अनंतिम टेस्ट गाइड

टीईसी ८५२२१:२०२३

(सं: टीईसी/टीजी/टीएक्स/ओएफ़सी-०२६/०१/मार्च-१८ को अधिक्रमित करता है)

PROVISIONAL TEST GUIDE

TEC 85221:2023

(Supersedes no. TEC/TG/TX/OFC-026/01/MAR-18)

for

लास्ट माइल एप्लिकेशन हेतु एरियल ड्रॉप ऑप्टिकल फाइबर केबल (शॉर्ट स्पैन)

(मानकसं: टीईसी ८५२२०:२०२२)

Aerial Drop Optical Fibre Cable for Last Mile Applications

(Short Span)

(STANDARD No. TEC 85220:2022)

ISO 9001:2015

दूरसंचार अभियांत्रिकी केंद्र

खुर्शीद लाल भवन, जनपथ, नई दिल्ली-११०००१, भारत

TELECOMMUNICATION ENGINEERING CENTRE

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www.tec.gov.in

टीईसी, २०२३

Release 2: February, 2023

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 Test Guide of testing pertains to test schedule and procedure for evaluating conformance/functionality/requirements/performance of Standard for Generic Requirements of Aerial Drop Optical Fibre Cable for Last Mile Applications (Short Span). This cable is envisaged to be utilized for extending last mile connectivity to FTTH customers on the Aerial route up to 30 meters of span length.

CONTENTS

A. INTRODUCTION

This document enumerates detailed test schedule and procedure for evaluating conformance / functionality / requirements / performance of Aerial Optical Fibre Drop Cable for Last Mile applications (For Short Span) as per Standard No. TEC 85220:2022

B. HISTORY SHEET

Sl. No.	TSTP No.	Equipment/Interface	Issue
1.	TEC/TG/TX/OFC-026/01/MAR-18	Aerial Optical Fibre Drop Cable for FTTH Applications (For Short Span)	Release 1
2.	No. TEC 85220:2023	Test Guide for Generic Requirement of Aerial Drop Optical Fibre Cable for Last Mile applications(Short Span)	Release 2

C. General information:

SN.	General Information	Details (to be filled by testing team)	
1	Name and Address of the Applicant		
2	Date of Registration		
3	Name and No. of GR/IR/Applicant's Spec. against which the approval sought		
4	Details of Equipment		
	Type of Equipment	Model No.	Serial No.
(i)			
(ii)			
5	Any other relevant Information:-		

D. **Testing team:** (to be filled by testing team)

S. N.	Name	Designation	Organization	Signature
1.				
2.				

E. **List of the Test Instruments:**

S.N.	Name of the test instrument	Make /Model (to be filled by testing team)	Validity of calibration (to be filled by testing team)
1	Optical Time Domain Reflector		dd/mm/yyyy
2	Optical Fibre Precision Cleaver		
3	Optical Fibre Stripper		
4	Mechanical splice		
5	Fibre Geometry Analyser		
6	ODA		
7	Micrometer		

F. **Equipment Configuration Offered:** (to be filled by testing team)

(a) **<Equipment/product name> Configuration:**

S.N.	Item	Details	Remarks

Relevant information like No. of cards, ports, slots, interfaces, size etc. may be filled as applicable for the product

(b) **<Other equipment name> Configuration:**

S. No.	Item	Details	Remarks

Relevant information like No. of cards, ports, slots, interfaces, size etc. may be filled as applicable for the product

G. **Equipment/System Manuals:** (to be filled by testing team)

Availability of Maintenance manuals, Installation manual, Repair manual & User Manual etc. **(Y/N)**

