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# Informational Marine Cables NEK TS 606



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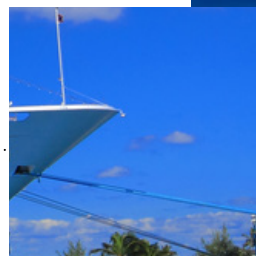
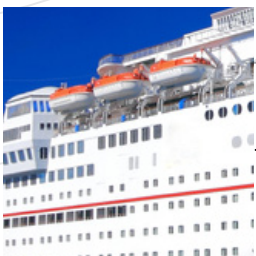


**NEK TS 606** specifies the basic requirements for Halogen-Free Low Smoke and Flame Retardant/Fire Resistant, (HFFR-LS) or MUD resistant low and high voltage power, control, lighting, instrumentation, telecommunication and optical fibre cables for offshore installations, and lists Enhanced oil resistance and MUD tests with more demanding requirements than IEC 60092-360:2014.

Generally based on the IEC 60092-350 – 360 and 370 series the purpose of the Technical Specification is to give the end user a selection of cables which meet the requirements for installation on mobile and fixed offshore units.

The predecessor of the Technical Specification was the publication “Recommended Practice for Specification of Cables”, issued by the Norwegian Oil Industry Association” (OLF). The background for that specification was the need of the industry to limit and standardize the number of cable types being used by the offshore industry in the late 1980s. The responsibility for the standard was taken over by the Norwegian Electrotechnical Committee (NEK), and the first edition was issued by NEK as “Norwegian electrotechnical standard” NEK 606 in 1993.

# Introduction



# Standards

Standards	Designation Title
IEC 60092-350	Electrical installations in ships – Part 350: General construction and test methods of power, control and instrumentation cables for shipboard and offshore applications.
IEC 60092-352	Electrical installations in ships – Part 352: Choice and installation of electric cables
IEC 60092-353	Electrical installations in ships – Part 353: Single and multicore cables with extruded solid insulation for rated voltages 1kV and 3kV
IEC 60092-354	Electrical installations in ships – Part 354: Single and three-core power cables with extruded solid insulation for rated voltages 6kV ( $U_m = 7.2kV$ ) up to 30kV ( $U_m = 36kV$ )
IEC 60092-360	Electrical installations in ships – Part 360: Insulating and sheathing materials for shipboard and offshore units, power, control, instrumentation and telecommunication cables. (Replacing IEC 60092 Parts 351 & 359)
IEC 60092-376	Electrical installations in ships – Part 376: 150/250V cables for Control and Instrumentation Circuits
IEC 60228	Conductors of insulated cables
IEC 60331-11/21/25	Test for electrical cables under fire conditions – Circuit integrity
IEC 60331-1/2	Test for electrical cables under fire conditions – Circuit integrity
IEC 60332-1-1/2 IEC 60332-2-1/2 IEC 60332-3-10/22/23/24/25	Test for electrical cables under fire conditions. (Flame retardant characteristics for electrical cables).
IEC 60445	Basic and safety principles for man-machine interface, marking and identification – identification of equipment terminals, conductor terminations and conductors
IEC 60754-1/2	Test on gases evolved during combustion of electric cables
IEC 60811	Common test methods for insulating and sheathing materials of electric cables
IEC 61034-1/2	Measurement of smoke density of electric cables burning under defined conditions Part 1: Test apparatus Part 2: Test procedure and requirements
HCF	Fire Curve according to EN 1363-2 alternatively ISO 834
JF	Fire test according to ISO 22899-1

	SHF1	SHF2
Type of material	Halogen-free Thermoplastic	Halogen-free Elastomeric or thermosetting material
Some main characteristics		
Mechanical characteristics after the immersion in hot oil (IEC 60811-2-1, clause 10)* *If oil resistance is required for a halogen-free compound, SHF2 compound is recommended	No requirements	100°C for 24hrs:  • ±40% maximum variation in tensile strength  • ±40% maximum variation in elongation at break
Hot set test (IEC 60811-2-1, clause 9)	No requirements	200°C, 15min time under load with 20(N/mm <sup>2</sup> ) mechanical stress:  • 175% Maximum elongation under load  • 25% Maximum permanent elongation after cooling
Pressure test at high temperature (IEC 60811-3-1, subclause 8.2)	80°C, 4-6min under load depending on cable diameter:  • 50% Maximum permissible deformation	No requirements
Heat shock test (IEC 60811-3-1, subclause 9.2)	150°C 1hr duration	No requirements
Ozone resistance test IEC 60811-2-1, clause 8 (Alternative test method may be used in some countries for legal reasons)	No requirements	25 ± 2°C for 24hrs:  • Max 0,025 to 0,030% ozone concentration (in volume)

