वर्गीय आवश्यकताओं के लिए मानक

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(सं: जीआर/ओएफसी-१४/०१. अगस्त-२००५ को अधिक्रमित करता है)

STANDARD FOR GENERIC REQUIREMENTS

TEC 85110:2021

(Supersedes No.: GR/OFC -14/01. AUG 2005)

फ्लेक्सिबल ऑप्टिकल फाइबर केबल

(आंतरिक अनुप्रयोग के लिये)

FLEXIBLE OPTICAL FIBRE CABLE

(FOR INDOOR APPLICATIONS)

ISO 9001:2015

दूरसंचार अभियांत्रिकी केंद्र

खुर्शीदलालभवन, जनपथ, नई दिल्ली-११०००१, भारत

TELECOMMUNICATION ENGINEERING CENTRE

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FOREWORD

Telecommunication Engineering Centre (TEC) is the technical arm of 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 Centers (RTECs) have been established which are located at New Delhi, Bangalore, Mumbai, and Kolkata.

ABSTRACT

This Standard for Generic Requirements of Optical fibre cable pertains to Flexible Optical Fibre cable (Type-A & Type-B) for indoor applications. Type-A is a Flexible cable with 2 fibres whereas Type-B is Flexible cable with 4, 6, 8 & 12 fibres. The tight buffered fibres are used in both of these cables which provides ease of termination. These cables are suitable for interconnecting/drop/distribution cabling purpose within the high rise

building including intra-building back bone connecting individual flats on a floor and shall have an excellent flexibility required for routing through various turns/curves ensuring fast and easy installation. The optical fibre cable is suitably protected with yellow colour LSZH (Low smoke zero Halogen) sheath.

The document has been revised to update all the Fibre parameters as per latest GR of Raw Material for manufacturing Optical fibre cable (Section-I of GR No. TEC/GR/TX/ORM-001/05/DEC-17 with Amendment No. 1 dated 06.07.2020). In the revised document, Fire Tests have been added under Safety requirements to increase human safety level in the event of fire in building escape routes and general installations in the event of fire.

CONTENTS

HISTORY SHEET

S. No.	Standard / document *No.*	*Title*	*Remarks*
1.	GR/OFC - 14/01. AUG 2005	Flexible Optical Fibre Cable (For Indoor applications)	1st Release
2.	Standard No. TEC 85110:2021	Standard for Generic Requirements for Flexible Optical Fibre Cable (For Indoor applications)	2nd Release • GR has been converted into Standard with new document No. and format is modified accordingly. • All Fibre parameters have been updated as per TEC/GR/TX/ORM-001/05/DEC-17 (Section-I) with Amendment No. 1 dated 06.07.2020. • New clauses (6.2 & 6.3) for Fire Test have been added. • Design parameters for Type-B cable, have been modified considering the suggestions of manufacturer which were agreed during the meeting.

REFERENCES

SN	*Document No.*	*Title/Document Name*
1.	G/OFT-01/03. APR 2006	Specification for Tools for Installation & Operating the OFC & for Assembly of the Optical Fibre Splice Closures
2.	TEC/GR/TX/FTB-01/03/MAY-2010	Specification for Optical fibre termination and distribution box
3.	TEC/GR/TX/ORM-001/05/DEC-17	Specification for Raw Material
4.	ITU-T Rec. G. 657	ITU-T Recommandation
5.	GR-20-CORE (Issue-4) Jul 2013	Generic Requirement for optical Fibre cable (Bell core)
6.	IEC 60793-1, IEC 60793-2-50	Characteristics of Optical Fibre
7.	ISO 9001:2015	International Quality Management System
8.	IEC Publication 304(4), EIA 598C	Color Standards
9.	TIA-EIA-455-33, TIA-EIA-455-41A, TIA-EIA-455-25A, TIA-EIA 455-104, TIA-EIA-455-85, TIA-EIA RS-455-37A	Test Methods
10.	IEC 60794-1-21-E1, IEC 60794-1-21-E3, IEC60794-1-21-E4, IEC 60794-1-21-E7, IEC 60794-1-21-F1, IEC 68-2-1	Test Methods
11.	GR-409-CORE (Issue-2) Nov 2008	Test Method
12.	IEC 60332	Fire Test Standard

CHAPTER-1

1.0 Introduction:

This document describes the standard for generic requirements of Flexible Optical Fibre cable (Type-A & Type-B) for indoor applications. Type-A is Duplex Flexible cable whereas Type-B is Flexible cable with 4, 6, 8 & 12 nos. of fibres. The tight buffered fibres shall be used in both of these cables which provides ease of termination. These cable are suitable for interconnecting/ drop/ distribution cabling purpose within the high rise building including intra-building back bone connecting individual flats on a floor and shall have an excellent flexibility for routing through various turns/curves ensuring fast and easy installation. The optical fibre cable shall be suitably protected with yellow colour LSZH (Low smoke zero Halogen) sheath. The Raw material used in the cable shall meet the requirements of the GR for Raw materials (GR No. TEC/GR/TX/ORM-001/05/DEC-17 (or latest release) and subsequent amendments, if any.)

