Comments on draft standard (Draft Standard No. TEC 85030:2025)

Name of Manufacturer/Stakeholder:

Organization:

Contact details:

Clause No.	Clause	Comments	Other Remarks, if any

Note: The comments on the draft Standard (Draft Standard No. TEC 85030:2025) may be provided in the above format vide email to email to **dirt2-tec-dot@gov.in**, **adet-tx-tec-dot@gov.in** and **ratx.tec-dot@nic.in**

वर्गीय आवश्यकताओं के लिए मानक

टीईसी ८५०३०:२०२५

(सं: जीआर/ओएफसी-०५/०२.मार्च २००६ को अधिक्रमित करता है)

STANDARD FOR GENERIC REQUIREMENTS

No.: TEC 85030:2025

(Supersedes No. GR/OFC-05/02. MAR 2006)

हाई काउंट मेटल फ्री ऑप्टिकल फाइबर केबल (रिबन टाइप) फॉर एक्सेस नेटवर्क

HIGH COUNT METAL FREE OPTICAL FIBRE CABLE (RIBBON TYPE) FOR ACCESS NETWORK

ISO 9001:2015

दूरसंचार अभियांत्रिकी केंद्र
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FOREWORD

Telecommunication Engineering Centre (TEC) functions under Department of Telecommunications (DOT), Government of India. Its activities include:

- Framing of TEC Standards for Generic Requirements for a Product/Equipment, Standards for Interface Requirements for a Product/Equipment, Standards for Service Requirements & Standard document of TEC for Telecom Products and Services
- Formulation of Essential Requirements (ERs) under Mandatory Testing and Certification of Telecom Equipment (MTCTE)
- Field evaluation of Telecom Products and Systems
- Designation of Conformity Assessment Bodies (CABs)/Testing facilities
- Testing & Certification of Telecom products
- Adoption of Standards
- Support to DoT on technical/technology issues

For the purpose of testing, four Regional Telecom Engineering Centres (RTECs) have been established which are located at New Delhi, Bangalore, Mumbai, and Kolkata.

ABSTRACT

This document pertains to Standard for Generic Requirements of high count metal free Optical fibre Cables (ribbon type) for access network.

CONTENTS

HISTORY SHEET

SN	*Standard/ Document No.*	*Title*	*Remarks*
1.	GR/OFC - 05/01. JUL 2000	High count Metal Free Optical Fibre Cable (Ribbon Type) for Access Network	First Issue
2.	GR/OFC - 05/02. MAR 2006	High count Metal Free Optical Fibre Cable (Ribbon Type) for Access Network	Second Issue
3.	Standard No. TEC 85030:2025	Standard for Generic Requirements of High count Metal Free Optical Fibre Cable (Ribbon Type) for Access Network	Third Issue

REFERENCES

SN	*Document No.*	*Title/Document Name*
1.	TEC 89010:2021	Standard for Generic Requirements of Raw Material for manufacturing of Optical Fibre Cable.
2.	TEC 89060:2006	Standard for Generic Requirements of Tools for installation & Operating the OFC & for assembly of the OF Splice closure.
3.	GR No. G/CBD-01/02. NOV 94	Generic Requirements of Wooden Cable Drum for Telecom Cables
4.	TEC 85140:2025	Standard for Generic Requirements of Metal Free Optical Fibre Cable
5.	TEC 85090:2018	Standard for Generic Requirements of Self Supporting Metal Free Aerial OF Cable (For Urban Areas)
6.	GR-20 – CORE July 98	Generic Requirements for Optical Fibre Cable. (Telcordia document)
7.	ITU-T G. 652 amd G.657	ITU-T Recommendation
8.	IEC 60811-5-1, IEC 60811-202, IEC 60793-1, IEC 60794-1-21-E1, IEC 60794-1-21-E2, IEC 60794-1-21-E3, IEC 60794-1-21-E4, 60794-1-21-E6, IEC 60794-1-21-E7, IEC 60794-1-21-E10, IEC 60794-1-21-E11, IEC 60794-1-22-F1, IEC 60794-1-22-F5, IEC 60794-1-22-F9, IEC 60794-1-22-F16, IEC 60794-1-219, IEC 60794-1-403, IEC 62230, IEC 60794-1-23-G2, IEC 60794-1-23-G7, IEC 60794-1-31, IEC 60794-	Test Methods for Optical Fibres

	1-301, IEC 60794-1-305, IEC 60794-1-306, IEC 60794-1-308, IEC 60794-1-310-G10B,	
9.	EIA 598-D IEC Publication 304(4)	Colour Standards
10.	FOTP-89 ,FOTP-131, FOTP-141	Test Methods
11.	ISO 9001: 2015	International Quality Management System
12.	ASTM D-566, ASTM D-790 ASTM-1248, ASTM D-4565	Test Methods

CHAPTER - 1

1.0 Introduction :

This document describes the Standard for Generic Requirements of high count metal free Optical fibre Cables (ribbon type) for access network. The cable is meant to be installed underground. The fibres in the cable shall be arranged in a ribbon form. A ribbon shall have 12 fibres. Multiple ribbons shall be deployed in cable to meet capacity requirements.

2.0 Functional Requirement:

2.1 The design and construction of Ribbon Optical Fibre Cable shall be inherently robust and rigid under all conditions of operation, installation, adjustment, replacement, storage and transport.

2.2 The Ribbon optical fibre cable shall be able to work in a saline atmosphere in coastal areas and should be protected against corrosion.

2.3 Life of cable shall be at least 25 years. Necessary statistical calculations shall be submitted by the manufacturer. The cable shall meet the cable aging test requirement.

2.4 It shall be possible to operate and handle the Ribbon optical fibre cable with tools as per Standard No. TEC 89060:2006 (or latest release) and subsequent amendments, if any. If any special toolis required for operating and handling this optical fibre cable, the same shall be provided along with the cable.

2.5 The HighCount Metal Free Optical Fibre Cable (Ribbon Type) for Access Network shall be suitable and compatible with the dimensions, fixing, terminating and splicing arrangement of the splice closure supplied along with

the cable & vice versa. The manufacturer shall indicate the type, make and the model no. of the splice closure to be supplied.

2.6 The manufacturer shall indicate the maximum and average splice loss of the Individual fibres in a ribbon with the permissible variation in sizes of the optical fibre ribbon during bulk production.

2.8 It is mandatory that the Optical fibre cable supplied in a particular route is manufactured from a single source of optical fibres.