# SHF-1 Vs SHF-2

# Definitions

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## **Flame retardant cables:**

The cables shall withstand the test specified in IEC 60332-3-10 Part -22, -23, -24 or -25. Single, earth and bonding wires shall withstand the test specified in IEC 60332-1-2 or IEC 60332-2-2.

## **Fire resistant cables without water spray:**

Fire resistance cables shall be tested according to IEC 60331-1/2 or IEC 60331-11, -21, -25. Test duration: Minimum 120mins without voltage breakdown or conductor rupture.

## **Fire resistant cables with water spray:**

Fire resistance cables shall be tested according to IEC 60331-1/2 or IEC 60331-11, -21, -25 water spray according to EN 50200 Annex E. Minimum 90min fire plus 15min water spray before breakdown.

## **Content of Halogen:**

All cables shall be halogen-free according to IEC 60754-1/2.

## **Smoke Emission:**

All cables shall be tested for low smoke emission according to IEC 61034-1/2 with minimum 60% light transmittance.

## **Conductor Resistance:**

The maximum conductor resistance for 250V instrumentation cables shall be in accordance with IEC 60092-376.

The maximum conductor resistance for cables with voltage rating 0.6/1kV and above shall be in accordance with IEC 60228 class 2 or class 5.

## Oil resistant and MUD resistant cables – Test procedures and requirements

NEK TS 606 requirements for oil and MUD resistance are more demanding than IEC 60092-360 requirements. These are marked with bold in table 1

**All SHF2 sheathed cables shall be suitable for an oil production installation.**

Minimum required oil resistance

All SHF2 sheathed cables covered by this specification shall fulfil minimum oil resistance according to table 1a.

Oil resistance shall be demonstrated by a test according to IEC 60092-360, SHF2 where test oil IRM902 is specified. Requirements are listed in Table 1a

Similar test shall also be performed with test oil IRM903. Requirements are listed in table 1a.

Optional Enhanced oil resistance

Oil resistance shall be demonstrated by a test according to IEC 60092-360 Annex C.

Test oils shall be IRM902 and IRM903. Requirements are listed in table 1b.

\*MUD resistance – (Mandatory requirement for NEK 606 cable descriptions containing SHF2 MUD RESISTANT)

For a cable to be MUD resistant, it must first be qualified as NEK 606 Enhanced oil resistant.

Oil resistance shall be demonstrated by a test according to IEC 60092-360 Annex D. 3.

Test Liquids shall be Calcium Bromide Brine (Water Based) and EDC95-11 (Oil Based). Requirements listed in table 1c.

\*When field specific MUD deviates from NEK 606 standard MUD test fluids, (table 1c) special evaluation or testing should be agreed.

0.6/1kV and above shall be in accordance with IEC 60228 class 2 or class 5.