The document has been revised to update all the fibre parameters as per latest GR of Raw Material for manufacturing Optical fibre cable (Section-I of GR No. TEC/GR/TX/ORM-001/05/DEC-17 with Amendment No. 1 dated 06.07.2020). In the revised document, Fire Tests have been added under Safety requirements to increase human safety level in the event of fire in building escape routes and general installations in the event of fire.

2.0 Functional Requirements:

2.1 The tight buffering of the fibres shall be done with LSZH and shall not get bonded with the outer sheath of LSZH material.

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

2.3 It shall be possible to operate and handle the Flexible optical fibre cable with tools as per GR No. G/OFT-01/03. APR 2006 (or latest release) and subsequent amendment, if any. If any special tool is required for operating and handling the optical fibre cable, the same shall be provided along with the cable.

2.4 The Flexible optical fibre cable shall be suitable and compatible with the dimensions, fixing, terminating and splicing arrangement of the Optical fibre termination and distribution box as per GR No. TEC/GR/TX/FTB-01/03/MAY-2010 (or latest release) and subsequent amendments, if any.

2.5 The Flexible optical fibre cable shall be flame retardant and shall meet the requirements of fire test as per IEC 60332.

2.6 The cable shall be able to work in saline atmosphere in coastal areas and should be protected against corrosion.

2.7 Life of cable shall be minimum 25 years. Necessary statistical calculations shall be submitted by the manufacturer, based upon life of the fibre and other component parts of the cable. The cable shall meet the cable aging test requirement.

Note: Each Raw Material manufacturer shall define the life and lifetime calculation of the individual raw material.

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

3.0 Technical Requirements:

Single Mode Optical Fibre, used in manufacturing this Fibre Cable shall be as per ITU-T Rec. G.657. A1 or G.657. A2 or G.657. B3. 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 GR No. TEC/GR/TX/ORM-001/05/DEC-17 (or latest release) and subsequent amendments, if any)

3.2 Geometrical Characteristics of fibre: As per Section I of the GR No. TEC/GR/TX/ORM-001/05/DEC-17 (or latest release) and subsequent amendments, if any.
(All the parametric values shall be as per latest TEC Standard for GR of Raw Material for manufacturing Optical fibre cable)

3.2.1	Nominal MFD at 1310nm	:	[8.8 - 9.2] ± 0.4 μm (A1 fibre) [8.6 -9.2] ± 0.4 μm (A2 fibre) 8.6 μm ± 0.4 μm (B3 fibre)
3.2.2	Nominal Cladding Diameter	:	125 μm ± 0.7 μm
3.2.3	Cladding non circularity	:	≤ 0.8%
3.2.4	Core Clad Concentricity Error	:	≤ 0.5 μm

3.2.5 Diameter over primary coated with double UV cured acrylate. (This shall be measured on un coloured fibre) :

a)	250 μm fibre	:	242 ± 5 μm (A1 & A2 fibre)
		:	242 ± 7 μm (B3 fibre)
b)	200 μm fibre (A1 & A2 fibre)	:	180 – 210 μm

Note: The thickness of colour coating may be over and above the values specified above, if the manufacturer adopts separate UV cured colouring process (to colour the un coloured fibres) other than the on line integrated colouring process (of secondary layer of primary coating) of the fibres, during fibre manufacturing.

3.2.6 Colored fibre coating diameter

a)	250 μm fibre	:	252 ± 10 μm
b)	200 μm fibre (A1 & A2 fibre)	:	180 – 220 μm

3.2.7 Coating / Cladding Concentricity

a)	250 μm fibre	:	≤ 12 μm
b)	200 μm fibre (A1 & A2 fibre)	:	≤ 10 μm

3.2.8 Primary coating material : UV Acrylate

3.2.9 Secondary coating Diameter : 900 μm ± 5 %

Note: The natural fibre can be color coated with colored LSZH.

3.2.10 Secondary coating material and colouring as per requirement : LSZH (Low Smoke Zero Halogen)

3.3 Transmission Characteristics: As per Section I of the GR No. TEC/GR/TX/ORM-001/05/DEC-17 (or latest release) and subsequent amendments, if any.

(All the parametric values shall be as per latest TEC Standard for GR of Raw Material for manufacturing optical fibre cable)

3.3.1 Attenuation:

a) Fibre attenuation before Cabling:

SN	Parameter	A1 Fibre	A2 Fibre	B3 Fibre
I	At 1270 nm	≤ 0.40 dB/Km	≤ 0.40 dB/Km	≤ 0.40 dB/Km
ii	At 1310 nm	≤ 0.34 dB/Km	≤ 0.35 dB/Km	≤ 0.35 dB/Km
iii	Between 1285 to 1360 nm	≤ 0.37 dB/Km	≤ 0.38 dB/Km	≤ 0.38 dB/Km
iv	Between 1360 – 1480nm	≤ 0.34 dB/Km	≤ 0.35 dB/Km	≤ 0.35 dB/Km
v	At 1490 nm	≤ 0.24 dB/Km	≤ 0.24 dB/Km	≤ 0.24 dB/Km
vi	Between 1480 to 1525 nm	≤ 0.34 dB/Km	≤ 0.34 dB/Km	≤ 0.35 dB/Km
vii	At 1550 nm	≤ 0.20 dB/Km	≤ 0.21 dB/Km	≤ 0.22 dB/Km
viii	Between 1525 to 1625 nm	≤ 0.24 dB/Km	≤ 0.24 dB/Km	≤ 0.24 dB/Km
ix	At 1625 nm	≤ 0.23 dB/Km	≤ 0.23 dB/Km	≤ 0.24 dB/Km

b) Fibre attenuation after Cabling

SN	Parameter	A1 Fibre	A2 Fibre	B3 Fibre
i	At 1310 nm	≤ 0.36 dB/Km	≤ 0.37 dB/Km	≤ 0.37 dB/Km
ii	At 1383 nm	≤ attenuation at 1310 nm	≤ attenuation at 1310 nm	≤ attenuation at 1310 nm
iii	At 1490nm	≤ 0.26 dB/Km	≤ 0.26 dB/Km	≤ 0.26 dB/Km
iv	At 1550 nm	≤ 0.22 dB/Km	≤ 0.23 dB/Km	≤ 0.24 dB/Km
v	At 1625 nm	≤ 0.25 dB/Km	≤ 0.25 dB/Km	≤ 0.26 dB/Km

Note:

1. Attenuation in the band 1380-1390 nm shall be checked at every 2 nm after Hydrogen aging as per IEC 60793-2-50. Hydrogen aging test is to be carried out by CACT, Bangalore or any other govt. recognized laboratory for type test.
2. Sudden irregularity in attenuation shall be less than 0.1 dB
3. The spectral attenuation shall be measured on un-cabled fibre in the 1250 nm–1625 nm band at an interval of 10nm and the test results shall be submitted.

3.3.2 Dispersion:

a) Total Dispersion

i) In 1285-1330 nm band : ≤ 3.5 ps/nm.Km

ii) In 1270-1340 nm band : ≤ 5.3 ps/nm. Km

iii) At 1550 nm : ≤ 18.0 ps/nm. Km

iv) At 1625 nm : ≤ 22.0 ps/nm. Km

Note: The dispersion in the 1250 nm–1625 nm band shall be measured at an interval of 10nm and the test results shall be submitted.

b) Polarization mode dispersion

SN	Parameter	A1 Fibre	A2 Fibre	B3 Fibre
i	Un-cabled Fibre	≤ 0.15 ps/√Km	≤ 0.2 ps/√Km	≤ 0.2 ps/√Km
ii	Cabled Fibre	≤ 0.3 ps/√Km	≤ 0.3 ps/√Km	≤ 0.3 ps/√Km
iii	Link design value for un-cabled fibre	≤ 0.06 ps/√Km	≤ 0.06 ps/√Km	≤ 0.06 ps/√Km

Note : Measurement on un-cabled fibre may be used to generate cabled fiber statistics and correlation established.

c) Zero Dispersion Slope : ≤ 0.092 ps/(nm^{2}Km)

d) Zero dispersion wave length range : 1300 -1324 nm (A1 & A2 fibre)
1300 -1350 nm (B3 fibre)

3.3.3 Cable Cut off wavelength : 1260 nm Max.

Note - The above cut off wavelength is w.r.t. 22M sample length of fibre.

3.4 Mechanical Characteristics:

(All the parametric values shall be as per latest TEC Standard for GR of Raw Material for manufacturing optical fibre cable)

3.4.1 Proof test for minimum strain level : 1 %

3.4.2 Strippability force to remove primary coating of the Un-aged and Aged fibre (Water aged and Damp heat aged): (Test method IEC- 60793 - 1 - 32)

a) 250 μm fibre

i) Peak strip force : 1≤ N ≤ 8.9N

ii) Average strip force : 1≤ N ≤ 5N

b) 200 μm fibre (A1 & A2 fibre)

i) Peak strip force : 0.4 ≤ N ≤ 8.9N

ii) Average strip force : 0.4 ≤ N ≤ 5N

Note :

1. The force required to remove 30 mm ± 3 mm of the fibre coating shall not exceed 8.9 N and shall not be less than 1 N for 250 μm fibre and 0.4 N for 200 μm fibre.
2. The secondary coated fibre shall be easily strippable so that primary and secondary coating can be removed separately.

