1) Routine inspection programmer or equivalent documents;

(1~~3~~2) Format of routine inspection report;

(1~~4~~3) Operation instructions for the products;

(1~~5~~4) Other documents to be submitted as required for approval.

5 Technical requirements

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

5.1.1 Shipboard electric cables and optical fibre 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 IEC60092-353:20~~16~~24.

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 60092-376:20~~03~~25.

5.1.5 Optical fibre cables shall be in accordance with the requirements of IEC 60092-378:2024.

All optical fibre cables discribed in this guidence are halogen-free as per Table 7.2.5.1.

5.1.6 Data and communication cables (ethernet cables) shall be in accordance with the requirements of IEC 60092-379:2024.

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 IEC60092-353:20~~16~~24.

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 IEC60092-360:2021. 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 IEC60092-360:2021. 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.

5.9 Cables used in intrinsically safe circuits shall be in accordance with the requirements of IEC60079-14:2024, 6.14.2.

6 Material and parts

Nil

7 Type tests

7.1 Shipboard electric cables~~Cables~~ and optical fibre 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 and optical fibre cables shall be subjected to type test according to Clause this Guidance 7.2.1 to 7.2.~~4~~6.

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

(1) Ambient temperature: 20℃±15℃~~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 7.2.2.1～7.2.2.6 where applicable. Test shall be provided according to Table 7.2.2.1～7.2.2.5 for braided armoured cables for installation in explosive atmospheres. Additional tests on cables for installation between areas with and without explosive atmospheres see Table 7.2.2.6.

7.2.3 Power cables for rated voltages 6 kV up to 30 kV shall be type tested according to Table 7.2.3 and Table 7.2.2.2～7.2.2.5 where applicable.

7.2.4 Cables for control and instrumentation circuits shall be type tested according to Table 7.2.4, Table 7.2.2.2～7.2.2.5 where applicable. Test shall be provided according to Table 7.2.4 and Table 7.2.2.2～7.2.2.5 for braided armoured cables for installation in explosive atmospheres. Additional tests on cables for installation between areas with and without explosive atmospheres see Table 7.2.2.6.

7.2.5 Optical fibre cables shall be type tested according to Table 7.2.5.1 and Table 7.2.2.3, Table

7.2.2.5 where applicable. Additional tests on cables with function integrity during fire shall be provided according to Table 7.2.5.2. Test on cables for installation in explosive atmospheres shall be provided according to Table 7.2.5.1 for braided armoured cables, and if any required according to and Table 7.2.2.3, Table 7.2.2.5. Tests on cables for installation between areas with and without explosive atmospheres shall be provided according to Table 7.2.5.1, Table 7.2.2.3, Table 7.2.2.5 where applicable and Table 7.2.2.6.

7.2.6 Data and communication cables (ethernet cables) shall be type tested according to Table 7.2.6.1 and Table 7.2.2.3, Table 7.2.2.5 where applicable. Fire resistant cables shall guarantee complete functional integrity during fire including defined data transmission characteristics in accordance with the requirements in Table 7.2.6.2. Test on cables for installation in explosive atmospheres shall be provided according to Table 7.2.6.1, Table 7.2.2.3 and Table 7.2.2.5 for braided armoured cables . Tests on cables for installation between areas with and without explosive atmospheres shall be provided according to Table 7.2.6.1, Table 7.2.6.2, Table 7.2.2.3 and Table 7.2.2.5 where applicable and Table 7.2.2.6.

~~**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~~	~~IEC60092-360:2021 Table 3~~	~~IEC60092-350:2020 para.7.2.1~~
~~1.2~~	~~Insulation resistance measurement at maximum rated temperature~~	~~IEC60092-360:2021 Table 3~~	~~IEC60092-350:2020 para.7.2.2~~
~~1.3~~	~~Increase of the a.c. capacitance after immersion in water when required~~	~~IEC60092-360:2021 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	IEC60092-360:2021 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	IEC60092-360:2021 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)	IEC60092-360:2021 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	IEC60092-360:2021 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)	IEC60092-360:2021 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	IEC60092-360:2021 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)	IEC60092-360:2021 Table 8	IEC60092-350:2020 para.8.13 IEC60811-509
2.14	Ozone resistance for insulations and sheaths	IEC60092-360:2021 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)	IEC60092-360:2021 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)	IEC60092-360:2021 Table 4	IEC60092-350:2020 para.8.18
2.18	Determination of modulus of elasticity (HEPR insulation)	IEC60092-360:2021 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~~	~~IEC60092-360:2021 Table 9~~	~~IEC60092-350:2020 para.8.15.2~~
~~6.3~~	~~Drill fluid test~~	~~IEC60092-360:2021 Table10~~	~~IEC60092-350:2020 para.8.16~~

Table 7.2.2.1 Type tests applicable to all cables for rated voltages 1 kV and 3 kV

