

**Fire Resistant Self-Supporting Single Mode Optical Fiber Cable**  
**(FRSS OFC)**

**1. GENERAL**

- 1.1 This specification covers the requirements of the fire resistant self- supporting single mode optical fiber cable (FRSS OFC) to be supplied to TOT Public Company Limited (TOT) intended primarily for aerial application especially using this type of cable in some area where the cable has been attacked from the rodent animal such as the squirrel etc., or some rural area where caused from forest fire which frequently happening. However such application shall be done on basis of maximum benefit to TOT.
- 1.2 The FRSS cable herein after referred to as the “CABLE” shall comply with the requirements of this specification and generally meet any latest relevant ITU-T Recommendation or better.
- 1.3 This specification shall be mainly designed to apply for core network/backbone network and also for the access network (last mile). Furthermore this specification shall also be able to apply for passive optical network (PON) such as G-PON, GE-PON, etc. by specifying attenuation at all three PON transmission wavelengths: 1310 nm, 1490 nm and 1550 nm.
- 1.4 The primary design consideration of the cable shall protect the optical fibers from environmental and mechanical stresses.
- 1.5 The cable proposed shall be new and its lifetime shall be at least 25 years without any significant deterioration.
- 1.6 Full details of this following information shall be provided in bidding document by bidder.
  - 1.6.1 Fiber information: manufacture name, factory location, manufacturing method (i.e. MCVD, OVD, VAD, etc.) and the refractive index.
  - 1.6.2 Product specification issued by manufacturer including cable weight (kg/km), overall diameter of cable and cable drum specification.
  - 1.6.3 Lifetime calculation of the proposed cable as required in Section 1.5.
  - 1.6.4 Test method and test data result of all requirements of Section 2.1, 2.2 and 5 according to this specification.
  - 1.6.5 Fully filled down in test instrument list which is attached to this specification including the pictures of all test instruments involved.

1.7 The other test method standards which are equivalent to as specified in this specification shall be allowable.

**2. FIBER CHARACTERISTICS**

All characteristics of the cabled fiber (fiber of finished cable) shall be, at least, in accordance with the ITU-T Recommendation G.652.D and shall be as follows. Unless otherwise specified, the test method of Section 2.1 and 2.2 shall be accordance with the ITU-T Recommendation G.650.

2.1 Fiber characteristics

Item	Specification
Fiber type	Single mode
Fiber material	High grade silica, compound silica glasses or equivalent material.
Fiber primary protective material	UV curable acrylate, UV curable urethane, epoxy acrylate or equivalent material.
Mode field diameter	9.2 $\mu\text{m} \pm 0.4 \mu\text{m}$ @1310 nm
Cladding diameter	125 $\mu\text{m} \pm 1 \mu\text{m}$
Core-cladding concentricity error	$\leq 0.5 \mu\text{m}$
Cladding non-circularity	$\leq 1.0 \%$
Coating diameter (primary coating)	245 $\mu\text{m} \pm 5 \mu\text{m}$ according to EIA/TIA-455-173
Fiber tensile strength	Proof-tested $\geq 0.69 \text{ Gpa}$ (100 kpsi) as per EIA-455-31B or IEC 60793-1-30

2.2 Cable Optical Characteristics

2.2.1 Attenuation coefficient (attenuation loss)

Wavelength (nm)	Maximum Attenuation (dB/km)
1310	0.35
1383*	0.35
1490	0.24
1550	0.21
1625	0.23

\* Maximum attenuation at this wavelength represents post-hydrogen aging performance according to IEC 60793-2-50 regarding the B1.3 fiber category.

2.2.2 The other optical characteristics

Item		Specification
Zero dispersion wavelength ( $\lambda_0$ )		1300 ~ 1324 nm
Zero dispersion slope @ $\lambda_0$		$\leq 0.092$ ps/(nm <sup>2</sup> .km)
Chromatic dispersion	@ 1310 nm	$\leq 3.5$ ps/(nm.km)
	@ 1550 nm	$\leq 18.0$ ps/(nm.km)
	@ 1625 nm	$\leq 22.0$ ps/(nm.km)
Cable Cut-Off Wavelength ( $\lambda_{cc}$ )		$\leq 1260$ nm according to EIA/TIA-455-170
Attenuation coefficient @1285~1330 nm		$\leq$ Measured attenuation @1310 nm 0.03 dB/km
Attenuation coefficient @1525~1575 nm		$\leq$ Measured attenuation @1550 nm 0.02 dB/km
Attenuation with macrobending of fiber 100 turns, 30 mm radius	@ 1550 nm	$\leq 0.10$ dB
Polarization Mode Dispersion (PMD) coefficient of individual fiber and the PMD link design value (PMD <sub>Q</sub> )		$\leq 0.2$ ps/km <sup>1/2</sup>

