

TYPE APPROVAL CERTIFICATE

This is to certify:**That the Fiber optical cable**with type designation(s)
QFCI, QFCU, AICI

Issued to

LS Cable & System Co., Ltd. (Indong Plant)
Gumi-si Gyeongbuk, Republic of Korea

is found to comply with

Det Norske Veritas' Rules for Classification of Ships, High Speed & Light Craft and Det Norske Veritas' Offshore Standards
IEC 60332-3-24 (2009-02)
IEC 60754-1/2 (2011-11)
IEC 60684-2 Ed. 3 (2011-08)
IEC 61034-2 Ed. 3.1 (2013-06)**Application :****Product(s) approved by this certificate is/are accepted for installation on all vessels classed by DNV GL.****Fiber optic cable. Flame retardant Cat. C. Fire resistant (QFCI & QFCU). Halogen free. Low smoke. Mud resistant (QFCU)**This Certificate is valid until **2021-07-04**.Issued at **Busan** on **2016-07-05**DNV GL local station: **Ulsan**for **DNV GL**Approval Engineer: **Eun Sook Kim**

Baeg Soon Choi
Head of Section

This Certificate is subject to terms and conditions overleaf. Any significant change in design or construction may render this Certificate invalid. The validity date relates to the Type Approval Certificate and not to the approval of equipment/systems installed.

Product description

Fiber optic cable: QFCI

Number of fibers	Max 48 - SM : Optical fiber 9.2 μm - MM : Optical fiber 50/62.5 μm
Number of fiber per tube	2 (for 2~8), 4 (for 10~16), 6 (for 18~24), 8 (for 26~32), 12 (for 34 ~ 48)
Loose buffer tube	Thixotropic jelly filled loose tube made from PBT (Polybutylene Terephthalate)
Fire resisting layer	Each tube is protected with fire resistant mica tape
Central strength element	Galvanized steelwire strength member
Moisture barrier	Swellable tape
Inner sheath	SHF1
Metal covering	Galvanized steel wire braid(QFCI) or Copper wire braid(QFOI) or Bronze copper wire braid(QFBI)
Outer sheath	SHF1

Fiber optic cable: QFCU

Number of fibers	Max 48 - SM : Optical fiber 9.2 μm - MM : Optical fiber 50/62.5 μm
Number of fiber per tube	2 (for 2~8), 4 (for 10~16), 6 (for 18~24), 8 (for 26~32), 12 (for 34 ~ 48)
Loose buffer tube	Thixotropic jelly filled loose tube made from PBT (Polybutylene Terephthalate)
Fire resisting layer	Each tube is protected with fire resistant mica tape
Central strength element	Galvanized steelwire strength member
Moisture barrier	Swellable tape
Inner sheath	SHF2
Metal covering	Galvanized steel wire braid(QFCU) or Copper wire braid(QFOU) or Bronze copper wire braid(QFBU)
Outer sheath	SHF 2 MUD

Fiber optic cable: AICI

Number of fibers	4, 8, 12, 16 (5+11), 24 (9+15) - SM : Optical fiber 9.2 μm - MM : Optical fiber 50/62.5 μm
Number of fiber per tube	1
Buffer	Tight buffer tube
Dielectric strength member	Aramid yarn
Central strength element	FRP (Fiber reinforced plastic)
Moisture barrier	Swellable tape
Inner sheath	SHF1
Metal covering	Galvanized steel wire braid(AICI) or Copper wire braid(AIOI) or Bronze copper wire braid(AIBI)
Outer sheath	SHF1

Application/Limitation

Operation: -10 to +70 °C
Storage : -20 to +70 °C

For QFCI & QFCU type, cable is considered to be fire resistant according to IEC 60331.

The requirements of SOLAS Amendments Chapter II-1, Part D, Reg. 45, 5.2 (provision to be taken to limit Fire Propagation along Bunches of Cables or Wires) are fulfilled without any additional measures.

Type Approval documentation

Tests carried out

Standard	Release	General description	Limitation
DNVGL-CP-0402	2016-02	DNVGL type approval program for optical fibre cables	
IEC 60793-1-30	2010-06	Measurement methods and test procedures – Fibre proof test	
IEC 60793-1-31	2011-08	Measurement methods and test procedures – Tensile strength	
IEC 60793-1-32	2011-05	Measurement methods and test procedures – Coating strippability	
IEC 60793-1-33	2001-08	Measurement methods and test procedures – Stress corrosion susceptibility	
IEC 60793-1-34	2006-03	Measurement methods and test procedures – Fiber curl	
IEC 60793-1-46	2001-07	Measurement methods and test procedures – Monitoring of changes in optical transmittance	
IEC 60793-1-47	2016-02	Measurement methods and test procedures – Macrobending loss	
IEC 60793-1-49	2006-06	Measurement methods and test procedures – Differential mode delay	
IEC 60794-1-2	2013-09	Optical fibre cables - Part 1-2: Generic specification - Basic optical cable test procedures	QFCI & QFCU: E1/E3/E4/E11A/E7/F1 AICI: E1/E3/E4/E6/E8/F1
IEC 60092-360	2014-04	Insulating and sheathing materials for shipboard and offshore units, power, control, instrumentation and telecommunication cables	
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	
IEC 60332-3-24	2009-04	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	Bunch test Category C
IEC 60331-25	1999-04	Tests for electric cables under fire conditions - Circuit integrity - Part 25: Procedures and requirements - Optical fibre cables	90 min. test QFCI & QFCU

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Standard	Release	General description	Limitation
IEC 60684-2	2011	Flexible insulating sleeving – Part 2: Methods of test.	Fluorine content <0,1%
IEC 60754-1	2011	Test on gases evolved during combustion of materials from cables – Determination of the amount of halogen acid gas	Low Halogen <0,5%
IEC 60754-2	2011	Test on gases evolved during combustion of materials from cables – Determination of the degree of acidity of gases evolved during the combustion of materials taken from electric cables by measuring pH and conductivity	Halogen free $\geq 4,3\text{pH}$, $\leq 10\mu\text{S/mm}$
IEC 61034-1/2	2013-06	Measurement of smoke density of cables burning under defined conditions – Test apparatus, procedure and requirements	Low smoke >60%
NEK 606	2009	Cables for offshore installations - Halogen-free low smoke and flame-retardant / fire-resistant (HFFR-LS)	Mud resistance QFCU
IEC 60811-403	2012	Ozone resistance test on cross-linked compounds	QFCU

Marking of product

QFCI – FIRE RESISTANT – (No. of fiber) FIBER – LS Cable & System – Year – Length

QFCU – FIRE&MUD RESISTANT – (No. of fiber) FIBER – LS Cable & System – Year – Length

AICI – FLAME RETARDANT – LS Cable & System – Year – Length

Periodical assessment

The scope of the retention/renewal survey is to verify that the conditions stipulated for the Type approval is complied with and that no alterations are made to the product design or choice of materials.

The main elements of the survey are:

- Inspection on factory samples, selected at random from the production line (where practicable)
- Results from Production Sample Tests (PST) and Routines (RT) checked (if not available tests according to PST and RT to be carried out)
- Review of type approval documentation
- Review of possible change in design, materials and performance
- Ensuring traceability between manufacturer's product type marking and Type Approval Certificate.

Survey to be performed at least every second year.

END OF CERTIFICATE