Comments on draft standard (Draft Standard No. TEC 85140:2025)

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 85140:2025) may be provided in the above format vide email to **dirt2-tec-dot@gov.in** , **adet-tx-tec-dot@gov.in** and **ratx.tec-dot@nic.in**

Annexure-I

वर्गीय आवश्यकताओं के लिए मानक

सं: टीईसी ८५१४०:२०२५

(सं: जीआर/ओएफसी-१७/०१. जून २००७ को अधिक्रमित करता है)

STANDARD FOR GENERIC REQUIREMENTS

No.: TEC 85140:2025(Initial Draft)

(Supersedes No.: GR/OFC-17/01. JUN 2007)

धातु मुक्त ऑप्टिकल फाइबर केबल

METAL FREE OPTICAL FIBRE CABLE

ISO9001:2015

दूरसंचार अभियांत्रिकी केंद्र

खुर्शीदलाल भवन, जनपथ, नई दिल्ली-११०००१, भारत

TELECOMMUNICATION ENGINEERING CENTRE

KHURSHIDLAL BHAWAN, JANPATH, NEW DELHI–110001, INDIA

www.tec.gov.in

Release 2: …….,2025

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 Metal free Optical fibre cable for underground installation in ducts.

CONTENTS

HISTORY SHEET

Sl. No	*Standard / Document No.*	*Title*	*Remarks*
1.	GR/OFC - 17/01. JUN 2007	Metal Free Optical Fibre Cable (G.652 D Fibre)	1st release
2.	Standard No. TEC 85140:2025	Standard for Generic Requirements of Metal Free Optical Fibre Cable	2nd release

REFERENCES

Sl. No	*Document No.*	*Title/Document Name*
1.	TEC 87060:2024	Standard for Generic Requirements of Installation Accessories & Fixture For Self Supporting Metal Free Aerial Optical Fibre Cable
2.	TEC 89060:2006	Standard for Generic Requirements of Tools For Installation & Operating the OFC & for Assembly of the Optical Fibre Splice Closures
3.	TEC 87080:2025	Standard for Generic Requirements of Splice Closure for Optical Fibre Cables
4.	TEC 89020:2011	Standard for Generic Requirements of Specification Protection Sleeve Optical Fibre (Type-I & Type-II)
	TEC 89030:2011	Standard for Generic Requirements of Splice Protection Sleeves for Ribbon Optical Fibre
5.	TEC 89010:2021	Standard for Generic Requirements of Raw Material for manufacturing of Optical Fibre Cable.
6.	G/CBD-01/02. NOV 94	Generic Requirements of Wooden Cable Drum for Telecom Cables
7.	QM 333 (or TEC 14016:2010) {Latest issue}	Specification for Environmental testing of electronic equipment for transmission and switching use.
8.	ITU-T G. 652, G.657	ITU-T Recommendations
9.	GR-20 –CORE July 98	Generic Requirement for optical

		Fibre cable (Telcordia document)
10.	ISO 9001:2015 or latest issue	International Quality Management System.
11.	EIA 598-D IEC Publication 304(4)	Color Standards
12.	IEC 811-5-1, 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-F9, IEC 60794-1-22-F5, IEC 60794-1-23-G7, IEC 60794-1-403, IEC 60794-1-22-F16, IEC 60794-1-219, IEC 62230	Test Methods
13.	FOTP-89	Test Methods
14.	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 Metal free Optical fibre cable (multi loose tube construction design) for underground installation in ducts. The optical fibre cable shall be suitably protected for the ingress of moisture by suitable water blocking materials. The raw material used in the cable shall meet the requirements of the Standard for GR for raw materials (Standard No TEC 89010:2021 or latest release and subsequent amendments, if any.).

2.0 Functional Requirements :

2.1 The design and construction of metal free optical fibre cable shall be inherently robust and rigid under all conditions of operation, installation, adjustment, replacement, storage and transport.

2.2 The 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 metal free optical fibre cable with tools as per Standard No TEC 89060:2006 (or latest release) and subsequent amendments, if any. If any special tool is required for operating and handling this optical fibre cable, the same shall be provided along with the cable.

2.5 The metal free optical fibre cable supplied shall be suitable and compatible to match with the dimensions, fixing, terminating & splicing arrangement of the splice closure & vice versa. The cable supplied shall also meet other requirement of splice closure as per Standard No TEC 87080:2025 (latest release) and subsequent amendments, if any.

2.6 The manufacturer shall submit an undertaking that the optical and mechanical fibre characteristics shall not change during the life time of the cable against the manufacturing defects.