### 3. CABLE STRUCTURE

3.1 The required cable structure and color identification shall be specified in the Table 1 and Table 2 respectively.

Fiber Capacities	No. of elements	Buffer tubes x fibers in buffer
12	5	2 x 6
24	5	4 x 6
48	5	4 x 12
60	5	5 x 12

Table 1 Cable Structure

Fibers/buffer tube	Fiber, Unit Identification
1	Blue
2	Orange
3	Green
4	Brown
5	Slate
6	White
7	Red

Fibers/buffer tube	Fiber, Unit Identification
8	Black
9	Yellow
10	Violet
11	Rose
12	Aqua

Table 2 Fiber and Unit Color Identification

3.1.1 The color identification specified in Table 2 shall be in accordance with EIA/TIA-598-A (Optical Fiber Cable Color Coding).

3.1.2 The coloring shall be stable during the lifetime of the cable. The fiber color ink shall be durably cured surrounding all fiber surfaces with color specified. The colored fiber, at least 2 hours after inking, shall be confirmed the quality of ink coating by using the industry-wide accepted "MEK Rub" test that herein after called the fiber rub test as described in item 5.10.

3.2 Minimum Bending Radius of Cable

The minimum allowable bending radius of the cable shall be 20 times the external diameter of the cable during handling or installation, and 15 times when fixed.

4. CABLE REQUIREMENTS

4.1 Cable cross section

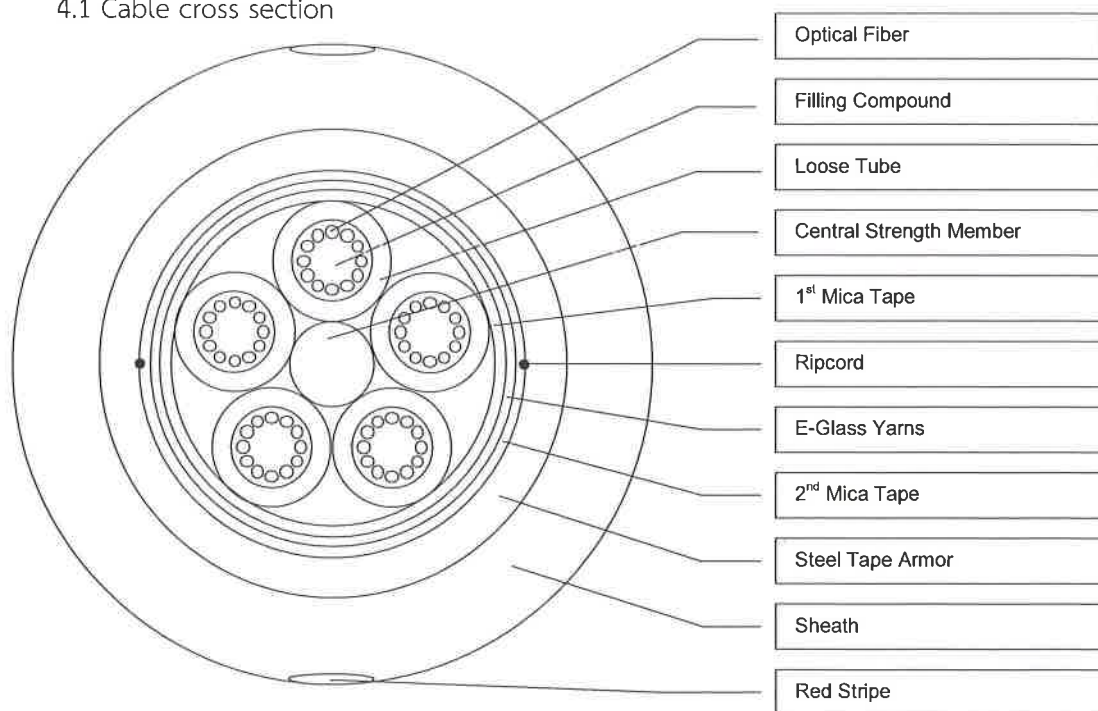


Figure 1 Cross-section views for fire resistant self-supporting (FRSS)