# Oil & MUD Resistant

# Oil & MUD Resistant

Table 1. Oil and MUD resistant tests	Unit	Requirement
<b>a. Minimum required oil resistance</b>		
Mechanical properties after ageing in IRM902 and <b><i>IRM903</i></b> : <ul style="list-style-type: none"> <li>• Temperature/tolerance of oil</li> <li>• Duration of treatment</li> </ul>	°C h	100 ±2 24
Results to be obtained: <ul style="list-style-type: none"> <li>• Tensile strength, variation max</li> <li>• Elongation at break, variation max</li> </ul>	% %	<b>±30</b> <b>±30</b>
<b>b. Optional, enhanced oil resistance</b>		
Mechanical properties after ageing in IRM902 and <b><i>IRM903</i></b> : <ul style="list-style-type: none"> <li>• Temperature/tolerance of oil</li> <li>• Duration of treatment</li> </ul>	°C d	100 ±2 7
Results to be obtained: <ul style="list-style-type: none"> <li>• Tensile strength, variation max</li> <li>• Elongation at break, variation max</li> <li>• Volume swelling, variation max</li> <li>• Weight change, variation max</li> </ul>	% % % %	<b>±30</b> <b>±30</b> <b>±30</b> <b>±30</b>
<b>c. Optional, MUD resistance</b>		
Mechanical properties after ageing in Calcium Bromide: <ul style="list-style-type: none"> <li>• Temperature/tolerance of oil</li> <li>• Duration of treatment</li> </ul>	°C d	70 ±2 56
Results to be obtained: <ul style="list-style-type: none"> <li>• Tensile strength, variation max</li> <li>• Elongation at break, variation max</li> <li>• Volume swelling, variation max</li> <li>• Weight change, variation max</li> </ul>	% % % %	±25 ±25 ±20 ±15
Mechanical properties after ageing in <b><i>EDC 95-11 base oil</i></b> : <ul style="list-style-type: none"> <li>• Temperature/tolerance of oil</li> <li>• Duration of treatment</li> </ul>	°C d	<b>70 ±2</b> <b>56</b>
Results to be obtained: <ul style="list-style-type: none"> <li>• Tensile strength, variation max</li> <li>• Elongation at break, variation max</li> <li>• Volume swelling, variation max</li> <li>• Weight change, variation max</li> </ul>	% % % %	<b>±30</b> <b>±30</b> <b>±25</b> <b>±25</b>
<b>d. Optional, hydraulic oil resistance, (Test oil to be agreed between producer and user)</b>		
Mechanical properties after ageing in Calcium Bromide: <ul style="list-style-type: none"> <li>• Temperature/tolerance of oil</li> <li>• Duration of treatment</li> </ul>	°C d	100 ±2 7
Results to be obtained: <ul style="list-style-type: none"> <li>• Tensile strength, variation max</li> <li>• Elongation at break, variation max</li> <li>• Volume swelling, variation max</li> <li>• Weight change, variation max</li> </ul>	% % % %	±30 ±30 ±30 ±30

Note:

- Requirements marked in bold and italic text are more demanding than IEC 60092-360:2014.

- EDC 95-11 is a well-defined base oil often used in oil based drilling fluids

A cable code of two letters, (1. & 4.) or four letters is used to describe the construction.

Additional abbreviation for instrumentation cables:

Collective screen = (c)

Individual pair or triple screen = (i)

The interpretation, (per letter) is given in the table below:

Materials	1. Letter: Insulation	2. Letter Bedding/ inner covering Inner sheath	3. Letter Armour/ Screen	4. Letter: Outer Sheath
Fire resistant tape + insulation	B	-	-	-
Ethylene propylene rubber – EPR	R	-	-	-
Cross-linked polyethylene - XLPE	T	-	-	-
Thermoplastic compound	I	-	-	-
Fibre – Tight buffered	A	-	-	-
Fibre – In loose tube	Q	-	-	-
Fire resistant silicone	S	-	-	-
Bedding/Inner covering or taping	-	F	-	-
Aluminium (laminated to outer jacket)	-	-	L	-
No armour	-	-	X	-
Tinned copper wire braid	-	-	O	-
Strength member yarn	-	-	A	-
Galvanized steel wire braid	-	-	C	-
Thermoplastic compound - SHF1	-	I	-	I
Thermoset compound – SHF2	-	-	-	U
MUD resistant thermoset compound – SHF MUD	-	-	-	U
MUD resistant thermoplastic compound	-	-	B	B <sup>1)</sup>

B<sup>1)</sup> QFCB cables only

# Cable Code Designation

# Core Identification

## 150/250V cables

For the 250V cables the identification of insulated conductors, (cores) shall be:

Pair: Black/Light Blue

Triple: Black/Light Blue/Brown

Pairs/triples are numbered with numbered tape or by numbers printed directly on the insulated conductors

## 0.6/1kV cables

For 0.6/1kV cables the identification of insulated conductors (cores) shall be in accordance with the CENELEC Harmonization Document HD308S2:

### With Earth

3core	Blue-Brown-Green/Yellow
4core	Brown-Black-Grey-Green/Yellow
*4core	Blue-Brown-Black-Green/Yellow
5core	Blue-Brown-Black-Grey-Green/Yellow
Above 5cores	White with Black numbers

### Without Earth

2core	Blue-Brown
3core	Brown-Black-Grey
*3core	Blue/Brown/Black
4core	Blue/Brown/Black/Grey
5core	Blue/Brown/Black/Grey/Black
Above 5cores	White with Black numbers

*\*For certain applications only*



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