



Guideline No.: E-01(201510)

E-01 SHIPBOARD ELECTRIC WIRES AND CABLES

Issued date: October 20,2015

© China Classification Society

Foreword:

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

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

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

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

Historical versions and release date :

Main changes and effective date:

CONTENTS

1 General provisions	4
2 Plans and documents	11
3 Technical requirements	12
4 Approval and tests.....	13
5 Unit/batch inspection	25

SHIPBOARD ELECTRIC WIRES AND CABLES

1 General provisions

1.1 Application

1.1.1 This Guideline applies to approval and inspection of cables which are permanently fixed and used on ships and offshore installations.

1.1.2 Shipboard electric cables are to include:

(1) Power cables;

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

1.2 Normative references

1.2.1 The approval and inspection of shipboard cables in this Chapter are to be based on the following documents:

1.2.2 Products and performance standards

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

IEC 60092-350(2008-02)	Electrical installations in ships - Part 350: Shipboard power cables - General construction and test requirements
IEC 60092-351(2004-04)	Electrical installations in ships - Part 351: Insulating materials for shipboard and offshore units, power, control, instrumentation, telecommunication and data cables
IEC 60092-353(2011-08)	Electrical installations in ships - Part 353: Power cables for rated voltages 1 kV and 3 kV
IEC 60092-354(2003-06)	Electrical installations in ships - Part 354: Single- and three-core power cables with extruded solid insulation for rated voltages 6 kV ($U_m = 7,2 \text{ kV}$) up to 30 kV ($U_m = 36 \text{ kV}$)

IEC 60092-359(1999-08)	Electrical installations in ships - Part 359: Sheathing materials for shipboard power and telecommunication cables
IEC 60092-376(2003-05)	Electrical installations in ships - Part 376: Cables for control and instrumentation circuits 150/250 V (300 V)
IEC 60228(2004-11)	Conductors of insulated cables

1.2.3 Test methods and standards

IEC 60331-1(2009-05)	Tests for electric cables under fire conditions - Circuit integrity - Part 1: Test method for fire with shock at a temperature of at least 830 °C for cables of rated voltage up to and including 0.6/1.0 kV and with an overall diameter exceeding 20 mm
IEC 60331-2(2009-05)	Tests for electric cables under fire conditions - Circuit integrity - Part 2: Test method for fire with shock at a temperature of at least 830 °C for cables of rated voltage up to and including 0.6/1.0 kV and with an overall diameter not exceeding 20 mm
IEC 60331-11(2009-07)	Tests for electric cables under fire conditions - Circuit integrity - Part 11: Apparatus - Fire alone at a flame temperature of at least 750 °C
IEC 60331-21(1999-04)	Tests for electric cables under fire conditions - Circuit integrity - Part 21: Procedures and requirements - Cables of rated voltage up to and including 0.6/1.0 kV
IEC 60331-23(1999-04)	Tests for electric cables under fire conditions - Circuit integrity - Part 23: Procedures and requirements - Electric data cables
IEC 60331-25(1999-04)	Tests for electric cables under fire conditions - Circuit integrity - Part 25: Procedures and requirements - Optical fibre cables

IEC 60332-1-1(2004-07)	Tests on electric and optical fibre cables under fire conditions - Part 1-1: Test for vertical flame propagation for a single insulated wire or cable – Apparatus
IEC 60332-1-2(2004-07)	Tests on electric and optical fibre cables under fire conditions - Part 1-2: Test for vertical flame propagation for a single insulated wire or cable - Procedure for 1 kW pre-mixed flame
IEC 60332-1-3(2004-07)	Tests on electric and optical fibre cables under fire conditions - Part 1-3: Test for vertical flame propagation for a single insulated wire or cable - Procedure for determination of flaming droplets/particles
IEC 60332-3-10(2009-02)	Tests on electric and optical fibre cables under fire conditions - Part 3-10: Test for vertical flame spread of vertically-mounted bunched wires or cables - Apparatus
IEC 60332-3-21(2000-10)	Tests on electric cables under fire conditions - Part 3-21: Test for vertical flame spread of vertically-mounted bunched wires or cables - Category A F/R
IEC 60332-3-22(2009-02)	Tests on electric and optical fibre cables under fire conditions - Part 3-22: Test for vertical flame spread of vertically-mounted bunched wires or cables - Category A
IEC 60754-1(2011-11)	Test on gases evolved during combustion of materials from cables - Part 1: Determination of the halogen acid gas content
IEC 60754-2(2011-11)	Test on gases evolved during combustion of materials from cables - Part 2: Determination of acidity (pH measurement) and conductivity
IEC 61034-1(2005-04)	Measurement of smoke density of cables burning under defined conditions - Part 1: Test apparatus
IEC 61034-2(2005-04)	Measurement of smoke density of cables burning under defined conditions - Part 2: Test procedure and