2.7 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 Optical Fibres :

Single Mode Optical Fibre used in manufacturing optical fibre cables shall be as per ITU-T Rec. G. 652 D and G. 657 A1. The specifications 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)

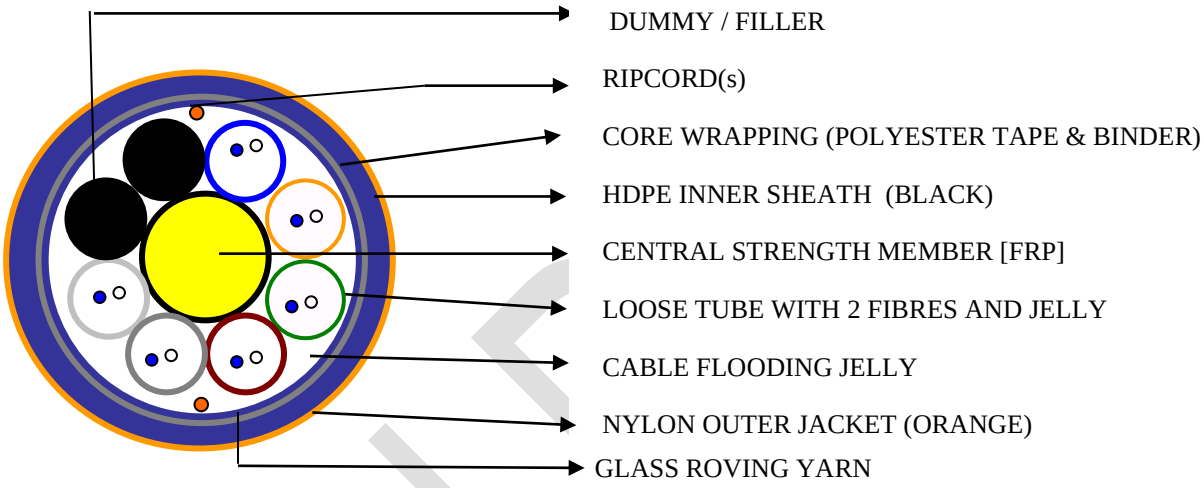
3.7 Colour Qualification and Primary coating Test :

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 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.

TYPICAL STRUCTURAL DRAWING FOR 12 FIBRE OF CABLE



3.8.1 Secondary Protection :

The coated fibres shall be protected by loose packaging within a tube, which shall be filled with thixotropic jelly. The tube dimensions shall be as per Annexure – I

3.8.2 Number of fibres : 6,12,24 or 48

(Type approval for a cable shall be issued depending upon the no. of fibres in the cable)

3.8.3 Strength Member :

3.8.3.1 **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 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.

3.8.4 **Cable Core Assembly :**

The primary coated fibres in loose tubes, stranded together around a central strength member (solid FRP rod) using helical or reverse lay techniques, shall form the cable core. The dimension of FRP and stranding pitch shall be as per annexure -I.

3.8.5 **Core Wrapping:** The main cable core shall be wrapped by a layer/layers of Polyester foil/tape. The Polyester foil/ tape shall be as per Section-X of Standard No. TEC 89010:2021(or latest release) and the subsequent amendments, if any. The Nylon/polyester binder thread shall be used to hold the 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 adhere to the secondary fibre coating and shall not leave any kink marks over the loose tubes.

3.8.6 **Moisture barrier (protection)**: The main cable core (containing Tube/FRP & Core wrapping) shall be protected by thixotrophic flooding compound (Jelly) having properties of non hygroscopic dielectric material.

3.8.7 **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.

3.8.8 Glass Reinforcement:

Impregnated Glass Fibre Reinforcement are used to achieve the required tensile strength of the optical fibre cables over the cable core to provide peripheral reinforcement along with Solid Rigid FRP Rod in the centre of cable core. These flexible strength members shall be of water blocking type. The use of Solid Rigid FRP Rod(s) is mandatory in Optical Fibre cable design. Impregnated Glass Fibre Reinforcement used shall be equally distributed over the periphery of the cable core. The quantity of the Impregnated Glass Fibre Reinforcement used per km length of the cable along with its dimensions shall be as per Annexure – I. . The specification of the glass roving shall be as per as per Section XII of TEC 89010:2021(or latest release) and the subsequent amendments, if any and as per other details given in the Annexure –I.