H. Clause-wise Test Type and Test No.:

Clause No.	Clause	Type of Test / Test No. etc. *
1.0	**Introduction**: This document describes the Standard for GR of Aerial Drop Optical Fibre Cable for Last Mile Applications (Short Span). This cable is envisaged to be utilized for extending last mile connectivity to FTTH customers on the Aerial route up to 30 meters of span length. The Raw material used in the cable shall meet the requirements of the Standard for GR for Raw materials (No. TEC 89010:2021 (or latest release) and subsequent amendments, if any.	Manufacturer compliance shall be checked and examined.
2.0	**Functional Requirements:**	
2.1	The design and construction of the cable shall be inherently robust and rigid under all conditions of installation, operation, adjustment, replacement, storage and transport.	Check as per the requirement of the clause and comment. The design shall also be checked.
2.2	The cable shall be able to work in saline atmosphere in coastal areas and should be protected against corrosion.	Test certificate or undertaking may be obtained as per the requirement of the clause
2.3	Life of cable shall be at least 25 years. Necessary statistical calculations shall be submitted by the manufacturer, based upon life of the fibre and other	The calculation shall be checked & observations are to be noted.

	component parts of the cable. The cable shall meet the cable aging test requirement. Note: Manufacturer shall define the cable life based on the lifetime calculation of the raw material used.	
2.4	The cable shall be suitable and compatible with the dimensions, fixing, terminating & splicing arrangement of the all applicable optical accessories i.e. FDMS, Splice closure, Termination box, splitters etc.	Compatibility of the optical fibre cable with all applicable optical accessories shall be checked and observation to be noted. The cable supplied shall be terminated in the FDMS, Splice closure, Fibre Termination and distribution boxes with splitters for conforming its suitability of the arrangements with the cable.
2.5	It shall be possible to operate and handle the cable with tools as per the Standard for GR No. TEC 89060:2006 and subsequent amendment, 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.	The cable shall be checked by operating with the tools as prescribed in the GR No. GR/OFT-01/03. APR 2006 and observation to be noted.
2.6	It shall be possible to install the Aerial optical fibre cable with accessories and fixtures as per the Standard for GR No TEC 87060:2017 and subsequent amendments, if any. If any special Accessories and Fixtures are required for installation of the cable, the same	The cable shall be checked by installing with the tools as prescribed in the Standard for GR No TEC 87060:2017 and observation to be noted. Any special accessories, if supplied, and accessories

	shall be provided along with the cable.	required for mounting splice closure shall also be checked.
2.7	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.	Test certificate or undertaking may be obtained as per the requirement of the clause
2.8	The cable shall be designed and manufactured to meet the following conditions of operation, installation and storage: a) Maximum Span length: 30m b) Maximum ice loading : Nil c) Operational wind velocity: 75 Kms per hour d) Sag of the span length: i) Maximum Installation sag allowed: 1 % of span length ii) Maximum Operational sag allowed: 2 % of span length e) Temperature range: - i) Operation: - 20° to + 70° C ii) Installation: - 15° to + 50° C iii) Storage: - 20° to + 70° C f) Tensile force design parameter: 500N g) Minimum bending Radius: 10 D (D-dia of the cable)	Check the design calculations and comment for the sub-clauses.
3.0	**Technical Requirements:** Single Mode Optical Fibre is used in manufacturing optical Fibre Cables	Check as per the requirement of the clause and comment.

	shall be as per ITU-T Rec. G 657 A1 or G 657 A2. The specification of optical fibre shall be as per Section-1 (Type-IV) of Standard No. TEC 89010:2021 (or latest release) and subsequent amendments, if any.	
3.1	**Type of fibre (Wavelength band optimized nominal 1310 nm):** Single Mode (Section-1(Type-IV) of Standard No. TEC 89010:2021(or latest release) and subsequent amendments, if any)	Check as per the requirement of the clause and comment.
3.2	**Geometrical Characteristics**	
3.2.1	Nominal MFD for matched clad (at 1310 nm): [8.8 - 9.2] ±0.4 µm (A1 Fibre) 8.6 ± 0.4 µm (A2 Fibre)	Check and observation to be noted in Table below.

Test Results:

Colour of Loose tube	Colour of Fibre	Measured Value	Observation / Remarks

Note :

1. Please state the type & number of fibres in the cable.

2. The manufacturer shall specify with the maximum and minimum values of the fibre during bulk production.

Clause No.	Clause	Type of Test / Test No. etc. *
3.2.2	Nominal Cladding Diameter: 125 µm ± 0.7µm	Check and observation to be noted in Table below

Test Results:

Colour of Loose tube	Colour of Fibre	Measured Value	Observation / Remarks

Note :

1. Please state the type & number of fibres in the cable.
2. The manufacturer shall specify with the maximum and minimum values of the fibre during bulk production.