requirements

IEC60811-201ed1.0(2012-03)	Electric and optical fire cables – Test methods for non-metal materials – Part 201: General tests – Measurement of insulation thickness
IEC60811-202ed1.0(2012-03)	Electric and optical fire cables – Test methods for non-metallic materials – Part 202: General tests – Measurement of thickness of non-metallic sheath
IEC60811-203ed1.0(2012-03)	Electric and optical fire cables – Test methods for non-metallic materials – Part 203 : General tests – Measurement of overall dimensions
IEC60811-401ed1.0(2012-03)	Electric and optical fire cables – Test methods for non-metallic materials – Part 401: Miscellaneous tests – Thermal ageing methods – Ageing in an air oven
IEC60811-412ed1.0(2012-03)	Electric and optical fire cables – Test methods for non-metallic materials – Part 412: Miscellaneous tests – Thermal ageing methods – Ageing in an air bomb
IEC60811-402ed1.0(2012-03)	Electric and optical fire cables – Test methods for non-metallic materials – Part 402: Miscellaneous tests – Water absorption tests
IEC60811-502ed1.0(2012-03)	Electric and optical fire cables – Test methods for non-metallic materials – Part 502: Mechanical tests – Shrinkage test for insulations
IEC60811-503ed1.0(2012-03)	Electric and optical fire cables – Test methods for non-metallic materials – Part 503: Mechanical tests – Shrinkage test for sheaths
IEC60811-606ed1.0(2012-03)	Electric and optical fire cables – Test methods for non-metallic materials – Part 606: Physical tests – Methods for determining the density

- IEC60811-403ed1.0(2012-03) Electric and optical fire cables – Test methods for non-metallic materials – Part 403: Miscellaneous tests – Ozone resistance test on cross-linked compounds
- IEC60811-404ed1.0(2012-03) Electric and optical fire cables – Test methods for non-metallic materials – Part 507: Mechanical tests – Hot set test for cross-linked materials
- IEC60811-508ed1.0(2012-03) Electric and optical fire cables – Test methods for non-metallic materials – Part 508: Mechanical tests – Pressure test at high temperature for insulation and sheaths
- IEC60811-509ed1.0(2012-03) Electric and optical fire cables – Test methods for non-metallic materials – Part 509: Mechanical tests – Test for resistance of insulations and sheaths to cracking (heat shock test)
- IEC60811-405ed1.0(2012-03) Electric and optical fire cables – Test methods for non-metallic materials – Part 405: Miscellaneous tests – Thermal stability test for PVC insulation and PVC sheaths
- IEC60811-409ed1.0(2012-03) Electric and optical fire cables – Test methods for non-metallic materials – Part 409: Miscellaneous tests – Loss of mass test for thermoplastic insulations and sheaths
- IEC60811-406ed1.0(2012-03) Electric and optical fire cables – Test methods for non-metallic materials – Part 406: Miscellaneous tests – Resistance to stress cracking of polyethylene and polypropylene compounds
- IEC60811-511ed1.0(2012-03) Electric and optical fire cables – Test methods for non-metallic materials – Part 511: Mechanical tests – Measurement of the melt flow index of polyethylene compounds

IEC60811-605ed1.0(2012-03)	Electric and optical fire cables – Test methods for non-metallic materials – Part 605: Physical tests – Measurement of carbon black and/or mineral filter in polyethylene compounds
IEC60811-607ed1.0(2012-03)	Electric and optical fire cables – Test methods for non-metallic materials – Part 605: Physical tests – Measurement of carbon black and/or mineral filter in polyethylene compounds
IEC60811-607ed1.0(2012-03)	Electric and optical fire cables – Test methods for non-metallic materials – Part 607: Physical tests – Test for the assessment of carbon black dispersion in polyethylene and polypropylene
IEC60811-407ed1.0(2012-03)	Electric and optical fire cables – Test methods for non-metallic materials – Part 407: Miscellaneous tests – Measurement of mass increase of polyethylene and polypropylene compounds
IEC60811-408ed1.0(2012-03)	Electric and optical fire cables – Test methods for non-metallic materials – Part 408: Miscellaneous tests – Long-term stability test of polyethylene and polypropylene compounds
IEC60811-410ed1.0(2012-03)	Electric and optical fire cables – Test methods for non-metallic materials – Part 410: Miscellaneous tests – Test method for copper-catalyzed oxidative degradation of polyolefin insulated conductors
IEC60811-510ed1.0(2012-03)	Electric and optical fire cables – Test method for non-metallic materials – Part 510: Mechanical tests – Methods specific to polyethylene and polypropylene compounds – Wrapping test after thermal ageing in air
IEC60811-512ed1.0(2012-03)	Electric and optical fire cables – Test methods for non-metallic materials – Part 512: Mechanical tests – Methods specific to polyethylene and

polypropylene compounds – Tensile strength and elongation at break after conditioning at elevated temperature