No.	Test	Requirement	Testing method

1	Conductor examination	IEC60092-353	~~IEC60092-350:2020 para.6.4~~eeee
2	Check of cables dimensions ——thickness of insulation	IEC60092-353	IEC60092-350:2020 para.6.5 & para.8.2
	——thickness of non-metallic sheaths (excluding inner coverings)	IEC60092-353	IEC60092-350:2020 para.6.6 & para. 8.3
	——external diameter	IEC60092-353	IEC60092-350:2020 para.6.7
~~3~~e	~~Coverage density of braid for braid armoured cables~~e	IEC60092-350	IEC60092-350:2020 para.4.8.2
~~4~~e	Insulation resistance measurement at maximum rated temperature	IEC60092-360	IEC60092-350:2020 para.7.2.2
~~5~~e	Increase in AC capacitance after immersion in water	IEC60092-360	IEC60092-350:2020 para.7.3
ee6	High-voltage test for 4 h	IEC60092-350	IEC60092-350:2020 para.7.4
7	Mechanical properties of insulation before and after ageing	IEC60092-360	IEC60092-350:2020 para.8.4
8	Mechanical properties of sheath before and after ageing	IEC60092-360	IEC60092-350:2020 para.8.5
9	Additional ageing compatibility test	IEC60092-360	IEC60092-350:2020 para.8.6
10	Loss of mass test on PVC ST2 sheath	IEC60092-360	IEC60092-350:2020 para.8.7
11	Behavior of PVC ST2 and halogen-free SHF1 Sheaths at high temperature (hot pressure test)	IEC60092-360	IEC60092-350:2020 para.8.8
12	Behavior of PVC ST2 and halogen-free SHF1 and SHF2 sheaths at low temperatures	IEC60092-360	IEC60092-350:2020 para.8.9
13	Test for coating of copper wires	IEC60092-350	IEC60092-350:2020 para.8.11
14	Galvanizing test	IEC60092-350	IEC60092-350:2020 para.8.12
15	Resistance to cracking heat shock of PVC ST2 and halogen-free SHF1 sheaths	IEC60092-360	IEC60092-350:2020 para.8.13

16	Ozone resistance for HEPR, EPR, HF90 insulations and SH, SE, SHF2 sheaths	IEC60092-360	IEC60092-350:2020 para.8.14
17	Hot oil immersion test for SE, SH and SHF2 sheaths	IEC60092-360	IEC60092-350:2020 para.8.15.1
18	Fire-retardant tests: IEC60332-1-2 and IEC60332-3-22	IEC60332-1-2 and IEC60332-3-22 in which case cables shall be installed in the touching configuration on the front of ladder.	IEC60092-350:2020 para.8.17.1 & para.8.17.2
19	Determination of hardness (HEPR insulation)	IEC60092-360	IEC60092-350:2020 para.8.18
20	Determination of modulus of elasticity (HEPR insulation)	IEC60092-360	IEC60092-350:2020 para.8.19
~~21~~e	Durability of marking	The marking shall remain legible following the test as given in IEC60092-350:2020, 8.20.	IEC60092-350:2020 para.8.20

Table 7.2.2.2 Additional type tests required for halogen-free cables

No.	Test	Requirement	Testing method
1	Acid gas emission	IEC60754-1	IEC60092-350:2020 para.8.17.4
2	pH and conductivity	IEC60754-2	IEC60092-350:2020 para.8.17.5
~~3~~e	Fluorine content test	IEC60684-2	IEC60092-350:2020 para.8.17.6

Table 7.2.2.3 Additional type tests required for low smoke cables

No.	Test	Requirement	Testing method
1	Smoke emission test for cables insulated and sheathed with halogen-free materials. When tested according to IEC 61034-2.	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

Table 7.2.2.4 Additional tests required for fire resistant cables

No.	Test	Requirement	Testing method
1	Test for fire resistance (limited circuit integrity)	The test is to be carried out in accordance with IEC60331-1 or IEC60331-2 or IEC60331-4 and the minimum time to failure shall be 90 min.	IEC60092-350:2020 para.8.17.7

Table 7.2.2.5 Additional tests required for specific performances

No.	Test	Requirement	Testing method
~~1~~e	Special test for low temperature behavior	IEC60092-350	IEC60092-350:2020 para.8.10
2	Enhanced hot oil immersion	IEC60092-360	IEC60092-350:2020 para.8.15.2
3	Drill fluid test	IEC60092-360	IEC60092-350:2020 para.8.16

Table 7.2.2.6 Additional test for cables for installation between areas with and without explosive atmospheres

No.	Test	Requirement	Testing method
1	Test for limitation of the gas flow through the cable	IEC60079-14:2024, Annex C. Test shall be provided without armour.	IEC60079-14:2024, Annex C