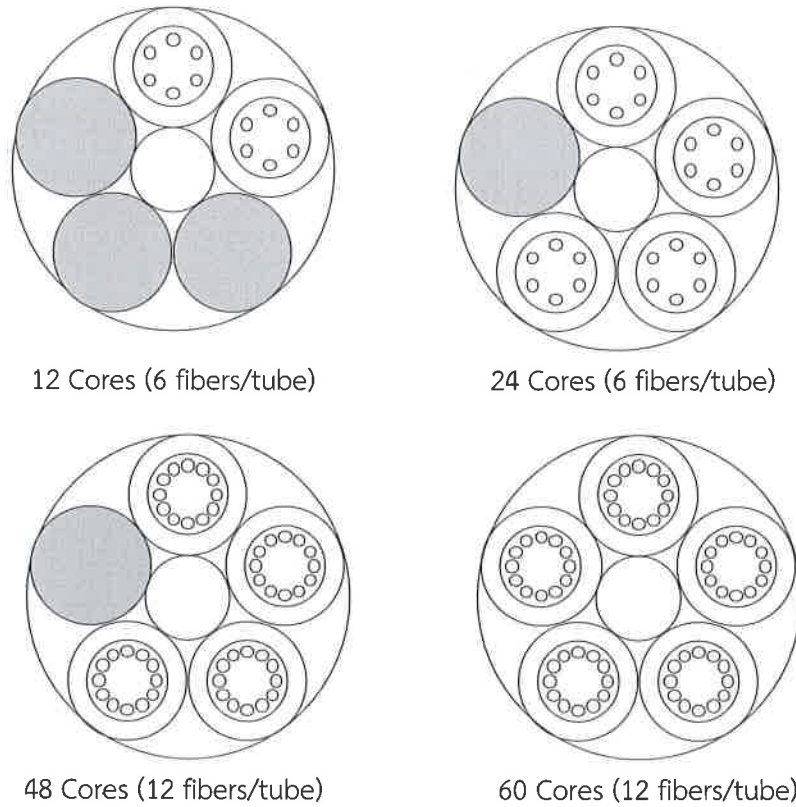


Figure 2 Cross-section views for fire resistant self-supporting (FRSS)

4.2 Cable core, construction and cable characteristic are described in detail below.

Item		Description
Optical fiber	Construction	As per section 2
Filling compound	Material	Thixotropic compound or equivalent
	Characteristic	Non-hygroscopic, non-nutritive to fungus, electrically non-conductive, free from dirt and foreign matter. It shall be readily removable with conventional non-toxic solvents
Buffer tube	Material	Polybutylene terephthalate (PBT) or polycarbonate or equivalent
	Construction	As per Figure 2
	Characteristic	Resistant to kinking and stranded around the CSM using stranding method of Reverse Oscillating Lay(ROL) Technique (SZ direction)

Item		Description
Filler rod	Material	Non-metallic
	Assembly	placed on position where not interrupt the consecutive positioning of the buffer tube
Stranding	Method	Reverse Oscillating Lay (ROL) Technique (SZ direction)
Central Strength Member (CSM)	Material	Steel wire coated with polyethylene
Core binder	Material	polyester or equivalent materials
	Characteristic	Helically applied around the core of stranded cables to secure the buffer tubes in their position
1 <sup>st</sup> Core Covering	Material	Mica Tape
	Characteristic	The tape shall be wrapped longitudinally over the cable core
Additional strength member	Material	E-glass yarns
2 <sup>nd</sup> Core Covering	Material	Mica Tape
	Characteristic	The tape shall be wrapped longitudinally over the additional strength member
Ripcord	Material	Aramid cords
	Number	2
	Characteristic	Capable of slitting the armor and cable sheath for a continuous length of 1 (one) meter
Armoring	Material	Corrugated steel tape coated with polymer
	Thickness	Steel tape : $0.15 \pm 10\%$ mm Coated polymer : Nom. 0.05 mm
	Overlap	$\geq 3.0$ mm
Sheath	Material	UV-proof Flame retardant polyethylene black compound (FRPE)
	Thickness	$\geq 1.5$ mm
Cable Structure	Figure 1 and 2	
Red Strip Dimension	2.5 – 4.0 mm	
Cable Maximum Overall Diameter (Max. O.D.)	$\leq 13.6$ mm	

4.3 Cable sheath specification

- a) The cable sheath shall not promote the growth of fungus and free from pinholes, joints, mended places and defects of any kind. The qualification of cable sheath shall be according to the table below.