IEC60811-513ed1.0(2012-03) Electric and optical fire cables – Test methods for non-metallic materials – Part 513: Mechanical tests – Methods specific to polyethylene and polypropylene compounds – Wrapping test after conditioning

IEC60811-501ed1.0(2012-03) Electric and optical fire cables – Test methods for non-metallic materials – Part 501: Mechanical tests – Tests for determining the mechanical properties of insulating and sheathing compounds

IEC 60189-1(2007-05) Low-frequency cables and wires with PVC insulation and PVC sheath - Part 1: General test and measuring methods

IEC 60189-2(2007-05) Low-frequency cables and wires with PVC insulation and PVC sheath - Part 2: Cables in pairs, triples, quads and quintuples for inside installations

IEC 60189-3(2007-05) Low-frequency cables and wires with PVC insulation and PVC sheath - Part 3: Equipment wires with solid or stranded conductor wires, PVC insulated, in singles, pairs and triples

IEC 60684-2(2011-08) Flexible insulating sleeving - Part 2: Methods of test

IEC 60885-2(1987-03) Electrical test methods for electric cables. Part 2: Partial discharge tests

1.2.4 Other standards

IEC 60050-461(2008-06) International Electrotechnical Vocabulary - Part 461: Electric cables

1.3 Definitions

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

2 Plans and documents

2.1 General requirements for plans and documents to be submitted to CCS for examination and approval are specified in PART ONE of the Guidelines.

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

2.2.1 Structural drawing of cables;

2.2.2 Technical specifications of cables or equivalent documents.

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

2.3.1 Designation of cable types and specifications;

2.3.2 Table of cable construction data or equivalent documents;

2.3.3 Production process flow chart indicating quality control points;

2.3.4 List of production technology;

2.3.5 List of production equipment;

2.3.6 List of test equipment;

2.3.7 List of trademarks and suppliers of main raw materials;

2.3.8 Specimen of quality certificate;

2.3.9 Asbestos free statement;

2.3.10 Routine inspection programmer or equivalent documents;

2.3.11 Format of routine inspection report;

2.3.12 Operation instructions for the products;

2.3.13 Other documents to be submitted as required for approval.

3 Technical requirements

3.1 Shipboard electric cables are to comply with the following standards:

3.1.1 Shipboard electric cables are to comply with the requirements of IEC60092-350(2008-02).

3.1.2 Power cables for rated voltages 1 kV and 3 kV are to comply with the requirements of IEC60092-353(2011-08).

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

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

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

3.3 Single-core cables or cores rated in excess of 20A are to be either non-armoured or armoured and covered with non-magnetic material.

3.4 Screens for power cables are to comply with the requirements in paragraph 5.5 of IEC60092-353. The metallic screen is to cover outside the cores at least consisting of two cores laid up. The individual insulating core of pair unit, triple unit and multi unit shipboard power cables is to be without metallic screen or cover (i.e. sub-screened cable is not permitted).

3.5 In case of a braid armour of galvanized steel wires in which case the inner covering is to be extruded for pair unit, triple unit and multi unit shipboard power cables.

3.6 The insulating compounds and their designation for shipboard power cables are to be as given in IEC60092-351. For cables having rated voltage of 0.6/1(1.2)kV and below, types EPR、HEPR、XLPE、HF 90 or S 95 are to be used. For cables having rated voltage of 1.8/3(3.6)kV and below, types EPR、HEPR、XLPE are to be used.

3.7 The inner, outer sheathing compounds are to be one of those given in IEC60092-359 except that PVC type ST1 is not permitted.

4 Approval and tests

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

4.2 Shipboard electric cables are to be subjected to type test according to 1.4.2.1 to 1.4.2.4.

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

(1) Ambient temperature: 15°C to 35°C;

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

(3) atmospheric pressure: 86 to 106 kPa.

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

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

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

Type test of power cables for rated voltages 1 kV and 3 kV Table 4.2.2

No.	Test	Requirement	Testing method
1	Electrical		
1.1	Insulation resistance test at 20°C	IEC60092-351:2004 Table 2	IEC60092-350:2008 para.7.2.1
1.2	Insulation resistance measurement at maximum rated temperature (90°C)	IEC60092-351:2004 Table 2	IEC60092-350:2008 para.7.2.2
1.3	Increase in a.c. capacitance after immersion in water	IEC60092-350:2008 para.7.3	IEC60092-350:2008 para.7.3