~~**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~~	~~IEC60092-360:2021Table 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~~	~~IEC60092-360:2021 Table 3~~	~~IEC60092-350:2020 para.7.2.2~~
~~1.4~~	~~Increase in a.c. capacitance after immersion in water~~	~~IEC60092-360:2021 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	IEC60092-360:2021 Table 4	IEC60092-350:2020 para.8.4 IEC60811-501 IEC60811-401
2.5	Mechanical properties of sheaths before and after ageing	IEC60092-360:2021 Table 6 and 8	IEC60092-350:2020 para.8.5 IEC60811-501 IEC60811-401
2.6	Additional ageing compatibility test	IEC60092-360:2021 Table 4 and 6	IEC60092-350:2020 para.8.6 IEC60811-501 IEC60811-401
2.7	Loss of mass test (PVC ST2 sheaths)	IEC60092-360:2021 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)	IEC60092-360:2021 Table 8	IEC60092-350:2020 para.8.8 IEC60811-508
2.9	Behavior at low temperature(ST2, SHF1 and SHF2 sheaths	IEC60092-360:2021 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)	IEC60092-360:2021 Table 8	IEC60092-350:2020 para.8.13 IEC60811-509
2.13	Ozone resistance (insulation and sheaths)	IEC60092-360:2021 Table 4 and 6	IEC60092-350:2020 para.8.14 IEC60811-403

2.14	Hot oil immersion (SE1, SH and SHF2 sheaths)	IEC60092-360:2021 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)	IEC60092-360:2021 Table 4	IEC60092-350:2020 para.8.18
2.17	Determination of modulus of elasticity (HEPR insulation)	IEC60092-360:2021 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~~	~~IEC60092-360:2021 Table 9~~	~~IEC60092-350:2020 para. 8.15.2~~
~~6.3~~	~~Drill fluid test~~	~~IEC60092-360:2021 Table 10~~	~~IEC60092-350:2020 para. 8.16~~

Table 7.2.3 Type tests applicable to all single and three-core power cables with extruded solid insulation for rated voltages 6 kV up to 30 kV

No.	Test	Requirement	Testing method

1	Conductor examination	IEC60092-354	IEC60092-350:2020 para.6.4
2	Check of cables dimensions - Thickness of insulation - Thickness of non-metallic sheaths - Dimensions of braid armour external diameter	 IEC60092-354 IEC60092-354 IEC60092-354:2020 para.e IEC60092-354	 IEC60092-350:2020 para.6.5 & para.8.2 IEC60092-350:2020 para.6.6 & para. 8.3 IEC60092-350 IEC60092-350:2020 para.6.7
3	Coverage density of braid eables	IEC60092-350	IEC60092-350:2020 para.4.8.2
~~4~~eeeee eeeeee	Insulation resistance test	IEC60092-360	IEC60092-350:2020 para.7.2.1
5	High voltage sequence test	IEC60092-350	IEC60092-350:2020 para.7.7
~~6~~e	Insulation resistance measurement at maximum rated temperature	IEC60092-360	IEC60092-350:2020 para.7.2.2
~~7~~e	Increase in AC capacit~~y~~e after immersion in water	IEC60092-360	IEC60092-350:2020 para.7.3
8	High-voltage test for 4 h	IEC60092-350	IEC60092-350:2020 para.7.7.9
9	Mechanical properties of insulation before and after ageing	IEC60092-360	IEC60092-350:2020 para.8.4
10	Mechanical properties of sheath before and after ageing	IEC60092-360	IEC60092-350:2020 para.8.5
11	Additional ageing compatibility test	IEC60092-360	IEC60092-350:2020 para.8.6
12	Loss of mass test on PVC ST2 sheath	IEC60092-360	IEC60092-350:2020 para.8.7
13	Behavior of PVC ST2 and halogen-free SHF1 Sheaths at high temperature (hot pressure test)	IEC60092-360	IEC60092-350:2020 para.8.8
14	Behavior of PVC ST2, halogen-free SHF1 and SHF2 sheaths at low temperatures	IEC60092-360	IEC60092-350:2020 para.8.9
15	Test for coating of copper wires	IEC60092-350	IEC60092-350:2020 para.8.11
16	Galvanizing test	IEC60092-350	IEC60092-350:2020 para.8.12

17	Resistance to cracking heat shock of PVC ST2 and halogen-free SHF1 sheaths	IEC60092-360	IEC60092-350:2020 para.8.13
18	Ozone resistance for insulations and sheaths	IEC60092-360	IEC60092-350:2020 para.8.14
19	Hot oil immersion test for SE, SH and SHF2 sheaths	IEC60092-360	IEC60092-350:2020 para.8.15.1
20	Flame-spread tests: IEC60332-1-2 and IEC60332-3-22	IEC60332-1-2 and IEC60332-3-22 in which case cables shall be installed in the touching configuration on the front of ladder.	IEC60092-350:2020 para.8.17.1 & para.8.17.2
21	Determination of hardness (HEPR insulation)	IEC60092-360	IEC60092-350:2020 para.8.18
22	Determination of modulus of elasticity (HEPR insulation)	IEC60092-360	IEC60092-350:2020 para.8.19
23	Durability of marking	The marking shall remain legible following the test as given in IEC60092-350:2020, 8.20.	IEC60092-350:2020 para.8.20

~~**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~~	~~IEC60092-360:2021 Table 3~~	~~IEC60092-350:2020, 7.2.1~~
~~1.2~~	~~Insulation resistance measurement at maximum rated temperature~~	~~IEC60092-360:2021 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~~	~~IEC60092-376:2017, 5.6 and 5.8~~	~~IEC60092-350:2020, 4.8.2~~