3.4.3 Dynamic Tensile Strength (Test method IEC- 60793 - 1 - 31)

a) Un-aged : ≥ 550 KPSI (3.80 GPa)

b) Aged (Damp heat aged) : ≥ 440 KPSI (3.00 GPa)

3.4.4 Dynamic Fatigue (Test method IEC- 60793 - 1 - 33)

a) Un-aged : ≥ 20

b) Aged (Damp heat aged) : ≥ 20

3.4.5 Fibre Curl : ≥ 4 meters radius of curvature

(Test method IEC 60793-1-34)

3.4.6 Fibre Macro bend:

(Test method FOTP–62/ IEC- 60793-1–47)

SN	Parameter	A1 Fibre	A2 Fibre	B3 Fibre
a)	Change in attenuation when fiber is coiled with 10 turns on 15mm radius mandrel	≤ 0.25 dB at 1550 nm ≤ 1.0 dB at 1625 nm	≤ 0.03 dB at 1550 nm ≤ 0.1 dB at 1625 nm	NA
b)	Change in attenuation when fiber is coiled with 1 turn around 10mm radius mandrel	≤ 0.75 dB at 1550 nm ≤ 1.5 dB at 1625 nm	≤ 0.1 dB at 1550 nm ≤ 0.2 dB at 1625 nm	≤ 0.03 dB at 1550 nm ≤ 0.1 dB at 1625 nm
c)	Change in attenuation when fiber is coiled with 1 turn on 7.5mm radius mandrel	NA	≤ 0.5 dB at 1550 nm ≤ 1.0 dB at 1625 nm	≤ 0.08 dB at 1550 nm ≤ 0.25 dB at 1625 nm
d)	Change in attenuation when fiber is coiled with 1 turn on 5 mm radius mandrel	NA	NA	≤ 0.15 dB at 1550 nm ≤ 0.45 dB at 1625 nm

3.5 Material Properties:

(As per latest TEC Standard for GR of Raw Material for manufacturing optical fibre cable)

3.5.1 Fibre Materials:

a) The substances of which the fibres are made : To be indicated by the manufacturer

b) Protective material requirement:

i) The physical and chemical properties of the material used for the fibre primary coating and for single jacket fibre. : It shall meet the requirement of fibre coating stripping force as per clause No.3.4.2

ii) The best way of removing protective coating material. : To be indicated by the manufacturer

c) Group refractive Index of fibre : To be indicated by the manufacturer

Note: The manufacturer shall indicate the variation in group refractive index of fibre during bulk production.

3.6 Environmental Characteristic of Fibre:
(As per latest TEC Standard for GR of Raw Material for manufacturing optical fibre cable)

3.6.1 Operating Temperature
(Test Method IEC – 60793 – 1 - 52)
Temperature Dependence of Attenuation : - 60° C to +85° C
Induced Attenuation at 1550 nm at -60°C to +85°C : ≤ 0.05 dB/Km

3.6.2 Temperature – Humidity Cycling
(Test method IEC- 60793 – 1 – 51)
Induced Attenuation at 1550 nm at -10°C to +85°C and 95% relative humidity. : ≤ 0.05 dB/Km

3.6.3 Water Immersion 23°C
(Test method IEC- 60793 – 1 – 53)
Induced Attenuation at 1550 nm due to Water Immersion at 23 ± 2°C : ≤ 0.05 dB/Km

3.6.4 Accelerated Aging (Temperature) 85°C
(Test method IEC- 60793 – 1 – 51)
Induced Attenuation at 1550 nm due to
temperature Aging at 85 ± 2°C : ≤ 0.05 dB/Km

3.6.5 Retention of Coating Color
(Test method IEC- 60793 – 1 – 51)
Coated Fiber shall show no discernible : 30 days at 85°C
change in color, when aged for and 95% Humidity
relative humidity. and then 20 days
in dry heat at 85°C

3.6.6 High Temperature and High Humidity (Damp Heat)
(Test Method IEC 60793-2-50)
Induced attenuation at 1550nm & 1625nm at 85°C
and 85% Relative Humidity for 30 days : ≤ 0.05 dB/Km

3.7 Colour Qualification and primary coating Test:
(All the parametric values shall be as per latest TEC Standard for GR of Raw Material for manufacturing optical fibre cable)

3.7.1 Colour Qualification Test:

a) MEK RUB Test (Methyle Ethon Ketone Test)
To be tested by using soaked (Solvent) tissue paper for ten strokes unidirectional on 10 cm length of fibre. No colour traces shall be observed on the tissue paper after testing.

b) Water immersion Test (Type Test):
To be tested for coloured fibre for 30 days. After the test Colour qualification, attenuation measurement & stripability test are to be taken.

3.7.2 Primary coating Test (Type Test):

a) Fourier Transform Infrared Spectroscopy (FTIR) Test:

To be tested to check the curing level of coating on the surface of natural fibre. The curing level shall be better than 90%.

b) Adhesion Test:

To be tested by using soaked (Solvent) tissue paper for ten strokes unidirectional on 10 cm length of fibre. No coating shall be observed on the tissue paper after testing.

3.8 Flexible (Duplex) Optical Fibre Cable Construction Specifications (Type-A):

The manufacturer shall submit designed calculation and the same shall be examined and checked.

3.8.1 Number of fibres : 2 Fibres

3.8.2 Secondary Protection :

The primary coated fibres shall be colour coated and tight buffered with LSZH. The colour of fibres shall be Blue & Orange.