3.0 Technical Requirements of fibre :

Single Mode Optical Fibre used in Ribbon fibre cable shall be as per ITU-T Rec. G 652-D or G.657 A1. The specification of optical fibres are mentioned below:

3.1 Type of fibre (Wavelength band optimized nominal 1310 nm):

Single mode as per Section-I of the Standard No. TEC 89010:2021(or latest release) and subsequent amendments, if any

3.2 Geometrical Characteristics of fibre :

As per Section-I of the Standard No. TEC 89010:2021(or latest release) and subsequent amendments, if any. All the parametric values shall be as per the Standard for GR for raw materials (Standard No. TEC 89010:2021(or latest release) and subsequent amendments, if any)

3.3 Transmission Characteristics of fibre :

As per Section-I of the Standard No. TEC 89010:2021(or latest release) and subsequent amendments, if any. All the parametric values shall be as per the Standard for GR for raw materials (Standard No. TEC 89010:2021(or latest release) and subsequent amendments, if any)

3.4 Mechanical Characteristics of fibre :

As per Section-I of the Standard No. TEC 89010:2021(or latest release) and subsequent amendments, if any. All the parametric values shall be as per the Standard for GR for raw materials (Standard No. TEC 89010:2021(or latest release) and subsequent amendments, if any)

3.5 Material Properties of fibre :

As per Section-I of the Standard No. TEC 89010:2021(or latest release) and subsequent amendments, if any. All the parametric values shall be as per the Standard for GR for raw materials (Standard No. TEC 89010:2021(or latest release) and subsequent amendments, if any)

3.6 Environmental Characteristic of Fibre :

As per Section-I of the Standard No. TEC 89010:2021(or latest release) and subsequent amendments, if any. All the parametric values shall be as per the Standard for GR for raw materials (Standard No. TEC 89010:2021(or latest release) and subsequent amendments, if any)

3.7 Colour Qualification and Primary coating Test :

As per Section-I of the Standard No. TEC 89010:2021(or latest release) and subsequent amendments, if any. All the parametric values shall be as per the Standard for GR for raw materials (Standard No. TEC 89010:2021(or latest release) and subsequent amendments, if any)

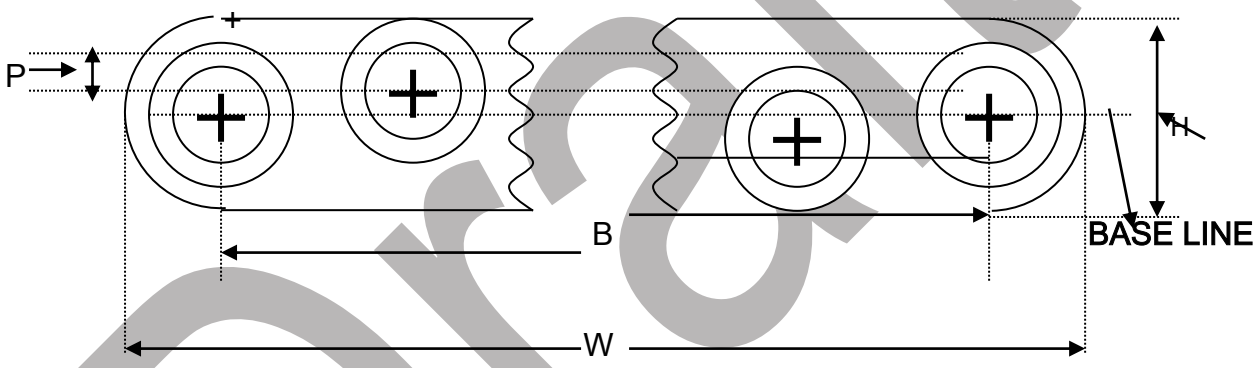
3.8 Ribbon Structure :

3.8.1 Twelve coated fibres shall be arranged in ribbon structure. The fibres in the structure shall be parallel and shall not cross over each other along the entire length of the ribbon. The dimensions of 12 fibres ribbon shall be as per the sectional specification of IEC 60794-3 / Telcordia GR-20-CORE (issue 4, July 2013) and as given below :

3.8.2 Ribbon Dimensions :

The maximum dimensions of fibre ribbon shall be as follows and the cross section geometry of the fibre ribbon shall be as shown in the following figure :

Number Of Fibres	Ribbon Width (W)	Ribbon height (H)	Extreme Fibres (B)	Planarity (P)
12	3220 μm	360 μm	2882 μm	50 μm



Cross section of Fibre Ribbon

3.8.3 Ribbon Material :

The ribbon shall be manufactured using single mode optical fibres coloured with UV cured resin and the ribbon shall be encapsulated with a further layer of UV cured acrylate. The fibres and the ribbons shall confirm to the colour requirement as per clause no. 4.4 of this GR.

3.8.4 Ribbon Mechanical Properties :

3.8.4.1 Ribbon Macro-bend

Change in attenuation when wrapped on a 60 mm : ≤ 0.05 dB

diameter mandrel for 100 turns at 1310 & 1550 nm

3.8.4.2 **Ribbon Compression Resistance**

Change in attenuation when subjected to a compressive load of 500 N at 1310 nm & at 1550 nm : ≤ 0.05 dB

3.8.4.3 **Ribbon Torsion Resistance**

Change in attenuation (At 1310 nm & 1550 nm) : ≤ 0.05 dB

3.9 **Ribbon Optical fibre Cable Construction Specifications:**

The cable shall be designed to the parameters mentioned in Annexure – I. The manufacturer shall submit designed calculation and the same shall be studied and checked.

New Clause: Secondary Protection: The coated Ribbon fibres may be protected by loose packaging within tube, which shall be filled with thixotropic jelly. The dimensions of tube shall be as per Annexure – I.

3.9.1 **Number of fibres in the cable** : 48, 96, 144, 288, 576
(Type approval for a cable shall be issued depending upon the no. of fibres in the cable).