Clause No.	Clause	Type of Test / Test No. etc. *
3.2.3	Cladding Non-circularity : ≤ 0.8 %	Check and observation to be noted in Table below

Test Results:

Colour of Loose tube	Colour of Fibre	Measured Value	Observation / Remarks

Note :

1. Please state the type & number of fibres in the cable.
2. The manufacturer shall specify with the maximum and minimum values of the fibre during bulk production.

Clause No.	Clause	Type of Test / Test No. etc. *
3.2.4	Core Clad concentricity error: ≤ 0.5 µm	Check and note down the observation in Table below.

Test Results:

Colour of Loose tube	Colour of Fibre	Measured Value	Observation / Remarks

Note :

1. Please state the type & number of fibres in the cable.
2. The manufacturer shall specify with the maximum and minimum values of the fibre during bulk production.

Clause No.	Clause	Type of Test / Test No. etc. *

3.2.5	Diameter over primary coated with double UV cured acrylate : 242 µm ± 5 µm (Shall be measured on un-coloured fibre) **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.	Check and note down the observation in Table below.

Test Results:

Colour of Loose tube	Measured Value	Observation / Remarks

Note :

1. Please state the type & number of fibres in the cable.
2. The manufacturer shall specify with the maximum and minimum values of the fibre during bulk production.

Clause No.	Clause	Type of Test / Test No. etc. *
3.2.6	Colored fibre coating diameter: 252 ± 10µm	Check and note down the observation in Table below.

Test Results:

Colour of Loose tube	Colour of Fibre	Measured Value	Observation / Remarks

Note :

1. Please state the type & number of fibres in the cable.
2. The manufacturer shall specify with the maximum and minimum values of the fibre during bulk production.

Clause No.	Clause	Type of Test / Test No. etc. *
3.2.7	Coating/Cladding Concentricity: ≤12µm	Check and note down the observation in Table below.

Test Results:

Colour of Loose tube	Colour of Fibre	Measured Value	Observation / Remarks

Note :

1. Please state the type & number of fibres in the cable.
2. The manufacturer shall specify with the maximum and minimum values of the fibre during bulk production.

<table>
<tr><th>Clause No.</th><th>Clause</th><th>Type of Test / Test No. etc. *</th></tr>
<tr><td>3.3</td><td>Transmission Characteristics:
All the parametric values shall be as per latest Standard for GR of Raw Material for manufacturing Optical fibre cable</td><td></td></tr>
<tr><td>3.3.1</td><td>Attenuation:
a) Fibre attenuation before Cabling

Table-II: Fibre attenuation before cabling
<table>
<tr><th>S.No</th><th>Parameter</th><th>A1 Fibre</th><th>A2 Fibre</th></tr>
<tr><td>i</td><td>At 1270 nm</td><td><0.40 dB/Km</td><td><0.40 dB/Km</td></tr>
<tr><td>ii</td><td>Between 1285 to 1360 nm</td><td><0.37 dB/Km</td><td><0.38 dB/Km</td></tr>
<tr><td>iii</td><td>At 1310 nm</td><td><0.34 dB/Km</td><td><0.35 dB/Km</td></tr>
<tr><td>iv</td><td>Between 1360-1480 nm</td><td><0.34 dB/Km</td><td><0.35 dB/Km</td></tr>
<tr><td>v</td><td>At 1490 nm</td><td><0.24 dB/Km</td><td><0.24 dB/Km</td></tr>
<tr><td>vi</td><td>Between 1480 to 1525 nm</td><td><0.34 dB/Km</td><td><0.34 dB/Km</td></tr>
<tr><td>vii</td><td>At 1550 nm</td><td><0.20 dB/Km</td><td><0.21 dB/Km</td></tr>
<tr><td>viii</td><td>Between 1525 to 1625 nm</td><td><0.24 dB/Km</td><td><0.24 dB/Km</td></tr>
<tr><td>ix</td><td>At 1625</td><td><0.23</td><td><0.23</td></tr>
</table></td><td>Check and note down the observation in Table below.</td></tr>
</table>

		nm	dB/Km	dB/Km	

Test Results:

Colour of Loose tube	Colour of Fibre	Measured Value									Observation / Remarks
		1270 nm	1310 nm	1490 nm	1550 nm	1625 nm	S. Attenuation				
							1285nm-1360nm	1360nm-1480nm	1480nm-1525nm	1525nm - 1625nm	

Note :

1. Please state the type & number of fibres in the cable.
2. The manufacturer shall specify with the maximum and minimum values of the fibre during bulk production.