Continued table 4.2.2

1.4	High-voltage test for 4 h	IEC60092-350:2008 para.7.4	IEC60092-350:2008 para.7.4
2	Non-electrical		
2.1	Conductor examination	IEC60092-353:2011 para.5.2 IEC60228:2004 Tables II、 III	IEC60092-350:2008 para.6.4
2.2	Check of cable dimensions . Thickness of insulation . Thickness of non metallic sheaths (excluding inner coverings) . External diameter	 IEC60092-353:2011 para.5.3.3 IEC60092-353:2011 para.5.5.2 IEC60092-353:2011 para.5.7.3	 IEC60092-353:2011 para.8.1 IEC60092-353:2011 para.8.2 IEC60092-353:2011 para.6.7
2.3	Hot set test (HEPR, EPR, XLPE, HF 90, S 95 insulations and SE1, SHF2 sheaths)	IEC60092-351:2004 Table 4 IEC60092-359:1999 Table II	IEC60092-350:2008 para.6.8
2.4	Coverage density of braid (Braid armoured Cables)	IEC60092-353:2011 para.5.8	IEC60092-350:2008 para.4.8.2
2.5	Mechanical properties of insulation before and after ageing	IEC60092-351:2004 Table 3	IEC60092-350:2008 para.8.3
2.6	Mechanical properties of sheath before and after ageing	IEC60092-359:1999 Table II	IEC60092-350:2008 para.8.4

Continued table 4.2.2

2.7	Additional ageing compatibility test	IEC60092-351:2004 Table 3	IEC60092-350:2008 para.8.5
2.8	Loss of mass test (ST2 sheath)	IEC60092-359:1999 Table III	IEC60092-350:2008 para.8.6
2.9	Behaviour at high temperature (ST2 and SHF1 Sheaths)	IEC60092-359:1999 Table III	IEC60092-350:2008 para.8.7
2.10	Behaviour at low temperatures (ST2, SHF1 and SHF2 sheaths)	IEC60092-359:1999 Table III	IEC60092-350:2008 para.8.8
2.11	Test for coating of copper wires	IEC60092-350:2008 para.8.10	IEC60092-350:2008 para.8.10
2.12	Galvanizing test	IEC60092-350:2008 para.8.11 ISO 7989-2:2007 para.5.3	IEC60092-350:2008 para.8.11 ISO 7989-2:2007 para.5.3
2.13	Resistance to cracking heat shock (ST2 and SHF1 sheaths)	IEC60092-359:1999 Table III	IEC60092-350:2008 para.8.12
2.14	Ozone resistance (Insulations and sheaths)	IEC60092-351:2004 Table 4 IEC60092-359:1999 Table III	IEC60092-350:2008 para.8.13
2.15	Hot oil immersion (SE1, SH and SHF2 sheaths)	IEC60092-359:1999 Table II	IEC60092-350:2008 para.8.14.1

Continued table 4.2.2

2.16	Flame-spread tests: IEC 60332-1-2 and IEC 60332-3-22	IEC60092-350:2008 para.8.16.1 IEC60332-1-2:2004 IEC60092-350:2008 para.8.16.2 IEC60332-3-22:2009	IEC60092-350:2008 para.8.16.1 IEC60332-1-2:2004 IEC60092-350:2008 para.8.16.2 IEC60332-3-22:2009 in which case cables are to be installed in touching configuration on the front of the ladder
2.17	Determination of hardness (HEPR insulation)	IEC60092-351:2004 Table 4	IEC60092-350:2008 para.8.17
2.18	Determination of modulus of elasticity (HEPR insulation)	IEC60092-351:2004 Table 4	IEC60092-350:2008 para.8.18
2.19	Durability of marking	IEC60092-350:2008 para.8.19 IEC60092-353:2011 para.4.2	IEC60092-350:2008 para.8.19 IEC60092-353:2011 para.4.2
3	Additional tests required for halogen-free cables		
3.1	Acid gas emission	IEC60092-350:2008 para.4.1.4	IEC60092-350:2008 para.8.16.4 IEC60754-1:2011
3.2	pH and conductivity	IEC60092-350:2008 para.4.1.4	IEC60092-350:2008 para.8.16.5 IEC60754-2:2011
3.3	Fluorine content test	IEC60092-350:2008 para.4.1.4	IEC60092-350:2008 para.8.16.6 IEC60684-2:2011
4	Additional test required for low smoke cables		

Continued table 4.2.2

4.1	Smoke emission test for cables insulated and sheathed with halogenfree materials. When tested according to IEC 61034-1 and IEC 61034-2	IEC60092-350:2008 para.8.16.3 IEC61034-1:2005 IEC61034-2:2005 The test is satisfactory for the finished cables if the levels of light transmittance exceeds 60% throughout the test	IEC60092-350:2008 para.8.16.3 IEC61034-1:2005 IEC61034-2:2005
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	IEC60092-350:2008 para.8.16.7 IEC60331-1:2009(Overall diameter exceeding 20mm) IEC60331-2:2009(Overall diameter not exceeding 20mm) IEC60331-21:1999	IEC60092-350:2008 para.8.16.7 IEC60331-1:2009(Overall diameter exceeding 20mm) IEC60331-2:2009(Overall diameter not exceeding 20mm) IEC60331-21:1999
6	Additional tests required for specific performances		
6.1	Special test for low temperature behaviour	IEC60092-350:2008 para.8.9	IEC60092-350:2008 para.8.9
6.2	Enhanced hot oil immersion	IEC60092-359:1999 Table II	IEC60092-350:2008 para.8.14.2
6.3	Mud fluid drilling test	IEC60092-350:2008 para.8.15	IEC60092-350:2008 para.8.15