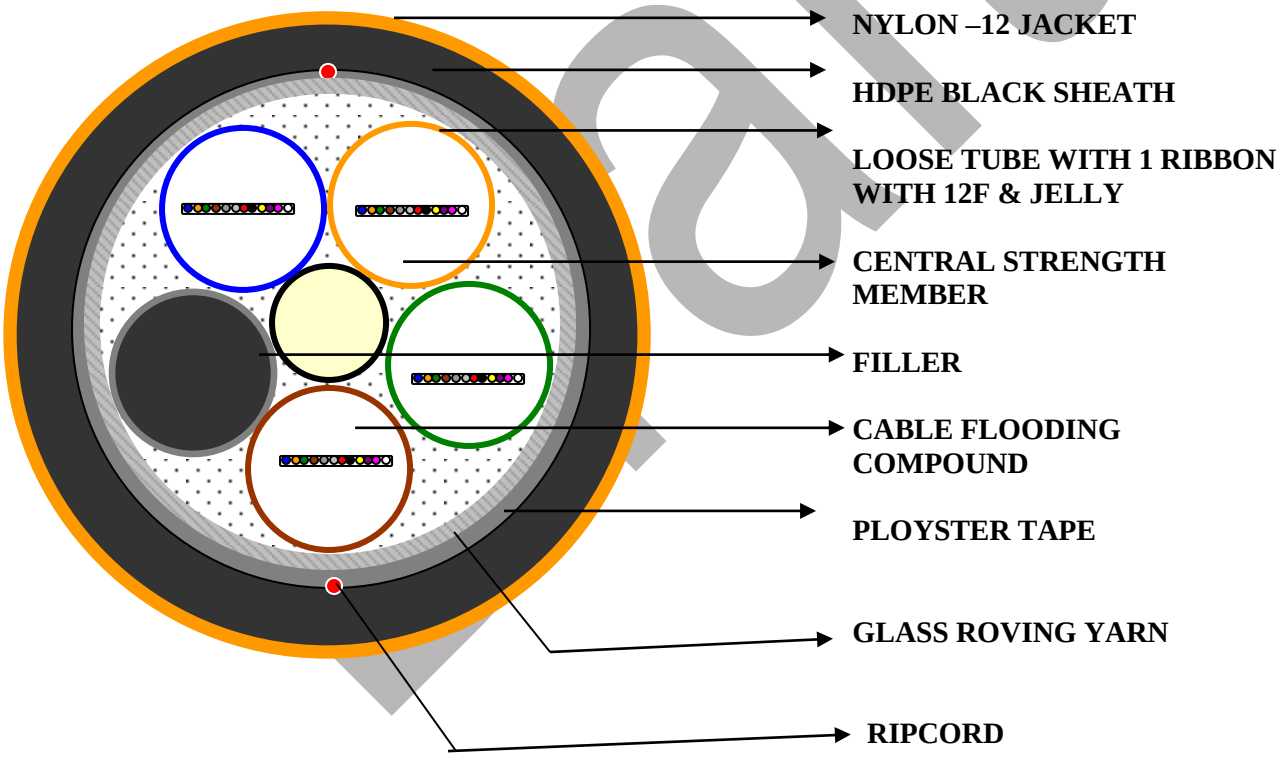
3.9.2 **Number of fibres in a ribbon** : Twelve (12) Fibres

3.9.3 The number of ribbons per loose tube in ribbon optical fibre cable shall be as follows :

S. No	No. of Fibres	Multi loose tube type
a.	48 fibres	Four Tube, 1 ribbon per tube

b.	96 fibres	Five tubes, Two tubes with 1 ribbon per tube Three tubes with 2 ribbons per tube
c.	144 fibres	Six tubes, Two ribbons per tube
d.	288 fibres	Six tubes, Four ribbons per tube
e.	576 fibres	Eight tubes, Six ribbons per tube

TYPICAL STRUCTURAL DRAWING FOR 48F RIBBON OPTICAL FIBRE CABLE



3.9.4 Strength Member : Solid FRP non - metallic strength member shall be used in the center of the cable core. The strength member in the cable shall be for strength and flexibility of the cable and shall have anti buckling properties. The FRP shall keep the fibre strain within permissible values. The strength member(FRP)

shall be as per the Standard No. TEC 89010:2021(or latest release) and the subsequent amendments, if any. The size of FRP shall be as per Annexure – I.

3.9.5 Cable Core Assembly : The coated fibres in ribbon structure shall be protected inside loose tubes / buffer tubes which are stranded together around a central strength member using helical or reverse lay techniques and form the cable core. The buffer tubes shall maintain the fibre's mechanical & optical integrity. It shall also protect them from tensile, thermal and vibration loads. The buffer tubes shall be gel filled to block the ingress of water.

3.9.6 Core Wrapping : The main cable core shall be wrapped by a layer/layers of Polyester foil/ tape. The nylon/polyester binder thread / tape shall be used to hold the thread / tape, if required. The nylon/polyester binder thread shall be as per Section-IX of Standard No. TEC 89010:2021(or latest release) and the subsequent amendments, if any. The core wrapping shall not leave any kink marks over the loose tube.

3.9.7 Moisture barrier (protection): The main cable core (containing fibres & core wrapping) shall be protected by flooding compound (Jelly) having properties of non hygroscopic dielectric material.

3.9.8 Filling and flooding compound: The filling /flooding compound used in the loose tube and in the cable core shall be compatible to fibre, secondary protection of fibre, core wrapping and other component parts of the cables.. The drip point shall not be lower than +70 °C. The fibre movement shall not be constrained by stickiness and shall be removable easily for splicing. The test method to measure drop point shall be as per ASTM D 566 . The filling and the flooding jelly compound shall be as per the Standard No. TEC 89010:2021(or latest release) and subsequent amendments, if any.

3.9.9 Sheath : A non-metallic moisture barrier sheath may be applied over and above the cable core. The core shall be covered with tough weather resistant

High Density Polyethylene (HDPE) sheath, black in colour (UV Stabilized). Thickness of the sheath shall be uniform and shall not be less than 1.8 mm including the strength members if used in the sheath. The sheath shall be circular, smooth, free from pin holes, joints, mended pieces and other defects. The reference test method to measure thickness shall be as per IEC 60811-202.

Note: HDPE material, black in colour, from the finished cable shall be subjected to following tests (on sample basis) and shall confirm to the requirement of the material as per as per Section III of Standard No. TEC 89010:2021(or latest release) and the subsequent amendments, if any.

a) Density.
b) Melt Flow Index.
c) Carbon Black Content.
d) Carbon Black Dispersion.
e) ESCR.
f) Moisture Content
g) Tensile Strength and Elongation at break
h) Oxidative Induction time
i) Absorption Coefficient
j) Brittleness Temperature

3.9.10 Outer Jacket : A circular sheath/Jacket of not less than 0.65 mm thick of Polamide-12/Nylon-12 material orange in colour, free from pin holes, scratches and other defects etc. shall be provided over and above the HDPE sheath. The nylon Jacket shall have smooth finish.

3.9.11 Cable diameter : The finished cable diameter shall be as per Annexure-I.

New Clause: Cable Weight : The nominal cable weight shall be as per Annexure -I

3.9.12 RIP Cord :

a) Two suitable rip cords shall be provided in the cable which shall be used to open the HDPE sheath of the cable. The rip cords shall be placed diametrically opposite to each other. It shall be capable of consistently slitting the sheath without breaking for a length of 1 meter at the installation temperature. The rip cords (3 ply & twisted) shall be properly waxed to avoid wicking action and shall not work as a water carrier.

b) The rip cord used in the cable shall be readily distinguishable from any other components utilized in the cable construction.

3.10 Mechanical Characteristics and Tests on Optical Fibre Cable :

3.10.1 Tensile Strength Test :

Objective : This measuring method applies to optical fibre cables which are tested at a particular tensile strength in order to examine the behavior of the attenuation as a function of the load on a cable which may occur during installation.

Method : IEC 60794-1-21-E1.

Test Specs.: The cable shall have sufficient strength to withstand a load of value T(N) = 9.81 x 2.5 W Newtons or 10000 N which ever is lower (where W-mass of 1Km of cable in Kg). The load shall be sustained for 10 minutes and the strain on the fibre and the attenuation shall be monitored.

Requirement : The load shall not produce a strain exceeding 0.25 % in the fibre and shall not cause any permanent physical and optical damage to any component of the cable. The attenuation shall be noted before strain and after the

release of strain. The change in attenuation of each fibre after the test shall be ≤ 0.05 dB, both for 1310 nm and 1550 nm wavelengths.