Clause No.	Clause	Type of Test / Test No. etc. *
3.3.1	b) Fibre attenuation after Cabling Table III: Fibre attenuation after cabling	Check and note down the observation in Table below.

SN	Parameter	A1 Fibre	A2 Fibre
i	At 1310 nm	<0.36 dB/Km	<0.37 dB/Km
ii	At 1383 ± 3 nm	< attenuation at 1310 nm	< attenuation at 1310 nm
iii	At 1490nm	<0.26 dB/Km	<0.26 dB/Km
iv	At 1550nm	<0.22 dB/Km	<0.23 dB/Km

	v	At 1625 nm	<0.25 dB/Km	<0.25 dB/Km

Note:

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

Test Results:

Colour of Loose tube	Colour of Fibre	Measured Value					Observation / Remarks
		1310 nm	1383 ± 3 nm	1550 nm	1490nm	1625 nm	

	Note : 1. Please state the type & number of fibres in the cable. 2. The manufacturer shall specify with the maximum and minimum values of the fibre during bulk production.

Clause No.	Clause	Type of Test / Test No. etc. *
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.	Check and note down the observation in Table below.

Test Results:

Colour of Loose tube	Colour of Fibre	Measured Value				Observation / Remarks
		(i)	(ii)	(iii)	(iv)	

Note :

1. Please state the type & number of fibres in the cable.
2. The manufacturer shall specify with the maximum and minimum values of the fibre during bulk production.

Clause No.	Clause	Type of Test / Test No. etc. *
3.3.2	b) Polarization mode dispersion at 1310 & 1550 nm. i) Un-cabled Fibre : ≤ 0.15 ps/√ km (A1) ≤ 0.2 ps/√ km (A2) ii) Cabled Fibre : ≤ 0.3 ps/√ 'km iii) Link design value for un-cabled fibre : ≤ 0.06ps/√km iv) Link design value for cabled fibre: ≤ 0.2 ps/√km **Note:** Measurement on un-cabled fibre may be used to generate cabled fiber statistics and correlation is established.	Check and note down the observation in Table below.

Test Results:

Colour of Loose tube	Colour of Fibre	Measured Value								Observation / Remarks
		1310nm				1550nm				
		(i)	(ii)	(iii)	(iv)	(i)	(ii)	(iii)	(iv)	

Note :

1. Please state the type & number of fibres in the cable.
2. The manufacturer shall specify with the maximum and minimum values of the fibre during bulk production.

Clause No.	Clause	Type of Test / Test No. etc. *
3.3.2	c) Zero Dispersion Slope : ≤ 0.092 ps/(nm 2 Km)	Check and note down the observation in Table below.

Test Results:

Colour of Loose tube	Colour of Fibre	Measured Value	Observation / Remarks

Note :

1. Please state the type & number of fibres in the cable.
2. The manufacturer shall specify with the maximum and minimum values of the fibre during bulk production.

Clause No.	Clause	Type of Test / Test No. etc. *
3.3.2	d) Zero dispersion wave length range: 1300 -1324 nm	Check and note down the observation in Table below.

Test Results:

Colour of	Colour of	Measured Value	Observation / Remarks

Loose tube	Fibre		

Note :

1. Please state the type & number of fibres in the cable.
2. The manufacturer shall specify with the maximum and minimum values of the fibre during bulk production.

Clause No.	Clause	Type of Test / Test No. etc. *
3.3.3	Cable cut off wavelength : 1260 nm Max. Note: The above cut off wavelengths is w.r.t. 22M sample length of fibre	Check and note down the observation in Table below.

