AN OVERVIEW OF TYPICAL STANDARDS RELEVANT FOR **TELDOR MARINE OIL & GAS CABLES**

TELDOR
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An overview of typical Standards relevant for Teldor Marine Oil & Gas Cables

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 60092-360	Part 360: Insulating and sheathing materials for shipboard and offshore units, power, control, instrumentation and telecommunication cables.
IEC 60092-352	Part 352: Choice and installation of electrical cables.
IEC 60092-353	Part 353: Power cables for rated voltages 1 kV and 3 kV.
IEC 60092-376	Part 376: Cables for control and instrumentation circuits 150/250 V (300 V).
IEC 60228	Conductors of insulated cables.
IEC 60331-1-1	Tests for electric cables under fire conditions - Circuit integrity - Part 1: Test method for fire with shock at a temperature of at least 830°C for cables of rated voltage up to and including 0,6/1,0 kV and with an overall diameter exceeding 20 mm.
IEC 60331-1-2	ests 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 20mm.
IEC 60331-21	Test for electric cables under fire conditions – Circuit integrity – Part 21 Procedures and requirements – Cables of rated voltage up to and including 0,6/1kV.
IEC 60331-23	Tests for electric cables under fire conditions - Circuit integrity - Part 23: Procedures and requirements - Electric data cables.
IEC 60331-25	Test for electric cables under fire conditions – Circuit integrity – Part 25 Procedures and requirements – FiberOptic cables.
IEC 60331-3	Tests for electric cables under fire conditions - Circuit integrity - Part 3: 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 tested in a metal enclosure.

STANDARDS	DESIGNATION TITLE
IEC 60332-1-1	Test on electric and FiberOptic cables under fire conditions. Part 1-1 Test for vertical flame propagation for a single insulated wire or cable - Apparatus.
IEC 60332-1-2	Test on electric and FiberOptic 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	Test on electric and FiberOptic 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 60332-2-1	Test on electric and FiberOptic cables under fire conditions. Part 2-1 Test for vertical flame propagation for a single small insulated wire or cable - Apparatus.
IEC 60332-2-2	Test on electric and FiberOptic cables under fire conditions. Part 2-2 Test for vertical flame propagation for a single small insulated wire or cable – Procedure for diffusion flame.

Clarification of terms from selected standards referring only to IEC standards.
Other standards are available.

Compliance with national, regional and international specifications and standards is mandatory. There is a wide variety of standards and certifications for flame retardant, fire-resistant cables issued by different certifying bodies which may vary from country to country.

Flame Retardance

Indicates the cable ability to prevent flame spread and prohibit flame propagation as defined by the flame-retardant or propagation tests. Flame-retardant tests measure flame propagation for both horizontal and vertical applications.

Fire Resistance / circuit integrity

Indicate the cable's ability to continue to operate in a desired manner for a defined period under specific fire conditions.

Content of halogens

Indicate & demonstrate that the cables are halogen-free, which means they when exposed to heat or fire the cables emits less corrosive, acidic and toxic smoke & fumes- maximum content of halogen = 5 mg/g.

Smoke Emission

Indicate the smoke density of the burnt materials.

Oil Resistance SHF-1 & SHF -2

Indicates the outer jacket material ability to maintain its initial mechanical properties after & during exposure to the tested oil & chemicals – see link.

Mud Resistance

Indicates the outer jacket material ability to maintain its initial mechanical properties after & during exposure to MUD. Different locations use different MUD solutions: properties shall be established & tests conducted according to specific oils used in different locations.

* MUD is a mixture of oil & chemicals used during drilling process for lubrication purposes.

Sheeting of off shore cables according to NEK 606 can be either SHF-1 or SHF-2.
For more information please see link to our paper:
Offshore Jacketing martials - Characterization of SHF-1, SHF-2 & NEK (606 (MUD)

CHARACTERISTICS OF
SHF-1 SHF-2 and SHF-2 NEK 606

Differences in material properties of the SHF1 and SHF2
Outer sheaths of offshore cables need to be stronger than of any other cable. As mentioned and according to the NEK 606 standard, offshore cables need to withstand all kinds of environmental aggressions.
Besides the above-mentioned differences there are differences in material characteristics as well. It depends on various factoes, such as environmental aspects and application types, whether SHF1 or SHF2 is the better choice. The table below outlines the differences in characteristics between SHF1 and SHF2:

	SHF1	SHF2
Type of material	Halogen-free thermoplastics	Halogen-free elastomeric or thermosetting material
Mechanical characteristics after immersion in hot oil (IEC 60881-404)	No requirements	100°C for 24 hours: • ±40% Maximum variation in tensile strength • ±40% Maximum variation in elongation at break
Hot set test (IEC 60811-507)	No requirements	200°C 15 minutes time under load with 20 N/mm^2 mechanical stress: • 175% Maximum elongation under load • 25% Maximum permanent elongation after cooling
Pressure test at high temperature (IEC 60811-508)	80°C, 4 to 6 hours under load depending on cable diameter: • 50% Maximum permissible deformation	No requirements
Heat shock test (IEC 60811-509)	Electric and optical fibre cables - Test methods for non-metallic materials - Part 509: Mechanical tests - Test for resistance of insulations and sheaths to cracking (heat shock test).	No requirements
Ozone resistance test (IEC 60811-403) (Alternative test method B may be used)	No requirements	25 ± 2°C for 24 hours: • Max 0,025% to 0,030% ozone concentration (in volume

An example of a SHF1 outer sheath

PVC is the kind of synthetic material which is often used for outer sheaths. This material is not accepted because it contains chlorine, which is a halogen. An excellent substitute is HFFR (Halogen-Free Flame Retardant). This synthetic material meets the IEC 60092-539 requirements for a SHF1 outer sheath. In case of fire, HFFR will not spread the fire, it will not melt / drip and it does not cause thick black smoke. Most important, it will not emit toxic gases during a fire.

An example of a SHF2 outer sheath

The synthetic material EVA (Ethylene Vinyl Acetate) is a multi-functional elastomer. This material is able to resist high temperatures, oil and harsh weather conditions. This synthetic material meets the IEC 60092-539 requirements for a SHF2 outer sheath. For the use and application in the offshore industry EVA can be composed in a way that it produces a minimum amount of smoke in case of a fire. The cable will not spread the fire and it will not emit halogen acids.

The update of SHF1 and SHF2

Until recently the distinction between the two sheathing materials was not very clear. In the latest version (edition 5) of NEK 606 requirements for oil and mud for outer sheaths (SHF2). demands for outer sheaths have been updated by distinguishing a mandatory minimum level and two optional levels of higher performance. The levels are divided as follows:

- Minimum required oil resistance.
- Enhanced oil resistance.
- Mud resistance.

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