3.10.2 Abrasion Test :

Objective : To test the abrasion resistance of the sheath and the marking printed on the surface of the cable.

Method : IEC-60794-1-21-E2

Test Specs.: The cable surface shall be abraded with needle (wt. 150 gm) having diameter of 1 mm with 500 grams weight (Total weight more than equal to 650 gms.).

No. of cycles : 100
Duration : One minute (Nominal)

Requirement : There shall be no perforation and loss of legibility of the marking on the sheath.

3.10.3 Crush Test (Compressive Test) :

Objective : The purpose of this test is to determine the ability of an optical fibre cable to withstand crushing.

Method : IEC 60794-1-21-E3.

Test Specs.: The fibres and component parts of the cable shall not suffer permanent damage when subjected to a compressive load of 2000 Newtons applied, between the plates of dimension 100 mm x 100 mm. The load shall be applied for 60 seconds. The attenuation shall be noted before and after the completion of the test.

Requirement : The change in attenuation of the fibre after the test shall be ≤ 0.05 dB, both for 1310 nm and 1550 nm wavelength.

3.10.4 Impact Test:

Objective : The purpose of this test is to determine the ability of an opticalfibre cable to withstand impact.

Method : IEC 60794-1-21-E4.

Test Specs : The cable shall have sufficient strength to withstand an impact caused by a mass weight of 50 Newtons, when falls freely from a height of 0.5 meters. The radius R of the surface causing impact shall be 300 mm. Ten such impacts shall be applied on the cable at different places typically spaced not less than 500mm apart. The attenuation shall be noted before and after the completion of the test.

Requirement: The change in attenuation of the fibre after the test shall be ≤0.05 dB, both for 1310 nm and 1550 nm wavelengths.

3.10.5 Repeated Bending Test:

Objective : The purpose of this test is to determine the ability of an optical fibre cable to withstand repeated bending.

Method : IEC 60794-1-21-E6

Test Specs. : The cable sample shall be of sufficient length (5 m minimum) to permit radiant power measurements as required by this test. Longer lengths may be used, if required.

Parameters: Weight : 5 Kg or as per FOTP-104 whichever is higher

Minimum distance from Pulley centre to holding device : 216 mm

Minimum distance from Wt. to Pulley centre : 457 mm

Pulley Diameter : 20 D(D cable diameter)

Angle of Turning : 90°

No. of cycles : 30

Time Required for 30 cycles : 1 minute to 2 minute

Length of Cable sample : 5m (minimum)

Requirement : During the test no fibre shall break and the attenuation shall be noted before and after the completion of the test. The change in attenuation of the fibre after the test shall be $\leq$ 0.05 dB, both for1310 nm and 1550 nm wavelengths.

3.10.6 Torsion Test:

Object : The purpose of this test is to determine the ability of an optical fibre cable to withstand torsion.

Method : IEC 60794-1-21-E7.

Test Specs. : The length of the specimen under test shall be 2 meters and the load shall be 100 N. The sample shall be mounted in the test apparatus with cable clamped in the fixed clamp, sufficiently tight, to prevent the movement of cable sheath during the test. One end of the cable shall be fixed to the rotating clamp, which shall be rotated in a clockwise direction for one turn. The sample shall then be returned to the starting position and then rotated in an anti-clockwise direction for one turn and returned to the starting position. This complete movement constitutes one cycle. The cable shall withstand ten such complete cycles. The attenuation shall be noted before and after the completion of the test.

Requirement: The cable shall be examined physically for any cracks, tearing on the outer sheath and for the damage to other component parts of the cable. The twist mark shall not be taken as damage. The change in attenuation of the fibre after the test shall be $\leq$ 0.05 dB, both for 1310 nm and 1550 nm wavelengths.

3.10.7 Kink Test :

Objective : The purpose of this test is to verify whether kinking of an optical fibre cable results in breakage of any fibre, when a loop is formed of dimension small enough to induce a kink on the sheath.

Method : IEC 60794-1-21-E10.

Test Specs. : The sample length shall be 10 times the minimum bending radius of the cable. The sample is held in both hands, a loop is made of a bigger diameter and by stretching both the ends of the cable in opposite direction, the loop is made to the minimum bend radius, so that no kink shall form. After the cable comes in normal condition,attenuation reading is taken.

Requirement : The kink should disappear after the cable comes in normal condition. The change in attenuation of the fibre after test shall be $\leq$ 0.05 dB, both for 1310 nm & 1550 nm wavelengths.

3.10.8 Cable Bend Test:

Objective : The purpose of this test is to determine the ability of an optical fibre cable to withstand repeated flexing. The

procedure is designed to measure optical transmittance changes and requires an assessment of any damage occurring to other cable components.

Method : IEC 60794-1-21-E11 (Procedure-I).

Test Specs. : The fibre and the component parts of the cable shall not suffer permanent damage when the cable is repeatedly wrapped and unwrapped 4 complete turns of 10 complete cycles around a mandrel of 20 D, where D is the diameter of the cable. The attenuation shall be noted before and after the completion of the test.

Requirement : The change in attenuation of the fibre after the test shall be $\leq$ 0.05 dB, both for 1310 nm and 1550 nm wavelengths. Sheath shall not show any cracks visible to the naked eye, when examined whilst still wrapped on the mandrel.

3.10.9 Test of Figure of 8 (Eight) on the cable (Type Test):

Objective : Check of easiness in formation of figure of 8 of the cable during installation in the field.

Test Method : 1000 meter (approximate) of the cable shall be uncoiled from the cable reel and shall be arranged in figure of 8 (eight). The diameter of each loop of the figure of 8 shall be maximum 2 meters.

Requirement : It shall be possible to make figure of 8 of minimum 1000 meter length of the cable uncoiled from the cable reel, without any difficulty. No visible damage shall occur.

3.10.10 Temperature Cycling (Type Test) :

Objective : To determine the stability behavior of the attenuation of a cable subjected to temperature changes, which may occur during storage, transportation and usage.

Method : IEC 60794-1-22-F1 (To be tested on Standard cable length of drum i.e. 2 Km $\pm$ 5 %).

Test Specs. : The permissible temperature range for storage and operation will be from -20°C to +70°C. The rate of change of temperature during the test shall be 1°C per minute approx. The cable shall be subjected to temperature cycling for 12 Hrs. at each temperature as given below :

TA2 temp. : - 20°C.
TA1 temp. : - 10°C.
TB1 temp. : + 60°C.
TB2 temp. : + 70°C.

The test shall be conducted for 2 cycles at the above temperatures.

Requirement : The change in attenuation of the fibre under test shall be $\leq$0.05 dB, for 1310 nm and 1550 nm wavelengths for the entire range of temperature.

3.10.11 Cable Aging test (Type Test):

Objective : To check the cable material change dimensionally as the cable ages.