Type test of single and three-core power cables with extruded**solid insulation for rated voltages 6 kV up to 30 kV Table 4.2.3**

No.	Test item	Technical requirement	Test method
1	Test, electrical		
1.1	Partial discharge test	IEC60092-354:2003 para.18.3.3	IEC60092-354:2003 para.18.3.3 IEC60885-2:1987
1.2	Bending test	IEC60092-354:2003 para.18.3.4	IEC60092-354:2003 para.18.3.4
1.3	Tan δ measurement as a function of voltage	IEC60092-354:2003 para.18.3.5	IEC60092-354:2003 para.18.3.5
1.4	Tan δ measurement as a function of temperature	IEC60092-354:2003 para.18.3.6	IEC60092-354:2003 para.18.3.6
1.5	Heating cycle plus partial discharge test	IEC60092-354:2003 para.18.3.7	IEC60092-354:2003 para.18.3.7
1.6	Impulse withstand test, followed by a power-frequency voltage test	IEC60092-354:2003 para.18.3.8	IEC60092-354:2003 para.18.3.8
1.7	Voltage test for 4h	IEC60092-354:2003 Table 5	IEC60092-354:2003 para.18.2 f)
2	Test, non-electrical		
2.1	Measurement of thickness of insulation	IEC60092-354:2003 Table 1 IEC60092-350:2008 para.4.3.3	IEC60092-350:2008 para.8.1
2.2	Measurement of thickness of non-metallic sheaths	IEC60092-354:2003 para.14.2 and 15.2 IEC60092-350:2008 para.4.7.3 and 4.9.3	IEC60092-350:2008 para.8.2

Continued table 4.2.3

2.3	Test for determining the mechanical properties of insulation before and after ageing in air bomb	IEC60092-351:2004 Table 3	IEC60092-350:2008 para.8.3
2.4	Test for determining the mechanical properties of sheaths before and after ageing in air bomb	IEC60092-359:1999 Table II	IEC60092-350:2008 para.8.4
2.5	Additional ageing test on pieces of completed cables (compatibility test)	IEC60092-351:2004 Table 3	IEC60092-350:2008 para.8.5
2.6	Loss of mass test on PVC insulation and ST1 and ST2 sheaths	IEC60092-351:2004 Table 4 IEC60092-359:1999 Table III	IEC60092-350:2008 para.8.6
2.7	Test for behavior at high temperature of PVC insulation and PVC and ST1, ST2 and SHF1 sheaths (pressure test)	IEC60092-351:2004 Table 4 IEC60092-359:1999 Table III	IEC60092-350:2008 para.8.7
2.8	Test for behavior at low temperature of PVC insulation and PVC and ST1, ST2, SHF1 and SHF2 sheaths	IEC60092-351:2004 Table 4 IEC60092-359:1999 Table III	IEC60092-350:2008 para.8.8
2.9	Special test for low temperature behaviour	IEC60092-350:2008 para.8.9	IEC60092-350:2008 para.8.9
2.10	Test of the metal coating of copper wires	IEC60228:2004 Tables II、 III	IEC60092-350:2008 para.8.10
2.11	Galvanizing test	IEC60092-350:2008 para.8.11	IEC60092-350:2008 para.8.11

Continued table 4.2.3

2.12	Test for resistance to cracking of PVC insulation, ST1, ST2 and SHF1 sheaths (heat shock test)	IEC60092-351:2004 Table 4 IEC60092-359:1999 Table III	IEC60092-350:2008 para.8.12
2.13	Hot-set test for insulations and for sheaths	IEC60092-351:2004 Table 4 IEC60092-359:1999 Table II	IEC60092-350:2008 para.6.8
2.14	Ozone resistance test for EPR, HEPR, HF EPR, HFHEPR, HF 90 insulation and for SE1, SH and SHF2 sheaths	IEC60092-351:2004 Table 4 IEC60092-359:1999 Table III	IEC60092-350:2008 para.8.13
2.15	Oil immersion test for elastomeric oversheaths	IEC60092-359:1999 Table II	IEC60092-350:2008 para.8.14
2.16	Flame-retardant test of a single wire or cable	IEC60092-350:2008 para.8.16.1 IEC60332-1-2:2004	IEC60092-350:2008 para.8.16.1 IEC60332-1-2:2004
2.17	Flame-retardant test of bunched wires or cables	IEC60092-350:2008 para.8.16.2 IEC60332-3-22:2000	IEC60092-350:2008 para.8.16.2 IEC60332-3-22:2009
2.18	Fire test of cables	IEC60092-350:2008 para.8.16.7 IEC60331-1:2009 IEC60331-21:1999	IEC60092-350:2008 para.8.16.7 IEC60331-1:2009 IEC60331-21:1999
2.19	Smoke emission test of completed cables	IEC60092-350:2008 para.8.16.3 IEC61034-1:2005 IEC61034-2:2005	IEC60092-350:2008 para.8.16.3 IEC61034-1:2005 IEC61034-2:2005