Parameters	Specification	Test Method
1. Minimum Tensile Strength	120 kg/cm <sup>2</sup>	ASTM D638
2. Minimum Elongation	300%	ASTM D638
3. Thermal oxidation stability	OIT at 210°C > 60 min.	ASTM D 3895 @ 210°C
4. Carbon Black Content	2.3 ± 0.25%	ISO 6964*
5. Environment Stress Cracking Resistance (50°C, 10% Igepal, F0)	≥ 500 hrs	ASTM D1693
6. Max. Shrinkback	5%	**

Table 3 Cable sheath specification

Notes:

- \* TGA test method calculates carbon black content by subtracting FR additive content.
- \*\* Shrinkback: Slab specimens shall be cut from the cable sheaths 5 cm. (2 in.) long, 13 mm (1/2 in.) wide, and the same thickness as the cable sheath. The slab specimens shall be placed in a convection type circulating air oven operating at a temperature of 100 ± 1 °C for a 4-hour period for inner sheath, and 115 ± 1°C for 4-hour period for outer sheath.
- b) The bidder shall provide full details of span lengths, sags, and tensions of FRSS cables that limit the elongation and sensitivity to static fatigue of cable under a specified design load concerning size and weight of cable, distance between the utility poles, and storm loading region for Thailand. The installation conditions specified in table 4 and shall be used for guideline to propose such detailed calculation.

Parameters	Value	
1. Maximum pole span length	70 m	
2. Temperature	Installation	32 °C
	Operation	Tropical, -10 °C to 70 °C
3. Worst case loading condition (short-term)	Wind Velocity	Max. 100 km/hr
	Temperature	25 °C
4. Initial Sag	1.0% of span length	
5. Relative humidity	Up to 90%, no frost	

Table 4 Installation Conditions

4.4 Cable marking

a) Length marking

The outside cable sheath shall have sequentially numbered length marking at intervals of approximately 1 meter along the whole cable length. The starting number of ordering length for any reel shall begin with 0000 M (zero meter). The accuracy of the measurement of length marking shall be held within the limits of  $\pm 1\%$ .

b) Identification marking

Each marking length interval, the identification marking shall be permanently identified as to TOT, manufacturer, contract number, project name, year (E.C.) of manufacture, type and size of cable

Example: TOT ABC 200/3270000698/2562 DEF 2019 OFC/SM/FRSS – XXX F

Where as

TOT	= TOT
ABC	= Manufacturer
200/3270000698/2562	= Contract number
DEF	= Project name (see remark)
2019	= Year (E.C.) of manufacture
OFC	= Optical Fiber Cable
SM	= Single Mode
FRSS	= Fire Resistant Self-Supporting
XXX	= Number of fibers
F	= Fibers

Remark: If supplied for turnkey project, the project name shall be marked.

c) Additional identification marking

The outside of cable sheath shall be permanently identified by extruding the red stripe while forming cable sheath throughout the cable length. Two red stripes diagonally opposite each other shall be provided.

The Color of marking for Section 4.4 a) and 4.4 b) shall preferably be white color and the color of marking for Section 4.4 c) shall be red color according to EIA/TIA-598-A.

The cable marking process shall not reduce or increase the sheath dimensions. The paint used shall be clearly visible, adhesive with the sheath and resistive to environmental conditions during the lifetime of the cable. The red stripe shall be added with UV protection material.



## 5. MECHANICAL AND ENVIRONMENTAL CHARACTERISTICS

This Section covers the mechanical, environment, and endurance qualification requirements for completed cables. Test wavelengths shall be within limit of  $1550 \pm 10$  nm. Test to establish the mechanical properties of the cables shall have no detrimental effect in transmission characteristics on the transmission properties of the cables.

### 5.1 Tensile Loading

To qualify the design, the cable must pass the Tensile Loading. Test specified by IEC 60794-1-2-E1 or EIA-455-33A. The conditions for testing shall be conformed to TOT's specification as follow:

Test standard: IEC 60794-1-2-E1 or EIA-455-33A

Pre-requirements:

Length of cable under load: sufficient to achieve the desired accuracy of measurement of attenuation change (Min. 50 meters).