	(Braid armoured cables and/or braid screened cable)		
2.4	Mechanical properties of insulation before and after ageing	IEC60092-360:2021 Table 4	IEC60092-350:2020, 8.4 IEC60811-501 IEC60811-401
2.5	Mechanical properties of sheath before and after ageing	IEC60092-360:2021 Table 6, 8	IEC60092-350:2020, 8.5 IEC60811-501 IEC60811-401
2.6	Additional ageing compatibility test	IEC60092-360:2021 Table 4, 6, 8	IEC60092-350:2020, 8.6 IEC60811-501 IEC60811-401
2.7	Loss of mass test (PVC ST2 sheath)	IEC60092-360:2021 Table 8	IEC60092-350:2020, 8.7 IEC60811-409
2.8	Behavior at high temperature (PVC ST2 and SHF1 sheaths)	IEC60092-360:2021 Table 8	IEC60092-350:2020, 8.8 IEC60811-508
2.9	Behavior at low temperatures (PVC ST2, SHF1 and SHF2 sheaths)	IEC60092-360:2021 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)	IEC60092-360:2021 Table 8	IEC60092-350:2020, 8.13 IEC60811-509
2.13	Ozone resistance (HEPR, EPR, HF90 insulations and SH, SE, SHF2 sheaths)	IEC60092-360:2021 Table 4, 6	IEC60092-350:2020 ,8.14 IEC60811-403
2.14	Hot oil immersion (SE, SH and SHF2 sheaths)	IEC60092-360:2021 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)	IEC60092-360:2021 Table 4	IEC60092-350:2020, 8.18
2.17	Determination of modulus of elasticity (HEPR insulation)	IEC60092-360:2021 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	IEC60092-360:2021 Table 9	IEC60092-350:2020, 8.15.2
6.3	Drilling fluid test	IEC60092-360:2021 Table 10	IEC60092-350:2020, 8.16

Table 7.2.4 Type tests applicable to all cables for control and instrumentation circuits

No.	Test	Requirement	Testing method

1	Conductor examination	IEC60092-376	IEC60092-350:2020 para.6.4
2	Check of cables dimensions - Thickness of insulation - Thickness of non-metallic sheaths (excluding inner coverings) - External diameter	 IEC60092-376 IEC60092-376 IEC60092-376	 IEC60092-350:2020 para.6.5 & para.8.2 IEC60092-350:2020 para.6.6 & para. 8.3 IEC60092-350:2020 para.6.7
3	Coverage density of braid for braid armoured cables and/or braid screened cable	IEC60092-350	IEC60092-350:2020 para.4.8.2
4	Insulation resistance constant test	IEC60092-360:2021 Table 3	IEC60092-350:2020 para.7.2.1
5	Insulation resistance measurement at maximum rated temperature	IEC60092-360	IEC60092-350:2020 para.7.2.2
6	Mutual capacitance	—	IEC60092-350:2020 para.7.5
7	Inductance to resistance ratio	—	IEC60092-350:2020 para.7.6
8	Mechanical properties of insulation before and after ageing	IEC60092-360	IEC60092-350:2020 para.8.4
9	Mechanical properties of sheath before and after ageing	IEC60092-360	IEC60092-350:2020 para.8.5
10	Additional ageing compatibility test	IEC60092-360	IEC60092-350:2020 para.8.6
11	Loss of mass test on PVC ST2 sheath	IEC60092-360	IEC60092-350:2020 para.8.7
12	Behavior of PVC ST2 and halogen-free SHF1 Sheaths at high temperature (hot pressure test)	IEC60092-360	IEC60092-350:2020 para.8.8
13	Behavior of PVC ST2 and halogen-free SHF1 and SHF2 sheaths at low temperatures	IEC60092-360	IEC60092-350:2020 para.8.9
14	Test for coating of copper wires	IEC60092-350	IEC60092-350:2020 para.8.11
15	Galvanizing test	IEC60092-350	IEC60092-350:2020 para.8.12
16	Resistance to cracking heat shock of PVC ST2 and halogen-free SHF1 sheaths	IEC60092-360	IEC60092-350:2020 para.8.13
17	Ozone resistance for HEPR, EPR, HF90 insulations and SH, SE, SHF2 sheaths	IEC60092-360	IEC60092-350:2020 para.8.14
18	Hot oil immersion test for SE, SH and SHF2 sheaths	IEC60092-360	IEC60092-350:2020 para.8.15.1

19	Fire-retardant tests: IEC60332-1-2 and IEC60332-3-22	IEC60332-1-2 and IEC60332-3-22 in which case cables shall be installed in the touching configuration on the front of ladder.	IEC60092-350:2020 para.8.17.1 & para.8.17.2
20	Determination of hardness (HEPR insulation)	IEC60092-360	IEC60092-350:2020 para.8.18
21	Determination of modulus of elasticity (HEPR insulation)	IEC60092-360	IEC60092-350:2020 para.8.19
22	Durability of marking	The marking shall remain legible following the test as given in 8.20 of IEC60092-350:2020.	IEC60092-350:2020 para.8.20