Test Results:

Colour of Loose tube	Colour of Fibre	Measured Value	Observation / Remarks

Note :

1. Please state the type & number of fibres in the cable.

2. The manufacturer shall specify with the maximum and minimum values of the fibre during bulk production.

Clause No.	Clause	Type of Test / Test No. etc. *
3.4	**Mechanical Characteristics:** All the parametric values shall be as per latest Standard for GR of Raw Material for manufacturing Optical fibre cable.	
3.4.1	Proof test for minimum strain level : 1% (Test method IEC-60793-1-30)	Check as per the requirement of the clause & comment.
3.4.2	Peak Stripability force to remove primary coating of the fibre. (Test method IEC-60793-1-32) : $1.3 \leq F \leq 8.9$ N **Note**: 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.	Check as per the requirement of the clause & comment.
3.4.3	Dynamic Tensile Strength (Test method IEC-60793-1-31) a) Un-aged : $\geq$ 550 KPSI (3.80 Gpa) b) Aged(Damp heat aged) : $\geq$ 440 KPSI (3.00 Gpa)	Check as per the requirement of the clause & comment.
3.4.4	Dynamic Fatigue (Test method IEC- 60793 –1-33) a)Un-aged : $\geq$ 20 b)Aged(Damp heat aged) : $\geq$ 20	Check as per the requirement of the clause & comment.
3.4.5	Fibre Macro bend (Test method FOTP–62/ IEC- 60793-1–47) a) Change in attenuation when fiber is coiled with	Check as per the requirement of the clause & comment.

	10 turns on 15 mm radius mandrel: ≤ 0.25 dB at 1550nm(A1) ≤ 1.0 dB at 1625nm(A1) ≤ 0.03dB at 1550 nm(A2) ≤ 0.1dB at 1625nm(A2) b) Change in attenuation when fiber is coiled 1 turn around 10 mm radius mandrel: ≤ 0.75 dB at 1550nm(A1) ≤ 1.5 dB at 1625nm(A1) ≤ 0.1 dB at 1550 nm(A2) ≤ 0.2 dB at 1625nm(A2) c) Change in attenuation when fiber is coiled 1 turn around 7.5 mm radius mandrel : ≤ 0.5 dB at 1550nm(A2) ≤ 1.0 dB at 1625nm(A2)	
3.4.6	Fibre Curl (Test method IEC- 60793 – 1- 34) : ≥ 4 Meter radius of Curvature	Check as per the requirement of the clause & comment.
3.5	**Material Properties:** (As per latest 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 requirement of fibre stripping force as per clause No. 4.4.2	Check and record the information as supplied by the manufacturer.

	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. d) Fibre materials shall be RoHS (Restriction of Hazardous Substance) complied	
3.6	**Environmental Characteristic of Fibre:** (As per latest 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 & 1625nm at -60°C to +85°C : ≤ 0.05 dB/km	Check and note down the observation in Table below

Test Results:

Colour of Loose tube	Colour of Fibre	Measured Value	Observation / Remarks
Note :			

1. Please state the type & number of fibres in the cable. 2. The manufacturer shall specify with the maximum and minimum values of the fibre.

3.6.2	Temperature-Humidity Cycling (Test Method IEC-60793-1) EIA/TIA-455-73 Induced Attenuation at 1550 nm & 1625nm at -10°C to +85°C and 95% relative humidity : ≤ 0.05 dB/km	Check and note down the observation in Table below

Test Results:

Colour of Loose tube	Colour of Fibre	Measured Value	Observation / Remarks

Note :

1. Please state the type & number of fibres in the cable.
2. The manufacturer shall specify with the maximum and minimum values of the fibre.

3.6.3	Water Immersion 23°C (Test Method IEC-60793-1-53) Induced Attenuation at 1550 nm & 1625nm due to Water Immersion at 23 ± 2°C : ≤ 0.05 dB/km	Check and note down the observation in Table below

Test Results:

Colour of Loose tube	Colour of Fibre	Measured Value	Observation / Remarks

Note :

1. Please state the type & number of fibres in the cable.
2. The manufacturer shall specify with the maximum and minimum values of the fibre.