Method : IEC 60794-1-22-F9

Method : At the completion of temperature cycle test, the test cable shall be exposed to 85 $\pm$ 2 °C for 168 hours. The attenuation measurement at 1310 nm & 1550 nm wavelength to be made after stabilization of the test cable at ambient temperature for 24 hours.

Requirement : The increase in attenuation allowed is $\leq$ 0.05 dB at 1310 nm and 1550 nm .

Note : The attenuation changes are to be calculated with respect to the base line attenuation values measured at room temperature before temperature cycling.

3.10.12 Water Penetration Test (Type Test):

Objective : The aim of this test is to ensure that installed Optical Fibre cable will not allow the water passage along its length.

Method : IEC 60794-1-22-F5

Test Specs.: A circumferential portion of the cable end (with HDPE sheath, after removing the nylon jacket) shall face the water head. The water tight sleeve shall be applied over the cable. The cable shall be supported horizontally and two meter water head, containing sufficient quantity of water soluble fluorescent dye for the detection of seepage, shall be applied on the HDPE sheath for a period of seven days, at ambient temperature. No other colored dye is permitted.

Requirement : No dye shall be detected when the end of the 3 m length cable sample is examined with ultraviolet light detector.

3.10.13 Cable Jacket Yield Strength And Ultimate Elongation :

Objective: To check the yield strength and elongation of polyethylene (HDPE) cable sheath.

Test Method : FOTP-89 or ASTM D1248 Type III Class.

Test Condition :

1) Sample shall be taken from a completed cable (The nylon to be removed for this test). The aged sample shall be conditioned at 100 $\pm$ 2^0 C for 120 hours before testing.
2) The cross-head speed shall be 50 mm per minute.

Requirement :

Jacket Material	Minimum Yield Strength		Minimum Elongation (%)
	(MPa)	(psi)	
HDPE un-aged	16.5	2400	400
HDPE aged	12.4	1800	375

3.10.14 Ribbon Dimension Measurements test:

Objective: To check the fibres in ribbon structure, fibre cross over and fibre identity to ensure the transmission performance and the mechanical service life of the fibre in the ribbon structure.

Test method : IEC 60794-1-23-G2

Requirement: It shall meet the dimensional requirements given in clause no. 3.8.2 of this GR. The fibres in the entire length of the ribbon shall not cross over at any point.

3.10.15 Ribbon Resistance to Twist (Robustness) test:

Objective : To check the robustness of the fibre ribbons to withstand the twist in installed conditions and to check the structural integrity of the ribbon over the deployed length for mid-span entry, maintenance purposes, consideration in rearrangements and housekeeping.

Test method : Telcordia GR-20-CORE (issue 4, July 2013) / FOTP-141

Requirement : The un-aged and aged (at 85 $\pm$ 2 °C with uncontrolled humidity for a period of 30 days) completed ribbon shall not show any separation of individual fibres from the ribbon structure after completion of the twist test when observed under 5X magnification.

3.10.16 Ribbon Residual Twist (Flatness) test (Type Test) :

Objective : To check the dimensional integrity of the ribbon without twisting to allow rearrangements and to limit the potential attenuation increases due to a macro-bending caused by twisting of the fibre ribbon.

Test Method : Telcordia GR-20-CORE (issue 4, July 2013) / FOTP-131 / IEC 60794-1-308

Requirement : The aged (at 85º $\pm$ 2º C with uncontrolled humidity for a period of 30 days) ribbon residual twist (if any) shall have a pitch : $\geq$ 450 mm (or maximum 8 deg/cm residual twist).

3.10.17 Ribbon Separation Test :

Objective :

a) To check the separation of individual fibres, separation of sub-unit of fibres and mid span separation from a fibre ribbon.

b) To check the retention of sufficient colorant for identification for any 2.5 cm length of fibre after separation for individual and sub-unit of fibres.

Test Method: IEC 60794-1-305

Test to be conducted for :

a) Separation of any single fibre or a multi-fibre subgroup by a tool or by hand from a ribbon for a length of 1 meter. Mid span separation from a 2 meter sample, separated close to middle for at least 0.5 meter (both single fibre and the six fibre sub – units) for un-aged ribbon.

Requirement : The un-aged ribbon of minimum length of a 0.3 meter (1.0 foot) of an individual fibre and a sub group of six fibres shall be separated from the ribbon without breaking the fibres or damaging the fibre coating. The force required to perform separation shall not exceed 4.4 N. The area at the separation shall not show any damage to the fibre coating when examined under 5X magnification.

b) Retention of the Colour and Fibre Identification after separation.

Requirement : Individual fibre colour identification shall be maintained after the separation test. It shall retain sufficient colorant that any 2.5 cm length is readily identifiable.

c) Removal of Ribbon matrix material to access individual fibres.

Requirement : No damage shall occur either to fibre coating or the fibres. The coating shall not sustain any swelling self-stripping, cracking or

splitting when examined under 5X magnification.

Note: The manufacturer shall recommend the procedure for the removal of ribbon matrix.

3.10.18 Ribbon Stripability Test (Type Test) :

Objective : Check of removal of the matrix material and the fibres protective coating mechanically with commercial stripping tools from un-aged and aged ribbons.

Test Method : IEC 60794-1-310-G10B

Pre Conditioning:

a. **Aged samples :** The humidity of aged ribbons shall be soaked at 85 ± 2°C and a non-condensing humidity of 85 ± 5% for a period of 30 days.
b. **Water aged samples:** The water aged ribbons shall be soaked in de-ionized or distilled water at a temperature of 23 ± 5°C for a period of 14 days.

The fibre ribbon strip-ability testing shall be conducted at standard atmospheric conditions. The un-aged, humidity – aged, and water aged ribbons shall be tested within eight hours after aging.

Requirement : There shall be no fibre breakage, and any coating residue shall be removable with a single isopropyl alcohol wipe when at least 25 mm of the matrix material and the fibre Protective coating is mechanically removed with commercial stripling tools from un-aged and aged ribbons.

4.17 3.10.19 Ribbon bend Test

Objective : To check the bend performance of a ribbon.

Test Method: IEC 60794-1-301

Method : One hundred turns of ribbon are wound around a 60 mm diameter ribbon and the loss increase at 1310 nm & 1550 nm shall be measured.

Requirement : The change in attenuation of the fibre shall be $\leq$ 0.05 dB, for 1310 nm and 1550 nm wavelengths.

3.10.20 Torsion Resistance of the ribbon test (Type test) :

Objective : To check the torsion resistance of the ribbon.

Test Method: IEC 60794-1-31, IEC 60794-1-306

Method : One meter length of ribbon is twisted to through five revolutions of 360° and measurement is taken.

Requirement : The change in attenuation of the fibre shall be $\leq$ 0.05 dB, for 1310 nm and 1550 nm wavelengths.

3.10.21 Crush Resistance of Ribbon (Type Test) :

Objective : To check the crush resistance of the ribbon.