Diameter of mandrel: 30 x outside diameter of cable

Load cable: 1,800 N (12-60 fibers cable)

Test result:

- The fiber strain is measured during the cable which has been subjected to the installation load for 1 hour. It shall not be greater than  $\frac{1}{3}$  of the fiber proof test (since fiber proof test = 1%, so that fiber strain  $\leq 33\%$  of 1% that means fiber strain shall not be greater than 0.33%).
- Change of attenuation for each test stage (during loaded and after load removal) compared with attenuation before testing  $\leq 0.10$  dB.
- No fiber break and no sheath damage.

### 5.2 Impact Resistance

To qualify the design, the cable must pass the impact Test specified by EIA/TIA-455-25C or IEC 60794-1-2-E4. The conditions for testing shall be conformed to TOT's specification as follow:

Test standard: EIA/TIA-455-25C or IEC 60794-1-2-E4

Pre-requirements:

Impact energy: according to Table 5

Number of Impacts: 20 Cycles

Radius of hammer head:  $12.5 \pm 0.1$  mm.

Impact rate:  $\leq 2$  sec/cycle

Test result:

- Change of attenuation measured between before and after test < 0.1 dB.
- No fiber break and no cable damage.

Cable Diameter		Impact Energy	
mm.	Inch	N.m	lb.ft.
D ≤ 3.8	D ≤ 0.15	0.74	0.54
3.8 < D ≤ 5.3	0.15 < D ≤ 0.21	1.47	1.08
5.3 < D ≤ 7.5	0.21 < D ≤ 0.30	2.21	1.63
7.5 < D ≤ 13.0	0.30 < D ≤ 0.51	2.94	2.17
13.0 < D ≤ 15.0	0.51 < D ≤ 0.59	4.41	3.25
15.0 < D ≤ 16.6	0.59 < D ≤ 0.65	5.51	3.80
16.6 < D ≤ 18.9	0.65 < D ≤ 0.75	5.88	4.31
18.9 < D ≤ 21.4	0.75 < D ≤ 0.84	6.62	4.88
21.4 < D	0.84 < D	7.53	5.42

Table 5 Impact resistance test

5.3 Compression/Crush Test

To qualify the design, the cable must pass the Compression Test specified by EIA/TIA-455-41A or Crush Test by IEC 60794-1-2-E3. The conditions for testing shall be conformed to TOT's specification as follow:

Test standard: EIA/TIA-455-41A or IEC 60794-1-2-E3

Pre-requirements:

Load cable: ≥ 3,000 N

Steel plate: according to EIA/TIA-455-41A or IEC 60794-1-2-E3

Loading time: ≥ 10 min. (one point and one time)

Test result:

- Change of attenuation for each stage (during loaded and after load removal) compared with attenuation before testing : < 0.1 dB.
- No fiber break and no cable damage.

5.4 Flexing/Repeat Bending Test

To qualify the design, the cable must pass the Flexing Test specified by EIA/TIA-455-104A or Repeat Bending Test by IEC 60794-1-2-E6. The conditions for testing shall be conformed to TOT's specification as follow:

Test standard: EIA/TIA-455-104A or IEC 60794-1-2-E6

Pre requirements:

Diameter of mandrel: 20 x diameter of cable

Load: according to Table 6

Number of cycles:  $\geq 25$  cycles  
 Flexing rate:  $\leq 2$  sec./cycle  
 Test result:

- Change of attenuation for each stage (during loaded and after load removal) compared with attenuation before testing :  $< 0.1$  dB.
- No fiber break and no cable damage.