3.6.4	Accelerated Aging(Temperature) 85^{o}C (Test Method IEC-60793-1-51) Induced Attenuation at 1550 nm & 1625nm due to Temperature Aging at 85 ± 2^{o}C : ≤ 0.05 dB/km	Check and note down the observation in Table below

Test Results:

Colour of Loose tube	Colour of Fibre	Measured Value	Observation / Remarks

Note :

1. Please state the type & number of fibres in the cable.
2. The manufacturer shall specify with the maximum and minimum values of the

fibre.

3.6.5	Retention of Coating Color (Test Method IEC-60793-1-51) Coated Fiber shall show no discernible with change in color, when aged for relative humidity : 30 days at 85°C 95% Humidity & then 20 days in 85°C dry	Check and note down the observation in Table below

Test Results:

Colour of Loose tube	Colour of Fibre	Measured Value	Observation / Remarks

Note :

1. Please state the type & number of fibres in the cable.
2. The manufacturer shall specify with the maximum and minimum values of the fibre.

3.6.6	High Temperature and High Humidity (Damp Heat) (Test Method IEC-60793-2) IEC 60793-1-50 Induced Attenuation at 1550 nm & 1625nm 85°C and 85% Relative Humidity for 30 days : ≤ 0.05 dB/km	Check and note down the observation in Table below

Test Results:

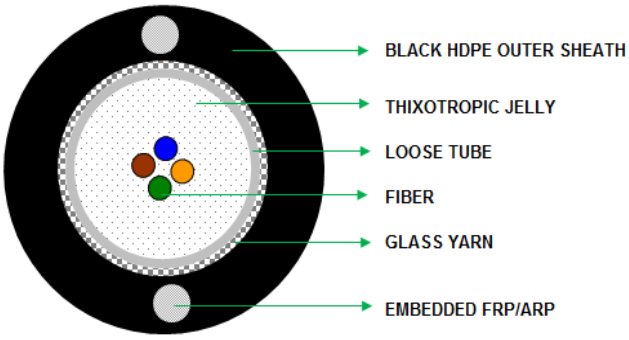
Colour of Loose tube	Colour of Fibre	Measured Value	Observation / Remarks

Note :

1. Please state the type & number of fibres in the cable.
2. The manufacturer shall specify with the maximum and minimum values of the fibre.

3.7	**Colour Qualification and Primary Coating Test** (As per latest Standard for GR of Raw Material for manufacturing Optical fibre cable)	
3.7.1	Colour Qualification Test: a. MEK Rub Test (Methyl Ethyl Ketone)(Test Method IEC-60794-219): To be tested by using soaked 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 fiber for 30 days. After the test Colour qualification, Attenuation measurement & Strippability test are to be taken.	Check and comment as per the procedure.

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.	Check and comment as per the procedure.

Clause No.	Clause	Type of Test / Test No. etc. *
3.8	**Aerial Drop Optical Fibre Cable Construction Specifications:** 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.  **Figure1: Typical Structure Drawing for 4**	Check as per the requirement of the clause & comment.

	Fibre Cable	
3.8.1	**Secondary Protection (Buffer tube):** The primary coated coloured fibres shall be protected by loose packaging within a tube which shall be filled with thixotropic jelly. The tubing material shall be as per Standard no. TEC 89010:2021 and subsequent amendments, if any. Various design parameters of the cable shall be as per Annexure – A.	Check as per the requirement of the clause & comment.
3.8.2	**Number of fibres:** 2, 4,6,12 Fibre Note: Approval for a cable shall be issued depending upon the no. of fibres in the cable)	Check as per the requirement of the clause & comment.
3.8.3	**Strength Member:** a. The cable shall be helically reinforced with Glass Yarn in the periphery over the loose tube. The Glass Yarn shall be uniformly and equally distributed on the entire periphery (circumference) of the buffer tube. The quantity of the Glass Yarn used per kilometre length of the cable shall be as per requirement in Annexure A. The Glass Yarn shall be as per Section XII of the Standard for GR No. TEC 89010:2021 (or latest release) and the subsequent amendments, if any.	Check as per the requirement of the clause & comment.
3.8.4	**Filling compound:** The filling compound used in the buffer tube	Check as per the requirement of the clause