Method : A 50 mm^2 sample is subjected to a load of 500 N and the attenuation measurement taken for both 1310 nm & 1550 nm wave lengths.

Requirement : The change in attenuation of the fibre shall be $\leq$ 0.05 dB, for 1310 nm and 1550 nm wavelengths.

3.10.22 Check of the quality of the loose tube (containing optical fibre ribbon) (Type Test) :

a. **Embrittlement Test of Loose Tube**

This test method is based on bending by compression and reflects embrittlement much better than the other tensile tests. This test is independent of wall thickness of the loose tube.

Sample: The minimum length of the test sample depends on the outside diameter of the loose tube and should be 85 mm for tubes up to 2.5 mm outside dia. The length of the bigger tubes should be calculated by using the following equation:

$$Lo > 100 \times \sqrt{\frac{(D^2 + d^2)}{4}}$$

Where Lo = Length of tube under test.

D = Outside dia of loose tube.

d = Inside dia of loose tube.

Procedure. : Both the ends of a buffer tube test sample may be mounted in a tool, which is clamped in jaws of a tensile machine which exerts a constant rate of movement. The movable jaw may move at a rate of 50 mm per minute toward the fixed jaw. Under load, the tube will bend so that it is subjected to tensile and compressive stresses. The fixture for holding the tube should be designed in a manner that the tube might

bend in all directions without further loading.

Requirement : The tube should not get embrittled. No kink should appear on the tube up to the safe bend diameter of tube (15 D), where D is the outside diameter of the loose tube. There should also not be any physical damage or mark on the tube surface.

b. **Kink Resistance Test on the Loose Tube**

Objective: To safeguard the delicate optical fibres, the quality of the loose tube material should be such that no kink or damage to the tube occur while it is being handled during installation and in splicing operations.

Method: IEC 60794-1-23-G7

Procedure: To check the kink resistance of the loose tube, a longer length of the loose tube is taken (with fibre and gel), a loop is made and loop is reduced to the minimum bend radius of loose tube i.e. 15 D (where D is the outside diameter of the loose tube). This test is to be repeated 4 times on the same sample length of the loose tube.

Requirement : No damage or kink should appear on the surface of the tube.

3.10.23 Drainage Test for loose Tube and Drip test on the cable (Type Test):

a. **Drainage Test for loose tube**

Sample Size : 30 cm tube length.

Test procedure :

1. Cut the tube length to 40 cm.
2. Fill the tube with the tube filling gel ensuring that there are no air bubbles and the tube is completely full.
3. Place the filled tube in a horizontal position on a clean worktop and cut 5 cm from either end so that the finished length of the sample is 30 cm.
4. Leave the filled tube in a horizontal position at an ambient temperature for 24 hrs.
5. The sample tube is then suspended vertically in an environment heat oven over a weighed beaker. It is left in the oven at a temperature of 70° C for a period of 24 Hrs.
6. At the end of the 24 hrs period the beaker is checked and weighed to see if there is any gel in the beaker.

Requirement :

1. If there is no gel or oil in the beaker the tube has PASSED the drainage test.
2. If there is gel or oil in the beaker the tube has FAILED the drainage test.

b. New Clause: Drip test on the cable

Objective: The purpose of this test is to determine the ability of jelly in the Optical Fibre cable to withstand a temperature of 70°C.

Method: IEC 60794-1-22-F16

Test Specs.: Take a sample of 30 cm length of the cable with one end sealed by end cap. Remove outer black sheath, binder tapes for 5 cm from open end of the sample. Then the sample is kept vertically with open end downwards in the oven for 24 hours at 70°C with a paper under the sample.

Requirement: Examine the paper placed below the cable inside the oven for dripping of the jelly after 24 hours. There should be no jelly drip or oily impression on the paper.

3.10.24 Check of easy removal of sheath:

Objective: Check of the easy removal of sheath of the optical fibre cable by using normal sheath removal tool.

Procedure: To check easy removal, the sheath shall be cut in circular way and the about 300 mm length of the sheath should be removed in one operation. It should be observed during sheath removal process that no undue extra force is applied and no component part of the cable is damaged. One should be able to remove the sheath easily.

Note : - Easy removal of both the outer jacket and the inner sheath shall be checked separately.

3.10.25 Check of the effect of aggressive media on the cable (Type Test):

Procedure: To check the effect of aggressive media, solution of PH4 and PH10 shall be made. The two test samples of the finished cable, each of 600 mm in length, are taken and the ends of the samples are sealed. These test samples are put in the PH4 and PH10 solutions separately. After 30 days these samples are taken out from the solutions and examined for any corrosion etc on the sheath and other markings of the cables. (Test method no. ISO175).

Requirement : The sample should not show any effect of these solution on the sheath and other marking of the cable.

New Clause: Flexural Rigidity Test on the optical fibre cable (Type Test):

Objective: To check the Flexural Rigidity of the optical fibre cable.

Method: To be tested as per ASTM D –790

Test Specs: The fibre and the component parts of the cable shall not suffer permanent damage in the cable subjected to Flexural Rigidity Test as per the above method. The attenuation shall be noted after and before the completion of the test.

Requirement: The change in attenuation of the fibre after the test shall be ≤ 0.05 dB at both 1310 nm and 1550 nm wavelengths. The sheath shall not show any cracks visible to the naked eye.

New Clause:Static Bend test (Type Test):

Objective: To check the cable under Static bend.

Method: As per the clause no 4.8 of the GR alternatively as per ASTM D 790.

Test Specs: The cable shall be subjected to static bend test. The optical fibre cable shall be bend on a mandrel having a Diameter of 10 D (D is diameter of the cable).

Requirement: The change in attenuation of the fibre after the test shall be ≤ 0.05 dB for both 1310 nm and 1550 nm wavelengths. Sheath shall not show any cracks visible to the naked eye when examined whilst still wrapped on the mandrel.

4.0 Engineering requirements:

4.1 Cable Marking :

4.1.1 A long lasting suitable marking shall be applied in order to identify this cable from other cables. The cable marking shall be imprinted (indented). The marking on the cable shall be indelible of durable quality and at regular intervals of one meter length. The accuracy of the sequential marking must be within -0.25% to +0.5% of the actual measured length. The sequential length markings on the cable must not rub off during normal installation and in life time of optical fibre cable. The total length of the cable supplied shall not be in negative tolerance.

4.1.2 The marking shall be in black colour over the orange colour nylon jacket and shall be done by hot foil indentation method. It must clearly contrast with the surface. The colour used must withstand the environmental influences experienced in the field.