Table 7.2.5.1 Type tests applicable to all optical fibre cables

No.	Test	Requirement	Testing method
1	Check of cables dimensions		
	Thickness of non-metallic sheaths (excluding inner coverings)	IEC60092-378	IEC60092-350:2020 para.6.6 & para. 8.3
	External diameter	IEC60092-378	IEC60092-350:2020 para.6.7
2	Coverage density of braid for braid armoured cables	⩾60%	IEC60092-350:2020
3	Mechanical properties of sheath before and after ageing	IEC60092-360	IEC60092-350:2020 para.8.5
4	Additional ageing compatibility test	IEC60092-360	IEC60092-350:2020 para.8.6
5	Behavior of halogen-free SHF1 Sheaths at high temperature (hot pressure test)	IEC60092-360	IEC60092-350:2020 para.8.8
6	Behavior of halogen-free SHF1 and SHF2 sheaths at low temperatures	IEC60092-360	IEC60092-350:2020 para.8.9
7	Galvanizing test	IEC60092-350	IEC60092-350:2020 para.8.12
8	Resistance to cracking heat shock of halogen-free SHF1 sheaths	IEC60092-360	IEC60092-350:2020 para.8.13
9	Ozone resistance for SHF2 sheaths	IEC60092-360	IEC60092-350:2020 para.8.14
10	Hot oil immersion test for	IEC60092-360	IEC60092-350:2020 para.8.15.1

	SHF2 sheaths		
11	Flame-spread tests: IEC60332-1-2 and IEC60332-3-24	IEC60332-1-2 and IEC60332-3-24 in which case cables shall be installed in the touching configuration on the front of ladder.	IEC60092-350:2020 para.8.17.1 & para.8.17.2
12	Durability of marking	The marking shall remain legible following the test as given in 8.20 of IEC60092-350:2020.	IEC60092-350:2020 para.8.20
13	Tensile performance	Ts=1000N(minimum value) or the weight of 1 km cable, the higher value is valid. No attenuation change after remove of load; maximum fibre strain during load 0.6%; after remove of load no fibre strain.	IEC60794-1-21, method E1
14	Temperature cycling	Maximum change of attenuation 0.3dB at 1550nm for single mode fibres and 0.5dB at 1300nm for multi mode fibres; no change of attenuation after the test.	IEC60794-1-22, method F1 cable sample length at least 100 m, length of the fibre under test 100 m; T_{A2}-25℃; T_{B2}70℃; number of cycles 3
15	Crush	No change of attenuation during the test and after the test.	IEC60794-1-21, method E3A 1500 N 10 min(long-term); 3 tests with at least 500 mm spacing between Multi mode measured at 1300 nm Single mode measured at 1550 nm
16	Crush	No change of attenuation after the test.	IEC60794-1-21, method E3A 2500 N 1 min(short-term); 3 tests with at least 500 mm spacing between

			Multi mode measured at 1300 nm Single mode measured at 1550 nm
17	Impact	No change of attenuation after the test.	IEC60794-1-21, method E4 3 impacts on one place frequency 30 impacts per minute Impact energy 2 Nm; striking surface radius 300 mm Multi mode measured at 1300 nm Single mode measured at 1550 nm
18	Kink	No kink.	IEC60794-1-21, method E10 Minimum loop diameter 20×cable diameter
19	Tube kinking	No kinking of tube.	IEC60794-1-23, method G7 L=60 mm L1=350 mm L2=100 mm 5 cycles
20	Bend	No change of attenuation after the test.	IEC60794-1-111, method E11A diameter of mandrel for unarmoured cables 20×cable diameter diameter of mandrel for armoured cables 40×cable diameter 4 turns 3 cycles Multi mode measured at 1300 nm Single mode measured at 1550 nm
21	Acid gas emission	IEC60754-1	IEC60092-350:2020 para.8.17.4
22	pH and conductivity	IEC60754-2 weighted values according to IEC60092-378:2024,8.3. The requirement is in IEC60092-350 for the complete cable performance.	IEC60092-350:2020 para.8.17.5
23	Fluorine content test	IEC60684-2	IEC60092-350:2020 para.8.17.6

No change in attenuation shall be according to IEC60794-1-1.
NOTE See IEC60794-1-1:2023, Annex B for guidelines for fibre selection for cable testing.