Continued table 4.2.3

2.20	Determination of degree of acidity of halogen gas in insulating, sheathing, fillers and other non-metallic materials	IEC60092-350:2008 para.4.1.4	IEC60092-350:2008 para.8.16.5
2.21	Determination of amount of halogen gas in insulating, sheathing, fillers and other non-metallic materials	IEC60092-350:2008 para.4.1.4	IEC60092-350:2008 para.8.16.4
2.22	Determination of fluorine content in insulating, sheathing, fillers and other non-metallic materials	IEC60092-350:2008 para.4.1.4	IEC60092-350:2008 para.8.16.6
2.23	Determination of hardness for HEPR and HF HEPR insulations	IEC60092-351:2004 Table 4	IEC60092-350:2008 para.8.17
2.24	Determination of elastic modulus for HEPR and HF HEPR insulations	IEC60092-351:2004 Table 4	IEC60092-350:2008 para.8.18
2.25	Visual examination of cables	IEC60092-354:2003 para.7	IEC60092-350:2008 para.8.19 IEC60092-354:2003 para.17.1

Note: Electrical test is to be carried out in the sequence from 1.1 to 1.7.

Type test of cables for control and instrumentation circuits Table 4.2.4

No.	Test	Requirement	Testing Method
1	Electrical		
1.1	Insulation resistance test at 20°C	IEC60092-351:2004 Table 2	IEC60092-350:2008 para.7.2.1
1.2	Insulation resistance measurement at maximum rated temperature(90°C)	IEC60092-351:2004 Table 2	IEC60092-350:2008 para.7.2.2

Continued table 4.2.4

1.3	Mutual capacitance	NIL	IEC60092-350:2008 para.7.5 IEC60092-376:2003 para.17.4 a)
1.4	Inductance to resistance ratio (L/R ratio)	NIL	IEC60092-350:2008 para.7.6 IEC60092-376:2003 para.17.4 b)
2	Non-electrical		
2.1	Conductor examination	IEC60092-376:2003 Table 6 IEC60228:2004 Tables II、 III	IEC60092-350:2008 para.6.4
2.2	Check of cable dimensions . Thickness of insulation . Thickness of non metallic sheaths (excluding inner coverings) . External diameter	IEC60092-376:2003 para.10.4 IEC60092-376:2003 para.13.2 IEC60092-376:2003 para.14.1	IEC60092-353:2011 para.8.1 IEC60092-353:2011 para.8.2 IEC60092-353:2011 para.6.7
2.3	Hot set test (HEPR, EPR, XLPE, HF 90, S 95 insulations and SE1, SHF2 sheaths)	IEC60092-351:2004 Table 4 IEC60092-359:1999 Table II	IEC60092-350:2008 para.6.8
2.4	Electrostatic screen (Screened Cables)	IEC60092-376:2003 para.12	IEC60092-350:2008 para.4.8.2
2.5	Coverage density of braid (Braid armoured Cables)	IEC60092-376:2003 para.15	IEC60092-350:2008 para.4.8.2
2.6	Mechanical properties of insulation before and after ageing	IEC60092-351:2004 Table 3	IEC60092-350:2008 para.8.3

Continued table 4.2.4

2.7	Mechanical properties of sheath before and after ageing	IEC60092-359:1999 Table II	IEC60092-350:2008 para.8.4
2.8	Additional ageing compatibility test	IEC60092-351:2004 Table 3	IEC60092-350:2008 para.8.5
2.9	Loss of mass test (ST2 sheath)	IEC60092-359:1999 Table III	IEC60092-350:2008 para.8.6
2.10	Behaviour at high temperature (ST2 and SHF1 Sheaths)	IEC60092-359:1999 Table III	IEC60092-350:2008 para.8.7
2.11	Behaviour at low temperatures (ST2, SHF1 and SHF2 sheaths)	IEC60092-359:1999 Table III	IEC60092-350:2008 para.8.8
2.12	Test for coating of copper wires	IEC60092-350:2008 para.8.10	IEC60092-350:2008 para.8.10
2.13	Galvanizing test	IEC60092-350:2008 para.8.11 ISO 7989-2:2007 para.5.3	IEC60092-350:2008 para.8.11 ISO 7989-2:2007 para.5.3
2.14	Resistance to cracking heat shock (ST2 and SHF1 sheaths)	IEC60092-359:1999 Table III	IEC60092-350:2008 para.8.12
2.15	Ozone resistance (Insulations and sheaths)	IEC60092-351:2004 Table 4 IEC60092-359:1999 Table III	IEC60092-350:2008 para.8.13
2.16	Hot oil immersion (SE1, SH and SHF2 sheaths)	IEC60092-359:1999 Table II	IEC60092-350:2008 para.8.14.1
2.17	Flame-spread tests: IEC 60332-1-2 and IEC 60332-3-22	IEC60092-350:2008 para.8.16.1 IEC60332-1-2:2004 IEC60092-350:2008 para.8.16.2 IEC60332-3-22:2009	IEC60092-350:2008 para.8.16.1 IEC60332-1-2:2004 IEC60092-350:2008 para.8.16.2 IEC60332-3-22:2009 in which case cables are to be installed in touching configuration on the front of the ladder
2.18	Determination of hardness (HEPR insulation)	IEC60092-351:2004 Table 4	IEC60092-350:2008 para.8.17