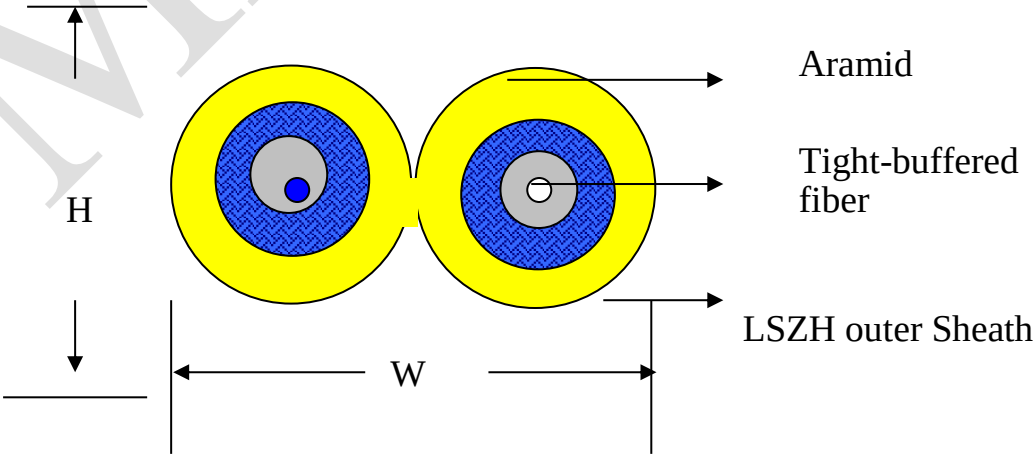

Fig. 1: Construction diagram of Flexible (Duplex) Optical Fibre Cable (Type-A)

3.8.3 Fibre Reinforcement :

The buffered fibre shall be covered with Aramid yarn Reinforcement which shall be distributed evenly over the entire periphery. The quantity of the fiber reinforcement material (Aramid yarn Reinforcement) used per Km length, shall be indicated by the manufacturer. The Aramid Yarn shall be as per Section XVII (17.1) of the GR No. TEC/GR/TX/ORM-001/05/DEC-17 (or latest release) and the subsequent amendments, if any.

3.8.4 Outer Sheath :

A sheath of LSZH (low smoke zero halogen) yellow in colour, free from pinholes and scratches and other defects etc. shall be provided.

3.8.5 Cable Dimensions :

Fiber Count	Dimensions in mm		
	Width	Height	Thickness
02 F	5.8 $\pm$ 0.3	2.8 $\pm$ 0.2	$\geq$ 0.5

3.8.6 Cable Weight :

The nominal cable weight shall be defined by the manufacturer.

3.9 Flexible Optical Fibre Cable Construction Specifications (Type-B):

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

3.9.1 Number of fibres : 4, 6, 8 & 12 Fibres

3.9.2 Secondary Protection :

The primary coated fibres shall be colour coated and tight buffered with LSZH.

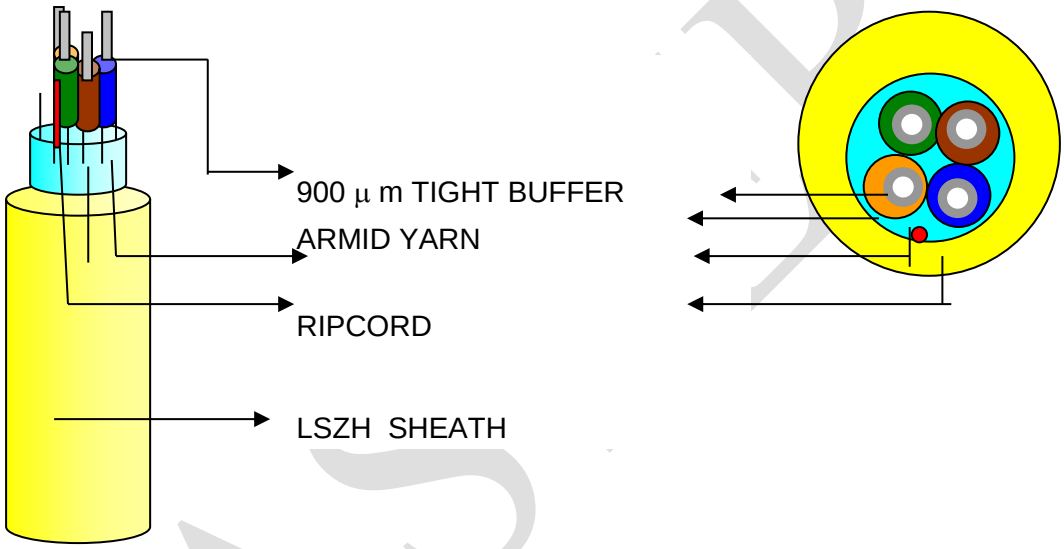

Fig. 2: Construction Diagram of Flexible Indoor Optical Fibre Cable (Type-B)

3.9.3 Fibre Reinforcement :

The tight buffered fibre shall be covered with Aramid Yarn Reinforcement which shall be distributed evenly over the entire periphery. The quantity of the fiber reinforcement material (Aramid yarn reinforcement), used per Km length, shall be as per Annexure- A. The Aramid Yarn shall be as per Section XVII (17.1) of the GR No. TEC/GR/TX/ORM-001/05/DEC-17 (or latest release) and the subsequent amendments, if any.