4.1.3 The type of legend marking on O.F. cable shall be as follows :

a) Company Legend
b) Legend containing telephone mark & international acceptable Laser symbol
c) Type of cable “Ribbon Loose Tube’’
d) Type of Fibres G.652 D / G.657 A1
e) Number of Fibres
f) Year of manufacture
g) Sequential length marking
h) User’s identification
i) Cable ID

4.2 Cable Ends:

4.2.1 Both cable ends (the beginning end and end of the cable reel) shall be sealed and readily accessible. Minimum 5 meter of the cable of the beginning end of the reel shall be accessible for testing. Both ends of the cable shall be kept inside the drums and shall be located so as to be easily accessible for the test. The drum (conforming to GR No. G/CBD-01/02. NOV 94 or latest release and subsequent amendments issued, if any) should be marked to identify the direction of rotation of the drum. Both ends of cable shall be provided with cable pulling (grip) stocking and the anti twist device (free head hook). The diameter of the cable shall also be marked on the cable drum. The wooden drum shall be properly treated against termites and other insects during transportation and storage. The manufacturer shall submit the methodology used for the same.

4.2.2 An anti-twist device (Free head hook) shall be provided attached to the front end of the cable pulling arrangement. The arrangement of the pulling eye and its coupling system, along with the anti twist system, shall withstand the prescribed tensile load applicable to the cable.

4.3 The nominal drum length:

4.3.1 Length of OF Cable in each drum shall be 2 Km / 4Km / 8Km and shall be supplied as per the order. The variation in length of optical fibre cable, in each drum shall be ± 5% to ± 10%, as decided by the purchaser. Purchaser may at their discretion procure shorter length cable drum as per their requirement.

4.3.2 The fibres in cable length shall not have any joint.

4.3.3 The drum shall be marked with arrows to indicate the direction of rotation.

4.3.4 Packing list supplied with each drum shall have at least the following information:

a) Drum No.

b) Type of cable

c) Physical Cable length

d) No. of fibres

e) Length of each fibre as measured by OTDR

f) The Cable factor - ratio of fibre / cable length

g) Attenuation per Km. of each fibre at 1310 nm & 1550 nm

h) User's / Consignee's Name

i) Manufacturer's Name, Month, Year and Batch No.

j) Group refractive index of fibres

k) Purchase Order No

l) Cable ID

4.4 Colour coding and Ribbon identification in O.F. Cables :

4.4.1 The colorant applied to individual fibres shall be readily identifiable throughout the life time of the cable and shall match and conform to the MUNSELL color standards (EIA-598-D) or IEC Publication 304 (4).

4.4.2 Colour Coding Scheme :

When the loose tubes are placed in circular format, the blue coloured loose tube is to be considered loose tube no. "1 followed by loose tube no.2 of orange and so on for other tubes as per the colour scheme given below at Table-1 and complete the circular format by placing the dummy /fillers at the end.

Table -1 : Colour Coding scheme of Loose tube

Loose tube No./Sequence	Loose tube identification
1	Blue
2	Orange
3	Green
4	Brown

5	Slate
6	White
7	Red
8	Black
9	Yellow
10	Violet
11	Rose/Pink
12	Aqua

Depending upon the number of fibres in a Ribbon (which depends on the cable capacity), the colour of the fibres within each Ribbon are serially chosen starting from blue colour as per the colour scheme given below at Table-2.

Table-2: Colour Coding scheme of the Optical Fibre within Ribbon

Fiber No./Sequence within Ribbon	Fibre Identification
1	Blue
2	Orange
3	Green
4	Brown
5	Slate
6	White
7	Red
8	Black
9	Yellow
10	Violet
11	Rose/Pink
12	Aqua

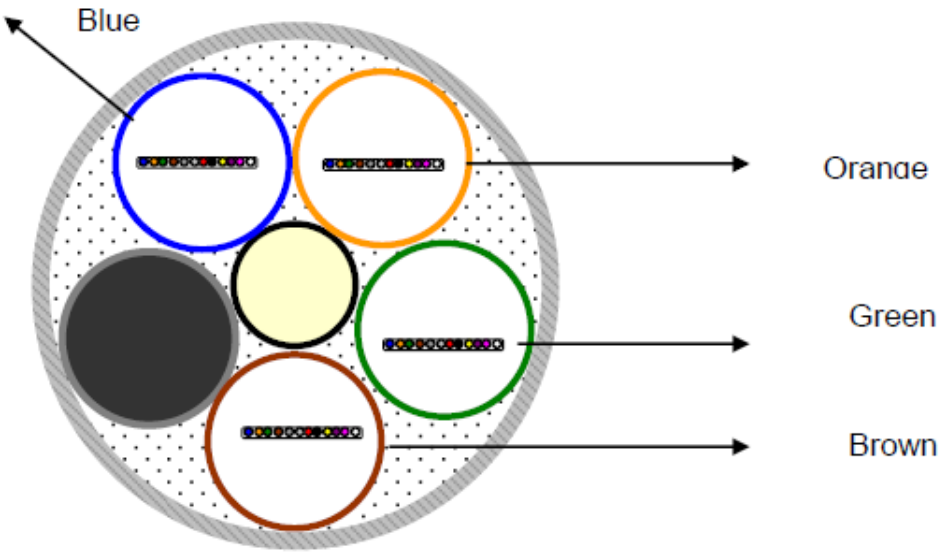
4.4.3 Identification of Ribbon :

No. of fibres in a cable	No. of Tubes	No. of Ribbons per Tube	Fiber Per Ribbon	Marking on Ribbon
48Fibres	Four	One	6	1 RIBBON 1
96 Fibres	Five	2 tubes with 1 ribbon per tube 3 tubes with 2 ribbon per tube	6	1 RIBBON 1 1 RIBBON 1 2 RIBBON 2
144 Fibres	Six	Two	6	1 RIBBON 1 2 RIBBON 2
288 Fibres	Six	Four	6	1 RIBBON 1 2 RIBBON 2 3 RIBBON 3 4 RIBBON 4
576 Fibres	Eight	Six	6	1 RIBBON 1 2 RIBBON 2 3 RIBBON 3 4 RIBBON 4 5 RIBBON 5 6 RIBBON 6

Note :

1. In case of 96 Fibre cable, Loose tube No. 1 & 2 shall have 1 ribbon per tube and Loose tube No. 3, 4 & 5 shall have 2 ribbons per tube.
2. The individual number marking shall be at regular interval of every 300 mm on natural color ribbon and shall be legible. The printing on the ribbon shall also be of durable quality and shall be compatible with coating of the ribbon and Thixotropic Jelly (filled in the loose tube of the cable).

Color coding of Loose tubes for 4 Ribbons (48 fibres) (Refer Table-1)



(Loose Tube Colour: Blue, Orange, Green and Brown)

5.0 Quality Requirements :

5.1 The cable shall be manufactured in accordance with the international quality standards ISO 9001-2015 or latest issue for which the manufacturer should be duly accredited. The Quality Manual shall be submitted by the manufacturer.

5.2 Raw Material:

5.2.1 The cable shall use the raw materials approved against the Standard No. TEC 89010:2021(or latest release) and the subsequent amendments issued, if any.The list and details of the Raw Materials used, the make and grade of the raw material and valid certificate of source approval issued by CACT or any Conformity Assessment Body(CAB) recognized by TEC, shall be submitted by the manufacturer.