	shall be compatible to fibre, secondary protection of fibre etc. The drip point shall not be lower than +70º C. The fibre movement shall not be constrained by stickiness and shall be easily removable for splicing. The test method to measure drop point shall be as per ASTM D 566. The filling jelly compound shall be as per Section-VII of TEC Standard for GR No. TEC 89010:2021(or latest issue) and the subsequent amendments, if any.	& comment.
3.8.5	**Outer Jacket:** A circular and uniform tough weather resistant UV Stabilized polyethylene compound HDPE material sheath/Jacket, black in colour, shall be provided over and above the reinforcement of Glass Yarn. The thickness of the outer sheath/Jacket shall be uniform & shall not be less than 2.0mm. The sheath shall be circular, smooth, free from pin holes, joints, scratches, mended pieces and other defects etc. Reference test method to measure thickness shall be as per IEC 189 para 2.2.1 and para 2.2.2. **Note:** HDPE material (in black colour) from the finished cable, shall be subjected to following tests (on sample basis) and shall conform to the requirement of the material as per Standard for GR No. TEC 89010:2021 : i) Density	Check as per the requirement of the clause & comment.

	ii) Melt flow index iii) Oxidative Induction time iv) Carbon black content v) Carbon black dispersion vi) ESCR vii) Moisture content viii) Tensile strength and elongation at break	
3.8.6	**Strength Member (Embedded):** Solid FRP/ARP non-metallic strength member embedded in the outer jacket. The strength member in the cable shall be for strength and flexibility of the cable and shall have anti buckling properties. This shall also keep the fibre strain within permissible values. The size of FRP/ARP shall be as per Annexure – A.	Check as per the requirement of the clause & comment.
3.8.7	**Rip Cord (Optional) :** a. Two suitable ripcords shall be provided in the cable which shall be used to open the outer sheath of the cable. The ripcords 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. b. The rip cord used in the cable shall be readily distinguishable from any other components (e.g. Aramid Yarn, Glass Yarns etc.) utilized in the cable construction. Note: The requirement of Rip cords (Single	

	ply) may be decided by purchaser.	
3.8.8	**Cable parameters:** The manufacturer shall define all the cable design parameters. The parameters of finished cable shall be as per Annexure- A.	Check as per the requirement of the clause & comment.

Clause No.	Clause	Type of Test / Test No. etc. *
4.0	**Mechanical Characteristics and Tests on Optical Fibre Cable:**	
4.1	**Tensile strength:** A load of value T(N) = 500N on cable sustained for 10 minutes shall not produce a strain exceeding 0.25 % in the fibre and shall not cause any permanent physical or optical damage to the cable. The change in attenuation of each fibre after the test shall be ≤ 0.05 dB, both for 1310 nm and 1550 nm wavelength. **Test Method:** IEC 60794-1-21-E1.	Check and observation to be noted in Table below.

Test Results:

Length code _____

Requirement:

1. Change in attenuation : < 0.05 dB
2. Strain under load : < 0.25%

Colour of Loose tube	Colour of Fibre	Initial Reading		Final Reading		Change in Attenuation (dB)		Observation / Remarks
		1310 nm	1550 nm	1310 nm	1550 nm	1310 nm	1550 nm	

Strain Testing: The strain is monitored by using fibre strain tester. The maximum strain under load is to be tested

Colour of Loose tube	Colour of Fibre	Initial Strain		Final Strain		Observation / Remarks
		1310 nm	1550 nm	1310 nm	1550 nm	

Note :

1. Please state the type & number of fibres in the cable.
2. The manufacturer shall specify with the maximum and minimum values of the fibre during bulk production.

Clause No.	Clause	Type of Test / Test No. etc. *

4.2	**Abrasion Test:** The cable surface abraded for 100 cycles with needle (wt. 150 gm) having diameter of 1 mm with 500 grams weight (Total weight more than or equal to 650gms) for 1 minute shall not cause any perforation and loss of legibility of the marking on the sheath. **Test Method:** IEC-60794-1-21-E2	Check and observation to be noted in Table below.

Test Results:

Length Code	Load Applied	No. of cycles	Duration	Observation / Remarks
	650 gms	100 cycles	01 Minute	

Note :

1. Please state the type & number of fibres in the cable.
2. The manufacturer shall specify with the maximum and minimum values of the fibre during bulk production.