3.9.4 Outer Sheath :

A circular sheath, yellow in colour, of LSZH (low smoke zero halogen), free from pinholes and scratches and other defects etc., shall be provided.

a) Outer sheath diameter for 4F, 6F, 8F, 12F	:	As per Annexure-A
b) Thickness of sheath	:	0.8 mm (Minimum)

3.9.5 RIP Cord:

Suitable rip cord (as per Section XVII of the GR No. TEC/GR/TX/ORM-001/05/DEC-17 (or latest release) and the subsequent amendments, if any) shall be provided in the cable which shall be used to open the sheath of the cable. It shall be capable of consistently slitting the sheath without breaking more than one meter length of outer sheath at the installation temperature.

3.9.6 Cable diameter :
The finished cable diameter shall be as per Annexure-A.

3.9.7 Cable Weight:
The nominal cable weight shall be as per Annexure-A.

3.10 Mechanical Characteristics and Tests on Flexible (Duplex and 4F, 6F, 8F & 12F) Indoor Cables:

The mechanical performance of the cable shall be in accordance with Bell core document GR-409 and shall meet the other requirements of the cable as per specifications. The procedures and method of testing are described briefly below.

3.10.1 Tensile Strength Test:

Objective: The purpose of this test is to measure the behaviour of attenuation as a function of load on the cable.

Method: IEC 60794-1-21-E1/ TIA-EIA-455-33

Test Spec: The cable shall have sufficient strength to withstand a load value of T (N): 660 N for Flexible cable and 300 N for Duplex cable. The load shall be sustained for 10 minutes and the load shall not cause any permanent physical or optical damage to any component of the cable.

Requirement: The change in attenuation shall be measured before and after the application of load and shall not be more than 0.1 dB at both 1310 nm and 1550 nm wavelengths.

3.10.2 Compressive Strength Test:

Objective: The cable designated for specific application shall be capable for withstanding a compressive load without exhibiting an increase in attenuation and physical damage.

Method: IEC 60794-1-21-E3 / TIA-EIA-455-41A

Test Spec: The cable is subjected to a load of 500 N applied in between the plates of dimension of 100mm x 100 mm for the duration of 10 minutes. There shall not be any optical and physical damage to the cable components.

Requirement: The change in attenuation of the fibre after the test shall be $\leq$0.1dB, at both 1310 nm and 1550 nm wavelengths.

3.10.3 Impact Resistance Test:

Objective: The purpose of this test is to determine the ability of the cable to withstand sudden impact on the cable surface.

Method: IEC 60794-1-21-E4 / TIA-EIA 455-25A
Test Spec: The impact energy of 0.5 J is applied on the surface of the cable under test. Such impacts are applied on to the cable. There shall not be any damage to the optical and physical components of the cable. Flatness on the cable due to impact shall not be considered as a physical damage.

Requirement : The cable outer sheath shall be visually inspected for any splits or cracks. The change in attenuation of the fibre after the test shall be $\leq$0.1dB, at both 1310 nm and 1550 nm wavelengths.

3.10.4 Cable Cyclic Flexing Test:

Objective: The purpose of this test is to determine the ability of an optical fiber cable to with stand mechanical flexibility with out experiencing an increase in attenuation.

Method: IEC 60794-1-21-E8 / TIA-EIA 455-104

Test Specs: The cable under test shall be tested for the flexibility; the cable sample of 5 m or longer length shall be taken to permit the power measurement. The following set up shall be used for the test.

Weight:	2.5 Kg
Minimum distance from Pulley centre to the holding device	216 mm

Minimum distance from Weight to Pulley centre	457 mm
Pulley diameter	20 D
Angle of turning	90º
No of cycles	25
Time required for 25 cycles	2 Min.

Requirement : During the test there shall be no fiber break and no physical damage to the cable. The change in attenuation of the fibre after the test shall be ≤0.1dB, at both 1310 nm and 1550 nm wavelengths.

3.10.5 Torsion /Twist Test:

Objective: The purpose of this test is to determine the cable withstanding the twist.

Method: IEC 60794-1-21-E7 /TIA-EIA-455-85

Test Specs: The cable length of 2 meter shall be subjected to twist of ± 180º with tension on the cable of 25 N. The cycle comprises of twist of 180º clock wise and anti-clockwise from the start position. Ten such cycles shall be performed on the cable.

Requirement :The twist shall not induce the attenuation more than 0.1dB, at both 1310 nm and 1550 nm wavelengths.

3.10.6 Low and High Temperature Cable Bend Test:

Objective: The purpose of this test is to determine the behaviour of cable attenuation when subjected to low and high temperature under bend condition.

Test Method: IEC 60794-1-21-E11B / EIA-RS-455-37A

Test Specs: The cable under test shall be wrapped to 4 turns on the 20 D diameter mandrel. The cable shall be tested at 0º and +70ºC for 12 hours each.