Cable Diameter		Minimum Load	
mm.	Inch	Kg Weight	N
$D \leq 2.5$	$D \leq 0.098$	1.5	14.71
$2.5 < D \leq 4.0$	$0.098 < D \leq 0.157$	2.5	24.52
$4.0 < D \leq 6.0$	$0.157 < D \leq 0.236$	4.0	29.23
$6.0 < D \leq 9.0$	$0.236 < D \leq 0.354$	4.5	44.13
$9.0 < D \leq 13.0$	$0.354 < D \leq 0.511$	5.0	49.03
$13.0 < D \leq 18.0$	$0.511 < D \leq 0.708$	5.5	53.94
$18.0 < D \leq 24.0$	$0.708 < D \leq 0.944$	6.5	63.74
$24.0 < D \leq 30.0$	$0.944 < D \leq 1.181$	7.0	68.65
$D > 30.0$	$D > 1.181$	7.5	73.55

Table 6 Flexing/Repeat Bending test

### 5.5 Twist/Torsion Test

To qualify the design, the cable must pass the Twist Test specified by EIA-455-85A or Torsion Test by IEC 60794-1-2-E7. The conditions for testing shall be conformed to TOT's specification as follow:

Test standard: EIA/TIA-455-85A or IEC 60794-1-2-E7

Pre-requirements:

Twist rate:  $\leq 1$  min./cycle  
 Twist angle:  $\pm 180^\circ$   
 Number of cycles: 10 cycles  
 Load: according to Table 7

Test result:

- Change of attenuation for each stage (during loaded and after load removal) compared with attenuation before testing:  $< 0.1$  dB.
- No fiber break and no cable damage.

Cable Diameter		Recommended Load	
mm.	Inch	Kg Weight	N
$D \leq 2.5$	$D \leq 0.098$	1.5	14.71
$2.5 < D \leq 4.0$	$0.098 < D \leq 0.157$	2.5	24.52
$4.0 < D \leq 6.0$	$0.157 < D \leq 0.236$	4.0	29.23
$6.0 < D \leq 9.0$	$0.236 < D \leq 0.354$	4.5	44.13
$9.0 < D \leq 13.0$	$0.354 < D \leq 0.511$	5.0	49.03
$13.0 < D \leq 18.0$	$0.511 < D \leq 0.708$	5.5	53.94
$18.0 < D \leq 24.0$	$0.708 < D \leq 0.944$	6.5	63.74
$24.0 < D \leq 30.0$	$0.944 < D \leq 1.181$	7.0	68.65
$D > 30.0$	$D > 1.181$	7.5	73.55

Table 7 Twist/torsion test

### 5.6 Cable Bending Test

To qualify the design, the cable must pass the Cable Bend Test by IEC 60794-1-2-E11B. The conditions for testing shall be conformed to TOT's specification as follow:

Test standard: IEC 60794-1-2-E11B.

Pre-requirements:

Diameter of mandrel: 20 x diameter of cable

Number of cycles: 1

Test result:

- Change of attenuation for each stage (during loaded and after load removal) compared with attenuation before testing : < 0.1 dB.
- No fiber break and no cable damage.

### 5.7 Temperature Cycling Test

To qualify the design, the cable must pass the Temperature Cycling Test specified by EIA/TIA-455-3A or IEC 60794-1-2-F1. The conditions for testing shall be conformed to TOT's specification as follow:

Test standard: EIA/TIA-455-3A or IEC 60794-1-2-F1

Pre-requirements:

Variation of temperature: - 10° C to + 70 ° C

Number of Cycles: 2

Soak time: according to Table 8

Condition measurement: - Low temperature condition (-10±2°C)

- High temperature condition (70±2°C)

Test result:

- Change of attenuation for each condition measurement compared with attenuation before testing: < 0.1 dB/km.
- No fiber break and no cable damage.

Minimum Soak for a Given Sample Mass		
Sample Mass (kg.)	Sample Mass (lb.)	Soak Time (Hours)
$M \leq 0.35$	$M \leq 0.77$	0.5
$0.35 < M \leq 0.70$	$0.77 < M \leq 1.50$	1
$0.70 < M \leq 1.50$	$1.50 < M \leq 3.30$	2
$1.50 < M \leq 15.00$	$3.30 < M \leq 33.00$	4
$15.00 < M \leq 100$	$33.00 < M \leq 220$	8
$100 < M \leq 250$	$220 < M \leq 550$	12
$250 < M \leq 500$	$550 < M \leq 1100$	14
$M > 500$	$M > 1100$	16

Table 8 Temperature Cycling Test

### 5.8 Flame Propagation

To qualify the design, the cable must pass the flame propagation Test by IEC 60331-25. The conditions for testing shall be conformed to TOT's specification as follow:

Horizontal Test:

- Test method: IEC 60331-25
- Test sample: A Sample shall comprise a length of the completed cable (at least 5 m.) sufficiently long so that the two ends emerge from the test chamber.
- At each end of the sample, length of identical optical fiber shall be connected, if necessary, to give a total length appropriate of the optical test method use.