Table 7.2.5.2 Additional tests required for fire resistant cables

No.	Test	Requirement	Testing method
1	Test for fire resistance (limited circuit integrity)	The test is to be carried out in accordance with IEC60331-1 or IEC60331-2. During the flaming period shall be measured the attenuation of the fibres. The attenuation increase during the test shall not be higher than 3 dB and the minimum time of the flaming period shall be 90min, 120 min or 180 min.	IEC60092-350:2020 para.8.17.7 Multi mode measured at 1300 nm Single mode measured at 1550 nm

Table 7.2.6.1 Type tests applicable to all Ethernet (category) cables

No.	Test	Requirement	Testing method
1	Check of cable dimensions Thickness of non-metallic sheaths (excluding inner coverings) external diameter	 IEC60092-379 IEC60092-379	 IEC60092-350:2020 para.6.6 & para. 8.3 IEC60092-350:2020 para.6.7
2	Coverage density of braid for braid armoured cables	IEC60092-350:2020 para.4.8.2	IEC60092-350:2020 para.4.8.2
3	Mechanical properties of sheath before and after ageing	IEC60092-360	IEC60092-350:2020 para.8.5
4	Additional ageing compatibility test	IEC60092-360	IEC60092-350:2020 para.8.6
5	Behavior of halogen-free SHF1 Sheaths at high temperature (hot pressure test)	IEC60092-360	IEC60092-350:2020 para.8.8
6	Behavior of halogen-free SHF1 and SHF2 sheaths at low temperatures	IEC60092-360	IEC60092-350:2020 para.8.9
7	Galvanizing test	IEC60092-350	IEC60092-350:2020 para.8.12
8	Resistance to cracking heat shock of halogen-free SHF1	IEC60092-360	IEC60092-350:2020 para.8.13

	sheaths		
9	Ozone resistance for SHF2 sheaths	IEC60092-360	IEC60092-350:2020 para.8.14
10	Hot oil immersion test for SHF2 sheaths	IEC60092-360	IEC60092-350:2020 para.8.15.1
11	Fire-retardant tests: IEC60332-1-2 and IEC60332-3-24 or IEC60332-3-25	IEC60332-1-2 and IEC60332-3-24 or IEC60332-3-25 in which case cables shall be installed in the touching configuration on the front of ladder.	IEC60092-350:2020 para.8.17.1 & para.8.17.2
12	Durability of marking	The marking shall remain legible following the test as given in 8.20 of IEC60092-350:2020.	IEC60092-350:2020 para.8.20
13	Conductor resistance	IEC 61156-5:2020, para.6.2.1 or IEC 61156-6:2020, para.6.2.1	-
14	Conductor resistance unbalance within pair	IEC 61156-5:2020, para.6.2.2.2 or IEC 61156-6:2020, para.6.2.2.2	-
15	Dielectric strength conductor/conductor and conductor/screen	IEC 61156-5:2020, para.6.2.3 or IEC 61156-6:2020, para.6.2.3	-
16	Insulation resistance conductor/conductor and conductor/screen	IEC 61156-5:2020, para.6.2.4 or IEC 61156-6:2020, para.6.2.4	-
17	Capacitance unbalance pair to ground	IEC 61156-5:2020, para.6.2.6 or IEC 61156-6:2020, para.6.2.6	-
18	Transfer impedance	IEC 61156-5:2020, para.6.2.7 or IEC 61156-6:2020, para.6.2.7	-
19	Coupling attenuation	IEC 61156-5:2020, para.6.2.8 or IEC 61156-6:2020, para.6.2.8	-
20	Phase and differential delay (delay skew)	IEC 61156-5:2020, para.6.3.2.1 or IEC 61156-6:2020, para.6.3.2.1	-
21	Differential delay(delay skew)	IEC 61156-5:2020, para.6.3.2.2 or IEC 61156-6:2020, para.6.3.2.2	-
22	Attenuation	IEC 61156-5:2020, para.6.3.3.1, para.6.3.3.2, para.6.3.3.3 or IEC 61156-6:2020, para.6.3.3.1, para.6.3.3.2, para.6.3.3.3	-
23	Unbalance attenuation	IEC 61156-5:2020, para.6.3.4 or IEC 61156-6:2020, para.6.3.4	-
24	Power sum Near-end crosstalk (PS NEXT)	IEC 61156-5:2020, para.6.3.5 or IEC 61156-6:2020, para.6.3.5	-
25	Near-end crosstalk (NEXT)	IEC 61156-5, para.6.3.5 or	-

		IEC 61156-6, para.6.3.5	
26	Power sum equal level far-end crosstalk (ACR-F)	IEC 61156-5:2020, para.6.3.6 or IEC 61156-6:2020, para.6.3.6	-
27	Impedance	IEC 61156-5:2020, para.6.3.10 or IEC 61156-6:2020, para.6.3.10	-
28	Return loss	IEC 61156-5:2020, para.6.3.11 or IEC 61156-6:2020, para.6.3.11	-
29	Crush resistance of the cable	IEC 61156-1:2023, para.6.4.8	IEC 61156-1
30	Impact resistance of the cable	IEC 61156-1:2023, para.6.4.9, IEC 60811-506	-
31	Single bend test U-bend test	IEC 61156-1:2023, para.6.4.10.3.2	IEC 61156-1
32	Simulated installation testing of the cable	IEC 61156-1:2023, para.6.4.10.3.2	IEC 61156-1
33	Tensile performance	IEC 61156-1:2023, para.6.4.12	IEC 61156-1
34	Tensile strength of the insulation	IEC 61156-5:2020, para.6.4.3 or IEC 61156-6:2020, para.6.4.3	-
35	Elongation at break of the insulation	IEC 61156-5:2020, para.6.4.4 or IEC 61156-6:2020, para.6.4.4	-
36	Acid gas emission	IEC60754-1	IEC60092-350:2020 para.8.17.4
37	pH and conductivity	IEC60754-2	IEC60092-350:2020 para.8.17.5
38	Fluorine content test	IEC60684-2	IEC60092-350:2020 para.8.17.6
All cables shall be referenced to IEC 61156-1. Horizontal cables shall be referenced additionally to IEC 61156-5. Work-area cables shall be referenced additionally to IEC 61156-6. NOTE The use of attenuation limits according to IEC 61156-6 leads to lower maximum transmission lengths compared to the attenuation limits according to IEC 61156-5.			