Test Temperature	0º and +70ºC
Mandrel Diameter	200 mm diameter
No of Turns	04 turns
Duration of Test	12 Hrs each

Requirement : The cable shall not show any visible cracks or splits on the surface. The change in attenuation of the fibre after the test shall be ≤0.1dB, at both 1310 nm and 1550 nm wavelengths.

3.10.7 Temperature Cycling:

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

Method IEC 60794-1-22-F1

Température	:	TA1	-	(-0 °C)
	:	TA2	-	(-5°C)
	:	TB1	-	(+60°C)
	:	TB2	-	(+70°C)

Time (t1) : 12 Hrs.
Rate of change of temp. : Approx.1 degree per minute
Number of cycles : 2 (Two).

Requirement : The change in attenuation of the fibre after the test shall be ≤0.1dB, at both 1310 nm and 1550 nm wavelengths.

3.10.8 Damp Heat test

Purpose : To check the effects on the cable for use and /or storage under conditions of high relative humidity at a constant temperature for a given period.

Method : IEC 68-2-1

a) Temperature : 40°C
b) Relative Humidity : 93% to 95%
c) Exposure time : 4 days.

Requirement : The change in attenuation of the fibre after the test shall be ≤0.1dB, at both 1310 nm and 1550 nm wavelengths.

3.10.9 Minimum Bending Radius of the cable:

Method: IEC 60794-1-21-E11

a) Loaded : 12.5 Dmm. (D is the diameter of the cable)
b) Unloaded : 7.5 Dmm. (D is the diameter of the cable)

Requirement : The cable shall not suffer any physical damage under the above conditions. The change in attenuation of the fibre after the test shall be ≤0.1dB, at both 1310 nm and 1550 nm wavelengths.

3.10.10 Cable Marking :

Objective: To check the durability of the cable marking.

Test method : As per section -6 of GR-409-Core (Issue-2) Nov 2008

Test Procedure:
A marked cable specimen shall be soaked in tap water at a temperature of 23± 5°C for a period of 24 hours. The sample shall be then subjected to the marking durability test (To check the printing the sample shall be rubbed with a dry paper. There shall not be any change in the printing /marking).

4.0 Engineering Requirements :

4.1 Cable Marking :

4.1.1 Marking on Flexible optical fibre cable shall be of durable quality. It shall be marked at one meter intervals in black colour over the yellow outer sheath of the fibre and it shall be insoluble in water. The accuracy of the sequential marking must be within -0.25% to +0.5% of the actual measured length. The markings on the cable must not rub off during normal installation and in life time of optical fibre cable..

4.1.2 The type of legend marking on the cable shall be as below:

a) Company Legend
b) Legend containing telephone mark & international acceptable Laser symbol
c) Type of cable i.e. Flexible Cable
d) Type of Fibre: G.657A1 or G.657 A2 or G.657 B3

e) Number of Fibres
f) Year of manufacture
g) Sequential length marking
h) User's Identification
i) Cable ID

4.2 Cable ends :

The cables shall be suitably packed in wooden bobbins for protection against damages during transit. Both inner and outer ends of the cable shall be accessible for testing.

4.3 Nominal Length of the Cable:

4.3.1 Length of OF Cable in each wooden bobbin shall be 1Km ± 5 % or 2Km ± 5% and shall be supplied as per the order.

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 cables
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

4.4 Colour coding in the OF Cable :

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 Colour standards (For EIA standard EIA 598C) and also IEC Publication 304 (4).

4.4.2 Colour Coding Scheme :

Depending upon the number of fibres in the cable (which depends on the cable capacity), the color of the fibres are serially chosen from the column no. II of the table. One of the fibres in the cable shall be of natural color, while the rest of fibres are colored.

Colour Coding scheme for fibres

No. of Fiber I	Tight buffered fibre identification II
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/Natural

5.0 Quality requirements:

5.1 The Flexible indoor optical fibre cable should be manufactured in accordance with International Quality Standards ISO 9001-2015 for which the manufacturer should be duly accredited. A quality manual describing the quality assurance system would be required to be submitted by the manufacturer at the time of approval.

5.2 Raw Material:

5.2.1 The cable shall use the raw materials approved against the TEC/GR/TX/ORM-001/05/DEC-17 (or latest release) and the subsequent amendment issued, if any.

5.2.2 The material used other than approved material as above, 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 approval testing

5.2.3 The raw materials used from multiple sources is permitted and the source/sources of raw materials (Type & 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 Quality Assurance wing of purchaser. In case of change of source/grade of SM Optical Fibre, the call for fresh evaluation/testing shall be decided by Quality Assurance wing of purchaser.

5.2.5 The material used in metal-free optical fibre cable must not release hydrogen to affect the characteristics of optical fibres.

Note: Test certificate from a recognized laboratory or institute may be acceptable

5.3 Cable Material Compatibility: Optical fibre and other components that are in direct contact within the cable structure, shall meet the requirements of the compatibility with each other (This shall be tested as per clause no. 6.3.3 of Telcordia document GR-20-CORE issue 4, July 2013).