Continued table 4.2.4

2.19	Determination of modulus of elasticity (HEPR insulation)	IEC60092-351:2004 Table 4	IEC60092-350:2008 para.8.18
2.20	Durability of marking	IEC60092-350:2008 para.8.19 IEC60092-376:2003 para.7.3	IEC60092-350:2008 para.8.19 IEC60092-376:2003 para.16.2
3	Additional tests required for halogen-free cables		
3.1	Acid gas emission	IEC60092-350:2008 para.4.1.4	IEC60092-350:2008 para.8.16.4 IEC60754-1:2011
3.2	pH and conductivity	IEC60092-350:2008 para.4.1.4	IEC60092-350:2008 para.8.16.5 IEC60754-2:2011
3.3	Fluorine content test	IEC60092-350:2008 para.4.1.4	IEC60092-350:2008 para.8.16.6 IEC60684-2:2011
4	Additional test required for low smoke cables		
4.1	Smoke emission test for cables insulated and sheathed with halogenfree materials. When tested according to IEC 61034-1 and IEC 61034-2	IEC60092-350:2008 para.8.16.3 IEC61034-1:2005 IEC61034-2:2005 The test is satisfactory for the finished cables if the levels of light transmittance exceeds 60% throughout the test	IEC60092-350:2008 para.8.16.3 IEC61034-1:2005 IEC61034-2:2005
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	IEC60092-350:2008 para.8.16.7 IEC60331-1:2009(Overall diameter exceeding 20mm) IEC60331-2:2009(Overall diameter not exceeding 20mm) IEC60331-21:1999	IEC60092-350:2008 para.8.16.7 IEC60331-1:2009(Overall diameter exceeding 20mm) IEC60331-2:2009(Overall diameter not exceeding 20mm) IEC60331-21:1999
6	Additional tests required for specific performances		

Continued table 4.2.4

6.1	Special test for low temperature behaviour	IEC60092-350:2008 para.8.9	IEC60092-350:2008 para.8.9
6.2	Enhanced hot oil immersion	IEC60092-359:1999 Table II	IEC60092-350:2008 para.8.14.2
6.3	Mud fluid drilling test	IEC60092-350:2008 para.8.15	IEC60092-350:2008 para.8.15

4.4 Principles for selection of samples

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

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

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

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

4.5 Test organization

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

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

4.6 Approval certificate

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

5 Unit/batch inspection

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

Test programme for unit/batch inspection of power cables**for rated voltages 1 kV and 3 kV****Table 5.1**

No.	Test	Requirement	Testing method
1	Routine Tests		
1.1	Measurement of electrical resistance of conductors	IEC60228:2004 Tables II、 III	IEC60092-350:2008 para.5.2.2
1.2	Voltage test	IEC60092-350:2008 para.5.2.3	IEC60092-350:2008 para.5.2.3
1.3	Voltage test on sheath (Armoured cables)	IEC60092-350:2008 para.5.2.3.4	IEC60092-350:2008 para.5.2.3.4
1.4	Insulation resistance test	IEC60092-351:2004 Table 2	IEC60092-350:2008 para.5.2.4
2	Sample Tests		
2.1	Insulation resistance test	IEC60092-350:2008 para.7.2.4	IEC60092-350:2008 para.5.2.4
2.2	Conductor examination	IEC60092-353:2011 para.5.2 IEC60228:2004 Tables II、 III	IEC60092-350:2008 para.6.4
2.3	Check of cable dimensions . Thickness of insulation . Thickness of non metallic sheaths (excluding inner coverings) . External diameter	IEC60092-353:2011 para.5.3.3 IEC60092-353:2011 para.5.5.2 IEC60092-353:2011 para.5.7.3	IEC60092-353:2011 para.6.5 IEC60092-353:2011 para.6.5 IEC60092-353:2011 para.6.7
2.4	Hot set test (HEPR, EPR, XLPE, HF 90, S 95 insulations and SE1, SHF2 sheaths)	IEC60092-351:2004 Table 4 IEC60092-359:1999 Table II	IEC60092-350:2008 para.6.8