3.8.9 Inner 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 color (UV stabilized). Thickness of the sheath shall be uniform and shall not be less than 1.8 mm. The sheath shall be circular, Smooth, free from pin holes, joints, mended pieces and other defects. 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. i) Density

ii) Melt Flow Index

iii) Carbon Black Content

iv) Carbon Black Dispersion

v) ESCR

vi) Moisture Content

vii) Tensile Strength and Elongation at break

viii) Oxidative Induction time

ix) Absorption Coefficient

x) Brittleness Temperature

3.8.10 Outer Jacket (Sheath) :

A circular sheath/Jacket of not less than 0.65 mm thick of Polyamide-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.

3.8.11 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.

3.8.12 Cable diameter : The finished cable diameter shall be as per Annexure –I.

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

4.0 Mechanical Characteristics and Tests on Optical Fibre Cable :

4.1 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.

Test 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 2670 N whichever is higher (where W-mass of 1 Km of cable in Kg). The load shall be sustained for 10 minutes and the strain on the fibre and the attenuation shall be monitored.

Requirements : The load shall not produce a strain exceeding 0.25% in the fiber 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 fiber after the test shall be $\leq$ 0.05 dB both for 1310nm & 1550 nm wavelengths.

4.2 Abrasion Test :

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

Test Method : IEC-60794-1-21-E2

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.).

Test Specs : No. of cycles : 100

Duration : One minute (Nominal)

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

4.3 Crush Test (Compressive test):

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

Test Method : IEC-60794-1-21-E3.

Test Specs : The fibers and component part of the cable shall not suffer permanent damage when subjected to a compressive load of 2000 N applied, between the plates of dimension 100 X 100 mm. The load shall be applied for 60 Seconds. The attenuation shall be noted before/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 1310nm and 1550nm wavelengths.

4.4 Impact Test :

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

Test 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 Newton, when falls freely from a height of 0.5 meters. The radius `R' of the surface causing impact shall be 300 mm. 10 such impacts shall be applied on 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 $\leq$ 0.05 dB, both for 1310nm and 1550nm wavelengths.

4.5 Repeated Bending Test :

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

Test 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 length may be used, if required.

Parameters :

a) Weight : 5 Kg or as per FOTP-104

whichever is higher

b) Minimum distance from Pulley centre to holding device : 216 mm

c) Minimum distance from Wt. to Pulley centre : 457 mm

d) Pulley Diameter. : 20 D (D - cable diameter)

e) Angle of Turning : 90°

f) No. of cycles : 30

g) Time Required for 30 cycles : 1 minute to 2 minutes

h) Length of Cable sample : 5m (minimum)

Requirement : During the test no fiber 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 less ≤ 0.05 dB, both for 1310 and 1550nm wavelengths.

4.6 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 clock wise direction for one turn. The sample shall then be returned to the starting position and then rotated in an anti-clock wise 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 ports 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 wave lengths.

4.7 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 60974-1-21-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, the 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.

4.8 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. The sheath shall not show any cracks visible to the naked eye, when examined whilst still wrapped on the mandrel.

4.9 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 ± 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, both for 1310 nm and 1550 nm wavelengths for the entire temperature range.

4.10 Cable aging Test (Type Test) :

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

Method : IEC 60794-1-22-F9

Test Specs : 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 & 1550 nm wave length to be made after

stabilization of the test cable at ambient temperature for 24 hours.

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

4.11 Water Penetration Test (Type Test) :

Objective : The aim of this test is to ensure that installed jelly filled Metal Free Optical Fibre cable will not allow 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 7 (seven) days, at ambient temperature. No other coloured dye is permitted.

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

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

Objective : To check the Flexural Rigidity of the metal free 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 when 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 $\leq$ 0.05 dB, both for 1310 nm and 1550 nm wavelength. The sheath shall not show any cracks visible to the naked eye.

4.13 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 of the cable shall be uncoiled from the cable reel and shall be arranged in figure of 8 (eight) shape. The dimensions 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 meters of the cable uncoiled from the cable reel, without any difficulty. No visible damage shall occur.

4.14 Static Bend test (Type Test) :

Objective : To check the cable under Static bend

Method : As per the clause no 4.8 of the GR or alternatively as per ASTM D790.

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 $\leq$ 0.05 dB both for 1310 nm and 1550 nm wavelength. Sheath shall not show any cracks visible the naked eye when examined whilst still wrapped on the mandrel.

4.16 Cable Sheath 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 :

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

4.17 To check of the quality of the loose tube (containing optical fibre) (Type Test) :

a. Embrittlement Test method

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 upto 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 method :

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 out side dia. 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.