Flame Temperature: at least 750°C

Period: 90 minutes

Test result:

- When the flame is applied and during a cooling period of an additional 15 minutes. It must still be possible to transmit signal via optical fibers (No fiber break) at wavelength 1550 nm.

## Notes:

- The test report from certified ISO/IEC 17025 third party test laboratory shall be provided in bidding document by bidder.
- Failure in section 5.8, the proposal shall be Disqualified.

## 5.9 Cable Sheath Test

The procedure for testing fiber cable sheath shall be as specified in section 4.3 a) cable sheath specification. The certificate of analysis (COA) or test report of raw material properties shall be referred for consideration.

## 5.10 Fiber Rub Test

To qualify the fiber color coating, the fiber shall pass the fiber rub test. The conditions for testing shall conform to TOT specification as follow:

## Pre-requirements:

- Sample: 50 cm length of the single colored fiber.
- Materials:
1. Absorbent materials in white color such as cleaning tissue or soft cotton cloth.
  2. Pincers
  3. MEK Solution, grade: MEK FOR ANALYSIS,  
Code: 462703, Carlo Erba Reagents Co., Ltd.  
Local supplier: Vidhaya-som Co., ltd. Etc.
  4. Tool for fixing one end of the colored fiber
  5. Rubber glove
  6. Mask



Figure 3 Fiber Rub Test

Procedure: The test shall be prepared and performed according to figure 3. The 5 ml (5 milliliters) of MEK solution shall be dripped at the middle point of absorbent material. After the absorbent material is soaked by the MEK solution then the MEK soaked cloth or tissue shall be wiped on the single colored fiber core

with uniform backward and forward motion (15 cm wiping span, one time of backward and forward motion = 1 cycle = 30 cm wiping length) requiring total 75 cycles. Observe the sample.

Test result:

- No color of fiber peel off until could see the surface of bare fiber by visual check.

## 6. QUALITY ASSURANCE AND FACTORY TESTING

- 6.1 Contractor shall submit full details of their Quality Assurance procedures which shall ensure that the cables fully comply with the requirements of specification
- 6.2 Contractor shall guarantee that the materials used for production of the fibers and coatings shall be of the same origin for all cables. Combination fibers and coatings from different suppliers is not acceptable. Factory splicing of optical fiber is not permitted.
- 6.3 Independently certified test records of specified materials and components and assembled cable parameters shall be submitted to the TOT if so requested.
- 6.4 Contractor shall submit to the TOT, on or before the delivery of cables, detailed test reports for every delivered length and for each production batch of a given size of cable.

## 7. Cable drum

- 7.1 The cable-drum shall be made from steel or wood.
- 7.2 The cable-drum shall be large enough to prevent damage to the cable during reeling or unreeling and prevent the rodent or squirrel from going inside the drum.
- 7.3 The cable ends shall be securely fastened so as not to protrude beyond any portion of the drum and to prevent the cable from becoming loose in transportation.
- 7.4 A protective wrap shall be applied over the outer convolutions of the cable on each reel. The wrap shall be weather resistant and shall remain in place until the cable is installed.
- 7.5 The both ends of the cable shall be firmly sealed with a suitable rubber cap or heat shrinkable cap to prevent ingress of moisture.
- 7.6 Details given below shall be distinctly marked on a weather proof material on both outer sides of each drum flange:
  - a) TOT, Thailand
  - b) Arrow showing the direction the drum shall be rolled.

- c) Country of origin
- d) The label of caution plate, 'CAUTION – OPTICAL FIBER CABLE NOT TO BE LAID FLAT' or equivalent instruction sign.
- e) Manufacturer's name or trademark
- f) A mark indicating the location of the inner end of the cable if located internally.
- g) TOT code
- h) Batch number (if required)
- i) Drum (or Reel) number

7.7 The marking plates containing the following information shall be securely attached to the both outer sides of each drum flange.