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

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

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

5.2.2 Partial discharge test (IEC60092-354:2003 para. 18.1 b));

5.2.3 High voltage test (IEC60092-350:2008 para. 5.5.3);

5.2.4 Conductor examination (IEC60092-350:2008 para. 6.4, for frequency of sample tests, see 60092-350:2008 para. 6.2);

5.2.5 Construction examination (IEC60092-350:2008 para. 6.5 to 6.7, for frequency of sample tests, see 60092-350:2008 para. 6.2);

5.2.6 Hot-set test for insulations and for sheaths (IEC60092-350:2008 para. 6.8, for frequency of sample tests, see 60092-350:2008 para. 6.2).

Test programme for unit/batch inspection of power cables

for rated voltages 6 kV and 30 kV

Table 5.2

No.	Test	Requirement	Testing method
1	Routine Tests		
1.1	Measurement of electrical resistance of conductors	IEC60092-354:2003 para.9 IEC60228:2004 Tables II、 III	IEC60092-350:2008 para.5.2.2
1.2	Partial discharge test	IEC60092-354:2003 para.18.1b)	IEC60092-354:2003 para.18.1b)
1.3	Voltage test	IEC60092-354:2003 para.18.1c)	IEC60092-350:2008 para.5.2.3
2	Special Tests		
2.1	Conductor examination	IEC60092-354:2003 para.9 IEC60228:2004 Tables II、 III	IEC60092-350:2008 para.6.4

Continued table 5.2

2.2	Check of cable dimensions . Thickness of insulation . Thickness of non metallic sheaths (excluding inner coverings) . External diameter	IEC60092-354:2003 para.10.3 IEC60092-354:2003 para.14.2 IEC60092-354:2003 para.15.2	IEC60092-353:2011 para.6.5 IEC60092-353:2011 para.6.5 IEC60092-353:2011 para.6.7
2.3	Hot set test (HEPR, EPR, XLPE, HF 90, S 95 insulations and SE1, SHF2 sheaths)	IEC60092-351:2004 Table 4 IEC60092-359:1999 Table II	IEC60092-350:2008 para.6.8
2.4	Behaviour at low temperatures (ST2, SHF1 and SHF2 sheaths)	IEC60092-359:1999 Table III	IEC60092-350:2008 para.8.8
2.5	Coverage density of braid (Braid armoured Cables)	IEC60092-354:2003 para.16	IEC60092-350:2008 para.4.8.2
2.6	Power-frequency voltage of 4 U ₀	IEC60092-354:2003 para.18.2f)	IEC60092-354:2003 para.18.2f)

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

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

Test programme for unit/batch inspection of cables for

control and instrumentation circuits

Table 5.3

No.	Test	Requirement	Testing method
1	Routine Tests		

Continued table 5.3

1.1	Measurement of electrical resistance of conductors, including drain wires	IEC60092-376:2003 para.17.1.a)	IEC60092-350:2008 para.5.2.2
1.2	Voltage test	IEC60092-376:2003 para.17.1.b)	IEC60092-350:2008 para.5.2.3
1.3	Insulation resistance test	IEC60092-376:2003 para.17.1.c)	IEC60092-350:2008 para.5.2.4
1.4	Screen insulation resistance	IEC60092-376:2003 para.17.1.d)	IEC60092-350:2008 para.5.2.4
1.5	The insulation resistance between any screen and the armour for armoured cables	IEC60092-376:2003 para.17.1.e)	IEC60092-350:2008 para.5.2.4
2	Special Tests		
2.1	Conductor examination	IEC60092-376:2003 para.9	IEC60092-350:2008 para.6.4
2.2	Check of cable dimensions . Thickness of insulation . Thickness of non metallic sheaths (excluding inner coverings) . External diameter	IEC60092-376:2003 para.10.4 IEC60092-376:2003 para.13.2 IEC60092-376:2003 para.14.1	IEC60092-353:2011 para.6.5 IEC60092-353:2011 para.6.5 IEC60092-353:2011 para.6.7
2.3	Hot set test (HEPR, EPR, XLPE, HF 90, S 95 insulations and SE1, SHF2 sheaths)	IEC60092-351:2004 Table 4 IEC60092-359:1999 Table II	IEC60092-350:2008 para.6.8
2.4	Behaviour at low temperatures (ST2, SHF1 and SHF2 sheaths)	IEC60092-359:1999 Table III	IEC60092-350:2008 para.8.8
2.5	Electrostatic screen (Screened Cables)	IEC60092-376:2003 para.12	IEC60092-350:2008 para.4.8.2
2.6	Coverage density of braid (Braid armoured Cables)	IEC60092-376:2003 para.15	IEC60092-350:2008 para.4.8.2

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