4.18 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 :

i. Cut the tube length to 40 cm.
ii. Fill the tube with the tube filling gel ensuring that there are no air bubbles and the tube is completely full.
iii. 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.
iv. Leave the filled tube in a horizontal position at an ambient temperature for 24 hrs.
v. 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.
vi. 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 :

i. If there is no gel or oil in the beaker the tube has PASSED the drainage test.
ii. 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 O.F. 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 jacket, binder tapes for 5 cm from open end of the sample. Clean the jelly. Then the sample is kept vertically with open end downwards in the oven for 24 hours at 70o 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.

4.19 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.

4.20 Check of Effect of aggressive media on the cable surface (Acidic and alkaline behavior) (Type Test) :

Procedure : To check the effect of aggressive media, solution of PH4 and

PH10 shall are 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.

5.0 Engineering Requirements :

5.1 Cable Marking :

5.1.1 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 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.

5.1.2 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:

5.1.3 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 Fibre – G.652 D/ G.657 A 1

d) Type of cable

e) Number of Fibres

f) Year of manufacture

g) Sequential length marking

h) User's identification

i) Cable ID

5.2 **Cable Ends:**

5.2.1 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 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 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 wooden drums shall be properly treated against termites and other insects during transportation and storage. The manufacturer shall submit the methodology used for the same.

5.2.2 An anti twist device (Free head hook) shall be provided attached to the both the ends 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.

5.3 **The nominal drum length:**

5.3.1 Length of OF Cable in each drum shall be 2 Km / 4Km / 8Km / 10Km . 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.

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

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

5.3.4 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 & 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

5.4 Colour coding in the OF Cable :

5.4.1 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 (For EIA standard EIA-598-D) or IEC Publication 304 (4).

5.4.2 Colour Coding Scheme :

When the loose tubes are placed in circular format, the marking to indicate the loose tube no. "1" shall be in blue colour 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

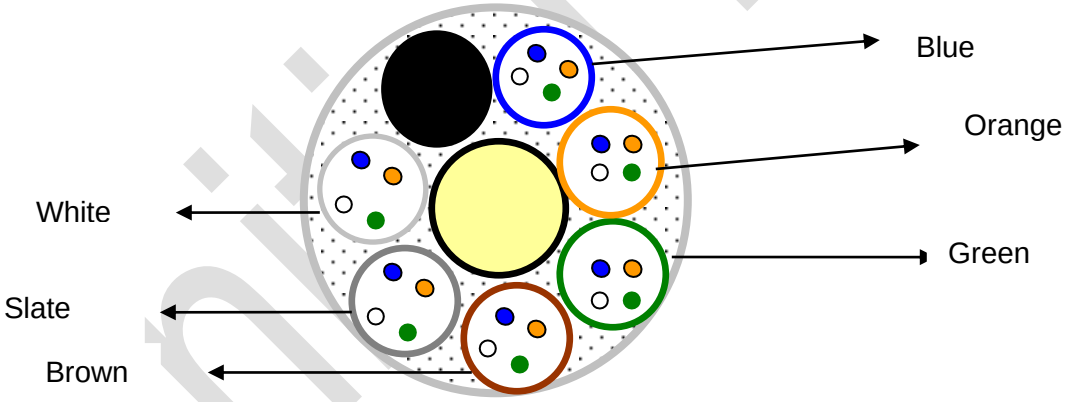
Loose tube No./Sequence	Loose tube identification
1	Blue
2	Orange
3	Green
4	Brown
5	Slate
6	White
7	Red
8	Black
9	Yellow
10	Violet
11	Rose/Pink
12	Aqua

Depending upon the number of fibres in a loose tube (which depends on the cable capacity), the fibres within each loose tube are serially chosen starting from blue colour as per the colour scheme given below at Table-2 . Last one of the fibres in a tube shall be of natural color, while the rest of fibres are colored.

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

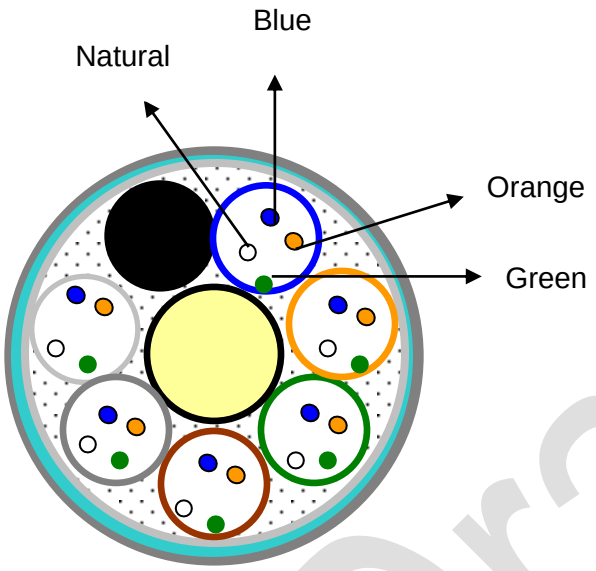
Fibre No./Sequence within loose tube	Fibre identification
1	Blue
2	Orange
3	Green
4	Brown
5	Slate
6	White
7	Red
8	Black
9	Yellow
10	Violet
11	Rose/Pink
12	Natural