Table 7.2.6.2 Additional tests required for fire resistant cables

No.	Test	Requirement	Testing method
1	Test for fire resistance (limited circuit integrity)	The test is to be carried out in accordance with IEC60331-1 or IEC60331-2. During the flaming period the parameters shall be measured - at minimum every 5 min in the first 20 min and later every 10 min in accordance with IEC60092-379:2024 Table 5. The minimum time of the flaming period shall be 90 min, 120 min or 180 min.	IEC60092-350:2020 para.8.17.7

7.43 Principles for selection of samples

7.43.1 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.

7.43.2 Types and specifications of the test samples shall be technically representative. In other words, it is difficultthe most tonerous for test samples to pass approval type test.

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

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

7.54 Test organization

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

7.54.2 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.

7.65 Approval certificate

7.65.1 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 8.1.1 and 8.1.2:

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)~~	~~IEC60092-360:2021 Table 4 and 6~~	~~IEC60092-350:2020 para.6.8 IEC60811-507~~
~~2.4~~	~~Insulation resistance test~~	~~IEC60092-360:2021Table 3~~	~~IEC60092-350:2020 para.7.2.1~~

Table 8.1.1 Routine tests of power cables for rated voltages 1 kV and 3 kV

No.	Test	Requirement	Testing method
1	Measurement of electrical resistance of conductors	IEC60228	IEC60092-350:2020 para.5.2.2
2	Voltage test	IEC60092-350	IEC60092-350:2020 para.5.2.3
3	Voltage test on sheath of armoured cables	IEC60092-350	IEC60092-350:2020 para.5.2.3.4

Table 8.1.2 Sample tests of power cables for rated voltages 1 kV and 3 kV

No.	Test	Requirement	Testing method

1	Insulation resistance test	IEC60092-360	IEC60092-350:2020 para.7.2
2	Conductor examination	IEC60092-353	IEC60092-350:2020 para.6.4
3	Check of cable dimensions - Thickness of insulation - Thickness of non metallic sheaths (excluding inner coverings) - External diameter	 IEC60092-353 IEC60092-353 IEC60092-353	 IEC60092-350:2020 para.6.5 & para.8.2 IEC60092-350:2020 para.6.6 & para.8.3 IEC60092-350:2020 para.6.7
4	Hot-set test for HEPR, EPR, XLPE, HF90, S95 insulations and SH, SE, SHF2 sheaths	IEC60092-360	IEC60092-350:2020 para.6.8

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 8.2.1 and 8.2.2:

~~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~~		

No.	Test	Requirement	Testing method
	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)	IEC60092-360:2021 Table 4 and 6	IEC60092-350:2020 para.6.8 IEC60811-507

Table 8.2.1 Routine tests of single and three-core power cables with extruded solid insulation for rated voltages 6 kV up to 30 kV

No.	Test	Requirement	Testing method
1	Measurement of electrical resistance of conductors	IEC60228	IEC60092-350:2020 para.5.2.2
2	Voltage test	IEC60092-350	IEC60092-350:2020 para.5.2.3
3	Voltage test on sheath of armoured cables	IEC60092-350	IEC60092-350:2020 para.5.2.3
4	Partial discharge test	IEC60885-3	IEC60092-350:2020 para.5.2.4

Table 8.2.2 Sample tests of single and three-core power cables with extruded solid insulation for rated voltages 6 kV up to 30 kV

No.	Test	Requirement	Testing method

1	Conductor examination	IEC60092-353	IEC60092-350:2020 para.6.4
2	Check of cables dimensions - Thickness of insulation - Thickness of non-metallic sheaths - Dimensions of braid armour - External diameter	 IEC60092-354 IEC60092-354 IEC60092-354:2020 para.5.9.2 & 5.9.3 IEC60092-354	 IEC60092-350:2020 para.6.5 & para.8.2 IEC60092-350:2020 para.6.6 & para. 8.3 IEC60092-350 IEC60092-350:2020 para.6.7
3	Hot-set test for HEPR, EPR, XLPE insulations and SH, SE, SHF2 sheaths	IEC60092-360	IEC60092-350:2020 para.6.8

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 8.3.1 and 8.3.2:

Table 8.3.1 Routine tests of cables for control and instrumentation circuits

No.	Test	Requirement	Testing method
1	Measurement of electrical resistance of conductors and drain wires	IEC60092-376:2017 Table 1 & Table 4	IEC60092-350:2020 para.5.2.2
2	Voltage test	IEC60092-350	IEC60092-350:2020 para.5.2.3
3	Voltage test on sheath of armoured cables	IEC60092-350	IEC60092-350:2020 para.5.2.3.4

Table 8.3.2 Sample tests of cables for control and instrumentation circuits

No.	Test	Requirement	Testing method
1	Insulation resistance test	IEC60092-360	IEC60092-350:2020 para.6.9
2	Screen insulation resistance, the insulation resistance between individually screened pair, triple or quad units and any collective screening	≥1MΩ ŀkm	IEC60092-350:2020 para.6.9
3	The insulation resistance between any screen and the	≥0,25MΩ ŀkm	IEC60092-350:2020 para.6.9

	armour for armoured cables		
4	Conductor examination	IEC60092-376	IEC60092-350:2020 para.6.4
5	Check of cable dimensions - Thickness of insulation - Thickness of non metallic sheaths (excluding inner coverings) - External diameter	 IEC60092-376 IEC60092-376 IEC60092-376	 IEC60092-350:2020 para.6.5 & para.8.2 IEC60092-350:2020 para.6.6 & para.8.3 IEC60092-350:2020 para.6.7
6	Hot set test for HEPR, EPR, XLPE, HF90, S95 insulations and SH, SE, SHF2 sheaths	IEC60092-360	IEC60092-350:2020 para.6.8

8.4 The cables for optical fibre cables are at least to be subjected to the inspections and tests at the manufacturer according to Table 8.4.1 and 8.4.2:

Table 8.4.1 Routine tests of optical fibre cables

No.	Test	Requirement	Testing method
1	Attenuation	IEC60092-378:2024 para.5.2, Table 1 and Table 2	IEC60793-1-40, method C

Table 8.4.2 Sample tests of optical fibre cables

No.	Test	Requirement	Testing method
1	Check of cable dimensions Thickness of non-metallic sheaths (excluding inner coverings) External diameter	 IEC60092-378 IEC60092-378	 IEC60092-350:2020 para.6.6 & para. 8.3 IEC60092-350:2020 para.6.7
2	Hot set test for SHF2 sheaths only	IEC60092-360	IEC60092-350:2020 para.6.8

8.5 Data and communication cables (ethernet cables) are at least to be subjected to the inspections and tests at the manufacturer according to Table 8.5:

Table 8.5 Sample tests of Ethernet (category) cables

No.	Test	Requirement	Testing method
1	Check of cable dimensions thickness of non-metallic sheaths (excluding inner coverings) external diameter	 IEC60092-379 IEC60092-379	 IEC60092-350:2020 para.6.6 & para. 8.3 IEC60092-350:2020 para.6.7
2	Hot set test for SHF2 sheaths only	IEC60092-360	IEC60092-350:2020 para.6.8
3	Conductor resistance	IEC 61156-5:2020, para.6.2.1 or IEC 61156-6:2020, para.6.2.1	-
4	Conductor resistance unbalance within pair	IEC 61156-5:2020, para.6.2.2.2 or IEC 61156-6:2020, para.6.2.2.2	-
5	Dielectric strength conductor/conductor and conductor/screen	IEC 61156-5:2020, para.6.2.3 or IEC 61156-6:2020, para.6.2.3	-
6	Insulation resistance conductor/conductor and conductor/screen	IEC 61156-5:2020, para.6.2.4 or IEC 61156-6:2020, para.6.2.4	-
7	Capacitance unbalance pair to ground	IEC 61156-5:2020, para.6.2.6 or IEC 61156-6:2020, para.6.2.6	-
8	Differential delay (delay skew)	IEC 61156-5:2020, para.6.3.2.2 or IEC 61156-6:2020, para.6.3.2.2	-
9	Attenuation	IEC 61156-5:2020, para.6.3.3.1, para.6.3.3.2, para.6.3.3.3 or IEC 61156-6:2020, para.6.3.3.1, para.6.3.3.2, para.6.3.3.3	-
10	Power sum Near-end crosstalk (PS NEXT)	IEC 61156-5:2020, para.6.3.5 or IEC 61156-6:2020, para.6.3.5	-
11	Near-end crosstalk (NEXT)	IEC 61156-5, para.6.3.5 or IEC 61156-6, para.6.3.5	-
12	Power sum equal level far-end crosstalk (ACR-F)	IEC 61156-5:2020, para.6.3.6 or IEC 61156-6:2020, para.6.3.6	-
13	Impedance	IEC 61156-5:2020, para.6.3.10 or IEC 61156-6:2020, para.6.3.10	-
14	Return loss	IEC 61156-5:2020, para.6.3.11 or IEC 61156-6:2020, para.6.3.11	-

8.~~4~~6 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~~7 Frequency of sample tests

8.~~5~~7.1 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~~7.2 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~~7.

Number of samples according to cable length **Table 8.~~5~~7**

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 *****