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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 service@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 IEC60092-353, etc. By now they have been updated to version 2024.
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.
h) Editorial modification.

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SHIPBOARD ELECTRIC WIRES AND CABLES

1 Scope

1.1 This Guidance is applicable to approval and inspection of shipboard and offshore cables (rated voltage up to 18/30(36) kV and optical fibre cables intended for fixed installations.

1.2 This Guidance applies to:

(1) Power cables;

(2) Cables for control and instrumentation circuits；

(3) Optical fibre cables;

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

1.3 This Guidance does not cover:

(1) Coaxial cables;

(2) Sub-sea and umbilical cables.

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
IEC60092-353:2024	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)
IEC60092-376:2025	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	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
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	Optical fibres - Part 1-40: Attenuation measurement methods
IEC60794-1-1:2023	Optical fibre cables - Part 1-1: Generic specification - General
IEC60794-1-21	Optical fibre cables - Part 1-21: Generic specification - Basic optical cable test procedures - Mechanical tests

	methods
IEC60794-1-22	Optical fibre cables - Part 1-22: Generic specification - Basic optical cable test procedures - Environmental test methods
IEC60794-1-23	Optical fibre cables - Part 1-23: Generic specification - Basic optical cable test procedures - Cable element test methods
IEC60794-1-111	Optical fibre cables - Part 1-111: Generic specification - Basic optical cable test procedures - Mechanical tests methods - Bend, method E11
IEC60332-3-25	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
IEC61156-1:2023	Multicore and symmetrical pair/quad cables for digital communications - Part 1: Generic specification
IEC61156-5:2020	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
IEC61156-6:2020	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
IEC60811-506	Electric and optical fibre cables - Test methods for non-metallic materials - Part 506: Mechanical tests - Impact test at low temperature for insulations and sheaths
IEC60684-2	Flexible insulating sleeving - Part 2: Methods of test
IEC60885-3	Electrical 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) Asbestos free statement;

(11) Routine inspection programmer or equivalent documents;

(12) Format of routine inspection report;

(13) Operation instructions for the products;

(14) 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 IEC60092-353:2024.

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 60092-376:2025.

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 IEC60092-353:2024.

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 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 7.2.6.

7.2.1 Unless otherwise specified in the details for the particular test, tests shall be made at an

ambient temperature of 20℃±15℃.

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

No.	Test	Requirement	Testing method
1	Conductor examination	IEC60092-353	IEC60092-350:2020 para.6.4
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	Coverage density of braid for braid armoured cables	IEC60092-350	IEC60092-350:2020 para.4.8.2
4	Insulation resistance measurement at maximum rated temperature	IEC60092-360	IEC60092-350:2020 para.7.2.2
5	Increase in AC capacitance after immersion in water	IEC60092-360	IEC60092-350:2020 para.7.3
6	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

Continuous Table 7.2.2.1

No.	Test	Requirement	Testing method
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	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

Additional type tests required for halogen-free cables Table 7.2.2.2

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	Fluorine content test	IEC60684-2	IEC60092-350:2020 para.8.17.6

Additional type tests required for low smoke cables **Table 7.2.2.3**

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

Additional tests required for fire resistant cables **Table 7.2.2.4**

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

Additional tests required for specific performances **Table 7.2.2.5**

No.	Test	Requirement	Testing method
1	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

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

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 tests applicable to all 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	Conductor examination	IEC60092-354	IEC60092-350:2020 para.6.4
2	Check of cables dimensions		
	- Thickness of insulation	IEC60092-354	IEC60092-350:2020 para.6.5 & para.8.2
	- Thickness of non-metallic sheaths	IEC60092-354	IEC60092-350:2020 para.6.6 & para. 8.3
	- Dimensions of braid armour	IEC60092-354:2020 para.5.9.2 & 5.9.3	IEC60092-350
	- External diameter	IEC60092-354	IEC60092-350:2020 para.6.7
3	Coverage density of braid for braid armoured cables	IEC60092-350	IEC60092-350:2020 para.4.8.2
4	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	Insulation resistance measurement at maximum rated temperature	IEC60092-360	IEC60092-350:2020 para.7.2.2
7	Increase in AC capacity 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

Continuous Table 7.2.3

No.	Test	Requirement	Testing method
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

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

Continuous Table 7.2.4

No.	Test	Requirement	Testing method
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

Type tests applicable to all optical fibre cables Table 7.2.5.1

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

Continuous Table 7.2.5.1

No.	Test	Requirement	Testing method
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 SHF2 sheaths	IEC60092-360	IEC60092-350:2020 para.8.15.1
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

Continuous Table 7.2.5.1

No.	Test	Requirement	Testing method
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

Continuous Table 7.2.5.1

No.	Test	Requirement	Testing method
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.			

Additional tests required for fire resistant cables **Table 7.2.5.2**

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

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

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 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 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

Continuous Table 7.2.6.1

No.	Test	Requirement	Testing method
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	-

Continuous Table 7.2.6.1

No.	Test	Requirement	Testing method
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.			

Additional tests required for fire resistant cables Table 7.2.6.2

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

7.3 Principles for selection of samples

7.3.1 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.

7.3.2 Types and specifications of the test samples shall be technically representative. In other words, it is the most onerous for test samples to pass approval type test. For example, if the scope of approval includes halogen-containing cables, the samples shall include at least one cable type with the smallest conductor cross-sectional area, without metal armour or screen, for all type tests including the bundled flame retardant test, such as the Type CEF/SA $3\times1.0mm^2$ etc. If the scope of approval includes halogen-free cables, the samples shall include at least one cable type with the smallest conductor cross-sectional area, having copper wire braid armour and a non-metallic outer sheath, for all type tests including the bundled flame retardant test, such as the Type CJPF80/SC $3\times1.0mm^2$ etc.

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

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

7.4 Test organization

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

7.4.2 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.

7.5 Approval certificate

7.5.1 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:

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

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

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

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:

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

No.	Test	Requirement	Testing method
	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

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

No.	Test	Requirement	Testing method
1	Conductor examination	IEC60092-353	IEC60092-350:2020 para.6.4
2	Check of cables dimensions		
	- Thickness of insulation	IEC60092-354	IEC60092-350:2020 para.6.5 & para.8.2
	- Thickness of non-metallic sheaths	IEC60092-354	IEC60092-350:2020 para.6.6 & para. 8.3
	- Dimensions of braid armour	IEC60092-354:2020 para.5.9.2 & 5.9.3	IEC60092-350
	- External diameter	IEC60092-354	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:

Routine tests of cables for control and instrumentation circuits **Table 8.3.1**

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

Sample tests of cables for control and instrumentation circuits **Table 8.3.2**

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·km	IEC60092-350:2020 para.6.9
3	The insulation resistance between any screen and the armour for armoured cables	≥0,25MΩ·km	IEC60092-350:2020 para.6.9

Continuous Table 8.3.2

No	Test	Requirement	Testing method
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	-

8.6 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.

8.7 Frequency of sample tests

8.7.1 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.

8.7.2 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 8.7.

Number of samples according to cable length **Table 8.7**

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