Color coding of Loose Tubes for 24 fibres (Refer Table 1)



(Loose Tube Colour: Blue, Orange, Green, Brown, Slate, White)

Color coding of 24 Fibres within Loose Tubes (Refer Table-2)



(Fiber Colour : Blue , Orange, Green, Natural)

6.0 Quality Requirements :

6.1 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.

6.2 Raw Material:

6.2.1 The cable shall use the raw materials approved against the Standard No TEC 89010:2021 (or latest issue) 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 other Conformity Assessment Body (CAB) recognized by TEC, shall be submitted by the manufacturer.

6.2.2 Any other materials use 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.

6.2.3 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 .

6.2.4 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 and/or design of cable shall call for fresh type approval/certification. The clauses 10.2 and 10.3 of this Standard for GR shall facilitate the clause 6.2.4 of this Standard for GR, in order to simplify the certification process and to avoid repetitive testing.

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

Note: Test certificate from CACT or 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.

6.2.6 The material used in optical fibre cable must not evolve hydrogen that will affect the fibre loss.

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

6.3 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 (This shall be tested as per clause no. 6.3.4 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 any Conformity Assessment Body(CAB) recognized by TEC.. 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.

7.0 Safety Requirements:

7.1 The material used in the manufacturing of the Optical fibre cables shall be non-toxic and dermatologically safe in its lifetime and shall not be hazardous to health. The manufacturer shall submit MSDS (Material safety Data Sheet) for all the material used in manufacturing of OF Cable to substantiate the statement.

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

CHAPTER - 2

8.0 Documentation:

8.1 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.

8.2 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 be also be submitted. A hard as well as soft copy of the manuals shall be provided.

9.0 New clause: Information for the Procurer/User:

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

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

10.0 New clause: Procedure for issue of Approval Certificate

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

10.2 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.

10.3 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.

10.4 The clauses 10.2 and 10.3 shall be read in conjunction with the clause 6.2.4.

Annexure – I

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

S. no.	Parameter	Unit	6 Fibre OF cable	12 Fibre OF cable	24 Fibre OF cable	48 Fibre OF cable
1	FRP Rod EAA Coated	mm	3.0+0.1/-0.0	3.0+0.1/-0.0	3.0+0.1/ -0.0	i) 3.5+0.1/-0.0 (Jacketed) ii) 4.6+0.1/-0.0 (Un-Jacketed)
2	FRP up jacketing thickness	mm	0	0	0	0.55
3	Tube ID(min)	mm	1.2	1.2	1.5	1.8
4	Tube OD	mm	1.8± 0.1	1.8± 0.1	2.3± 0.1	2.7± 0.1
5	No of fibre /tube	No	2	2	4	6
6	Color of fibre		BL, Nat	BL, Nat	BL,OR,GR, Nat	BL,OR,GR, BR,SL Nat
7	Fibre packing density	%	12 (Max.)	12 (Max.)	14 (Max.)	14 (Max.)
8	No of loose tubes	No	3	6	6	8
9	Colour of loose tubes		BL,OR,GR	BL,OR,GR, BR,SL,WH	BL,OR,GR, BR,SL,WH	BL,OR,GR, BR,SL,WH, Red,BK
10	No of dummy	No	5	2	1	0
11	Tube stranding lay over length	mm	100-120	100-120	100-120	125-150

12	Glass flex (Impregnated glass roving) Qty (min)	Kg/km	3.8	3.8	5.4	14.91
13	Cable diameter	mm	12.4 ± 0.5	12.4 ± 0.5	13.4± 0.5	16.5 ± 0.5
14	Nominal cable weight	Kg/km	124-140	124-140	145-161	210-232
15	Cable to be designed to Fibre strain value of.	%	0.1	0.1	0.1	0.1
16	Excess fibre length	%	0.65	0.65	0.65	0.70
17	Cable to be tested at defined load for fibre strain value of.	%	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
ISO	- International Standard Organisation
ITU-T	- International Telecommunication Union – Telecommunication Standardization 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
UV	- Ultra Violet
µm	- micrometer
°C	- Degree Celsius