Note: The tests may be conducted in house (if facility exist) or may be conducted at CACT, Bangalore or any other govt. recognized laboratory. The test certificate may be accepted and the tests may not be repeated subsequently, in next evaluation/testing, 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 metal free optical fibre cables shall be non-toxic and dermatological 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 Indoor optical fibre cable to substantiate the statement.

6.2 Flame spread – Single cable (Duplex):

Objective: To test the resistance to vertical flame propagation for a single vertical optical fibre cable, under fire conditions.

Method: IEC/EN 60332-1-2

Requirement: charring should not extend greater than 540 mm from the lower edge of the top support.

6.3 Flame spread – Bunched cable:

Objective: To test the resistance to vertical flame spread of vertically mounted bunched optical fibre cable, under defined conditions.

Method: IEC/EN 60332-3-24, Cat C

Requirement: The cable shall pass the test if the distance between the lower edge of the top support and the onset of charring is greater than 50mm and charring shall not extend downwards to a point greater than 540mm from the lower edge of the top support.

Note: Latest issue of all the Standards mentioned in this chapter, 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. The pictorial diagrams of the accessories (with model no. and manufacturer name) supplied along with the cable as package shall be also be submitted .

7.2 All aspects of cable installation, operation and maintenance and fibre splicing shall also be covered in the handbook. A hard as well as soft copy of the manuals shall be provided.

8.0 Information for the Procurer of product:

8.1 The procurer may ask for Flexible cable (Type-A or Type-B) for Indoor applications as per their requirements. Type-A is Duplex Flexible cable whereas Type-B is Flexible cable with 4, 6, 8 & 12 nos. of fibres. The tight buffered fibres are used in both of these cables which provides ease of termination. These cable are suitable for interconnecting / drop/ distribution cabling purpose within the high rise building including intra-building back bone connecting individual flats on a floor.

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

9.0 Procedures for the issue of Approval certificate for Lower Fibre Count Cables

The manufacturer may seek approval certificate for Lower Fibre Count Cables against this GR without conducting the actual tests on the cables only when he is having valid approval certificate for higher fibre count of cable against this GR.

The manufacturer seeking approval certificate for the Lower Fibre Count cable shall apply afresh and submit the documents as per the prescribed approval procedure along with

- List of Raw Materials used, the make and grade of the raw material and the certificate of source approval issued by CACT or any other recognized laboratory along with the details of the raw materials used in the manufacturing of the higher fibre count cable for which he is holding valid approval certificate. Both the raw materials shall be compared and are required to be of same make and grade.

- Samples of at least 5 cable reels (2 Kms each approx.) for each lower fibre count cable.

Any additional information as required may be sought from the manufacturer and the manufactured cable may be inspected at the manufacturer's premises. After all the above requirements are met, the approval certificate may be issued to the lower fibre count of the cable based upon the test results and other details submitted by the manufacturer. The tariff in each case shall be as applicable for category – II.

The following shall be mentioned in the remarks column of the Approval

Certificate to be issued for the lower fibre count of the cable:

"This certificate is issued on the basis of certificate No. _____ dated _____ for _____ fibre count cable".

The validity of the certificate for lower fibre count cables shall be coterminous to the validity of approval certificate of higher fibre count cable.

The above procedure shall be applicable only for the approval of Flexible Optical Fibre Cable against this Standard for GR and subsequent amendments, if any.

ABBREVIATIONS

ASTM	-	American Society for Testing and Materials
BIS	-	Bureau of Indian Standards
CACT	-	Component Approval Centre For Telecommunications
EIA	-	Electronic Industry Association
FOTP	-	Fibre Optic Test Procedure
FRP	-	Fibre Reinforced Plastic
GPa	-	Giga Pascal
HDPE	-	High Density Polyethylene
IEC	-	International Electro –Technical Commission
IS	-	Indian Standards
ISO	-	International Standard Organizations
ITU-T	-	International Telecommunication Union – Telecommunication
MFD	-	Mode Field Diameter
nm	-	Nanometer
OTDR	-	Optical Time Domain Reflectometer
Ps/nm	-	Pico second/ Nano meter
Ps	-	Pico second
QA	-	Quality Assurance
QM	-	Quality Manual
RMS	-	Route Mean Square
SMOF	-	Single Mode Optical Fibre
UV	-	Ultra Violet
UL	-	Underwriters Laboratory

ANNEXURE –A

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

Table A1: Cable design parameters for Flexible Cable (Type-B)

	Parameter	Unit	4F	6F	8F	12F
1	Tight Buffer Diameter	µm	900± 5%	900± 5%	900± 5%	900± 5%
2	No. of TBF	No	4	6	8	12
3	Aramid Yarns	Kg/Km	2.4	2.4	2.4	3.5
4	Cable Diameter	mm	5.0±0.4	5.4 ±0.5	5.8 ±0.5	6.2 ± 0.5
5	Nominal cable weight	Kg/Km	20 – 26	23 –30	26 – 34	30 – 38