5.2.2 Any other material used, shall be clearly indicated by the manufacturer. The detailed technical specifications of such raw materials used shall be furnished

by the manufacturer at the time of evaluation/testing.

5.2.3 The raw materials used from multiple sources is permitted. The source / sources of raw materials (Type and grade) from where these have been procured shall be submitted by the manufacturer.

5.2.4 The manufacturer can change the raw material from one approved source to other approved source with the approval of QA, wing of purchaser . The change of source/grade of SM Optical Fibre / Ribbon and / or design shall call for fresh type approval/certification. The clauses 9.2 and 9.3 of this Standard for GR shall facilitate the clause 5.2.4 of this Standard for GR, in order to simplify the certification process and to avoid repetitive testing.

5.2.5 The HDPE, Black in colour, used for sheath shall be UV stabilized.

Note: A test certificate from CACT or from any Conformity Assessment Body(CAB) recognized by TEC may be acceptable for the UV stability of the HDPE sheath material. Source Approval Certificate (SAC) issued by CACT against Standard No. TEC 89010:2021(or latest release) for the HDPE raw material used, indicating UV stabilized grade, may also be acceptable in this respect.

5.2.6 The material used in optical fibre cable must not evolve hydrogen that will affect the characteristics of optical fibres.

Note: A test certificate from a recognized laboratory or institute may be acceptable.

5.3 Cable Material Compatibility:

Optical fibre, buffers/core tubes, and other core components shall meet the requirements of the compatibility with buffer/core tube filling material(s) and/or water-blocking materials that are in direct contact with identified components

within the cable structure as per clause no. 6.3.3 of Telecordia document GR-20-CORE issue 4, July 2013 or as per IEC 60794-1-219.

Note : The tests may be conducted in house (if facility exist) or may be conducted at CACT or any other recognized laboratory. The test certificate may be accepted and the tests may not be repeated subsequently, in next type approvals, if the raw material used is of same make and grade.

6.0 Safety Requirement:

6.1 The material used in the manufacturing of the High count Metal free optical fibre cable (ribbon type) shall be non toxic and dermatologically safe in its life time and shall not be hazardous to health. The manufacturer shall submit MSDS (Material safety Data Sheet) for all the material used in manufacturing of optical fibre cable to substantiate the statement.

Note: Latest issue of the Standards mentioned in the GR, may be referred.

CHAPTER - 2

7.0 Documentation:

7.1 Complete technical literature in English with detailed cable construction diagram of various sub-components with dimensions, weight & test data and other details of the cable shall be provided.

7.2 All aspects of cable installation, operation, maintenance and fibre splicing shall also be covered in the handbook. The pictorial diagrams of the accessories (with model no. and manufacturer name) supplied along with the cable as package shall also be submitted. A hard as well as soft copy of the manuals shall be provided.

8.0 New clause:Information for the Procurer/User:

9.1 It is suggested that the Optical fibre cable used/deployed in a particular route is manufactured from a single source of optical fibres.

8.2 User shall check for compatibility issues that may arise because of different fibre types and MFD mismatch.

9.0 New Clause: Procedure for issue of Approval Certificate:

9.1 The approval certificate against this Standard for GR shall be issued subsequent to successful testing against the clauses of this Standard.

9.2 Single Mode Optical Fibre used in manufacturing optical fibre cables shall be as per ITU-T Rec. G.652 D or G.657 A1. The manufacturer having a valid approval certificate against this Standard for GR for cable of specific fibre count and specific fibre type, may also seek approval certificate for cable having same fibre count but different fibre type, provided the manufacturer gets testing done for all corresponding and concerned parameters. This will

be applicable when there is change only in the fibre type while all other cable design parameters and fibre count remain the same.

9.3 The manufacturer having valid approval certificate against this Standard for GR for cable with higher fibre count and specific fibre type, may seek approval certificate for cable with lower fibre count without conducting actual tests, provided that all cable design parameters including the fibre type being same.

9.4 The clauses 9.2 and 9.3 shall be read in conjunction with the clause 5.2.4.

ANNEXURE – I

The following parameters of the component of the cable are to be taken into account while designing and manufacturing the optical fiber cables of the required fiber count. These parameters shall be checked during evaluation of the OF Cables.

SN	Parameter	Unit	48 Fiber OF Cable	96 Fiber OF Cable	144 Fiber OF Cable	288 Fiber OF Cable	576 Fiber OF Cable
1	FRP Rod EAA coated	mm	3.5+0.1/-0.0	3.5+0.1/-0.0	3.5+0.1/-0.0	3.5+0.1/-0.0	3.5+0.1/-0.0
2	FRP up jacketing thickness	mm	0	0	0.7	1.5	3.8
3	Tube ID (min)	mm	3.9	3.9	3.9	5.1	5.4
4	Tube OD	mm	5.0 ±0.1	5.0 ± 0.1	5.0 ± 0.1	6.4 ±0.1	6.7 ±0.1
5	No. of Ribbons / tube	No	1	2 tubes with 1 ribbon/tube and 3 tubes with 2 ribbon/tube	2	4	6
6	No of loose tubes	No	4	5	6	6	8
7	No of dummy	No	1	0	0	6 thin dummies in the interstices	8 thin dummies in the interstices
8	Tube stranding lay over length	mm	>200	>200	>200	>300	>300

9	Cable diameter	mm	19 ±0.5	19 ± 0.5	20.5± 0.5	24 ±1	30 ± 1
10	Nominal cable weight	Kg/km	280	280	340	525	740
11	Cable to be designed to fiber strain value	%	0.1	0.1	0.1	0.1	0.1
12	Cable to be tested at defined load for fiber strain value of	%	0.25	0.25	0.25	0.25	0.25

Note: The manufacturer shall submit the design calculations which shall be cross checked.

LIST OF ABBREVIATIONS

ASTM	-	American Society for Testing and Materials
BIS	-	Bureau of Indian Standards
CAB	-	Conformity Assessment Body
CACT	-	Component Approval Centre For Telecommunications
dB	-	decible
EIA	-	Electronic Industry Association
ESCR	-	Environmental Stress Crack Resistance
FOTP	-	Fibre Optic Test Procedure
FRP	-	Fibre Reinforced Plastic
HDPE	-	High Density Polyethylene
IEC	-	International Electro -Technical Commission
IS	-	Indian Standards
ISO	-	International Standard Organisations
ITU-T	-	International Telecommunication Union – Telecommunication Standardisation Sector
KV	-	Kilo Volt
MFD	-	Mode Field Diameter
MSDS	-	Material Safety Data Sheet
N	-	Newton
OF	-	Optical Fibre
OTDR	-	Optical Time Domain Reflectometer
QA	-	Quality Assurance
QM	-	Quality Manual
SM	-	Single Mode
TEC	-	Telecommunication Engineering Centre
UV	-	Ultra Violet
µm	-	micrometer
°C	-	Degree Celsius