The numerals shall be punched:

- a) Material specification (according to the outer sheath type)
- b) Type and size of cable
- c) Cable length in meters
- d) Net weight in kilograms
- e) Gross weight in kilograms
- f) Reel number or Drum number
- g) Manufacturer's name
- h) Purchase order number (P/O NO.)
- i) Project number / TOT's Contract number

The plated shall be made of non – corrodible material. All marking shall be in accordance with Figure 4 and 5

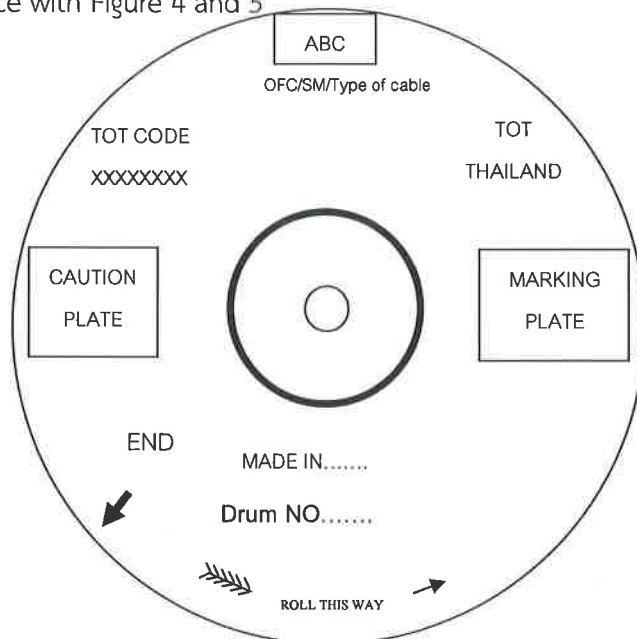


Figure 4 Cable-drum marking



MATERIAL SPECIFICATION	:	SINGLE MODE OPTICAL FIBER CABLE
TYPE AND SIZE	:	SM/FRSS Cable xx C
CABLE LENGTH	:	X,XXX M
DRUM (REEL) NUMBER	:	XXX
NET WEIGHT	:	XXX KGS.
GROSS WEIGHT	:	XXX KGS.
MANUFACTURER'S NAME	:	ABC
PURCHASE ORDER NUMBER	:	XXXXXXXXXX
CONTRACT NUMBER	:	XXX/XXXXXXXXXX/25XX

Figure 5 Marking plate

**8. SPECIFIC CONDITIONS**

The proposed cable shall be met the requirement in these specific conditions, otherwise those cables will be rejected.

**8.1 Specific environmental conditions**

All the cable shall meet or exceed to the following temperature ranges as below:

**8.1.1 Temperature Cycling**

Installation, Operation and Storage/Shipping temperature ranges are as follow:

- Installation: 0 to 60 °C
- Operation: -10 to 70 °C
- Storage/Shipping: -20 to 70 °C

With their Technical Proposals, Bidder shall submit certification or other suitable evidence verifying that the products offered are qualified to the above environmental condition and ranges.

**8.2 Specific acceptance test**

8.2.1 For the acceptance test, the cable will be tested against the requirements as specified in the contract document.

8.2.2 The tests shall be performed by laboratory of Technical Research and Develop Department of TOT or official representative. TOT reserve the right to test some vital item if so requires.

8.2.3 The contractor shall submit the detail of factory testing after delivered the cable to TOT. In the event that the cables so test fail to meet the specified requirements, TOT reserves the right to reject all the cable.

END OF SPECIFICATION

(Attached 1 page of test instrument list)

End of Specification



OES-004-058-01

No	Inspection Items	Test Instrument Information					Remark
		Name of Instrument	Model	Manufacturer	Cal Date	Due Date	
1	TOT Spec.OES-004-058-01 Attenuation at 1310 nm, 1383 nm, 1490 nm, 1550 nm, 1625 nm						
2	Dispersion at 1288 nm- 1339 nm; Dispersion at 1550 nm, 1625 nm; Zero dispersion wavelength; Zero dispersion slope;						
3	PMD						
4	Cable cutoff wavelength ( $\lambda_{cc}$ ); Fiber cutoff wavelength ( $\lambda_c$ );						
5	MFD at 1310 nm						
6	Fiber construction Cladding diameter; Core-Clad concentricity error; Cladding non-circularity;						
7	Cable mechanical performance Tensile loading; Fiber strain; Impact resistance; Compression/Crush; Flexing/Repeated bending; Twist/Torsion; Cable bending; Fiber rub test;						
8	Temperature cycling						
9	Flame propagation						
10	Cable sheath properties						

B.

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