Clause No.	Clause	Type of Test / Test No. etc. *
4.3	**Crush Test (Compressive Test):** A compressive load of 1000 Newton applied, between the plates of dimension 100 x 100 mm for 60 seconds shall not damage the cable. The change in attenuation of each fibre after the test shall be ≤ 0.05 dB, both for 1310 nm and 1550 nm wavelength. **Test Method:** IEC 60794-1-21-E3	Check and observation to be noted in Table below.

Test Results:

Colour of Loose tube	Colour of Fibre	Initial Reading		Final Reading		Change in Attenuation (dB)		Observation / Remarks
		1310 nm	1550 nm	1310 nm	1550 nm	1310 nm	1550 nm	

Note :

1. Please state the type & number of fibres in the cable.
2. The manufacturer shall specify with the maximum and minimum values of the fibre during bulk production.

Clause No.	Clause	Type of Test / Test No. etc. *
4.4	**Impact Test:** The impact caused by a weight of 20 Newton, dropped 3 times (one in 3 different places spaced not less than 500 mm apart) from a height of 0.5 meters on a surface of radius 300 mm shall be withstood by cable. The change in attenuation of each fibre after the test shall be ≤ 0.05 dB, both for 1310 nm and 1550 nm wavelength. **Test Method** : IEC 60794-1-21-E4.	Check and observation to be noted in Table below.

Test Results:

Colour of Loose tube	Colour of Fibre	Initial Reading		Final Reading		Change in Attenuation (dB)		Observation / Remarks
		1310 nm	1550 nm	1310 nm	1550 nm	1310 nm	1550 nm	

Note :

1. Please state the type & number of fibres in the cable.
2. The manufacturer shall specify with the maximum and minimum values of the fibre during bulk production.

Clause No.	Clause	Type of Test / Test No. etc. *
4.5	**Repeated Bending Test:** **Parameters:** Length of Cable sample : 5 M (minimum) Weight : 5 Kg Minimum distance from Pulley centre to holding device : 216 mm	Check and observation to be noted in Table below.

	Minimum distance from Wt. to Pulley centre: 457mm Pulley Diameter: 20D (D–cable diameter) Angle of Turning : 90° No. of cycles: 30 Time required for 30 cycles: 2 min The fibre shall not break during repeated bending of cable. The change in attenuation of each fibre after the test shall be ≤ 0.05 dB, both for 1310 nm and 1550 nm wavelength. **Test Method:** EIA-455-104/ IEC 60794-1-2-E6	

Test Results:

Colour of Loose tube	Colour of Fibre	Initial Reading		Final Reading		Change in Attenuation (dB)		Observation / Remarks
		1310 nm	1550 nm	1310 nm	1550 nm	1310 nm	1550 nm	

Note :

1. Please state the type & number of fibres in the cable.
2. The manufacturer shall specify with the maximum and minimum values of the fibre during bulk production.

Clause No.	Clause	Type of Test / Test No. etc. *
4.6	**Torsion Test:** **Parameters:** Length of sample: 2 M Load: 100 N No. of cycles: 10 The cable shall withstand the 100N load for 10 cycles and there shall be no cracks and tearing on the outer sheath of the cable. The fibres and other component parts of the cable shall not be damaged. The change in attenuation of each fibre after the test shall be ≤ 0.05 dB, both for 1310 nm and 1550 nm wavelength. **Test Method:** IEC 60794-1-21-E7	Check and observation to be noted in Table below.

Test Results:

Colour of Loose tube	Colour of Fibre	Initial Reading		Final Reading		Change in Attenuation (dB)		Observation / Remarks
		1310 nm	1550 nm	1310 nm	1550 nm	1310 nm	1550 nm	

Note :

1. Please state the type & number of fibres in the cable.
2. The manufacturer shall specify with the maximum and minimum values of the fibre during bulk production.

Clause No.	Clause	Type of Test / Test No. etc. *
4.7	**Kink Test:** **Parameters:** Length of sample: 10 R (R – Minimum bending radius) Minimum Bend radius: 20D (D- Diameter of cable) The loop to the minimum bend radius shall not form any kink on the cable. The change in attenuation of each fibre after the test shall be ≤ 0.05 dB, both for 1310 nm and 1550 nm wavelength. **Test Method:** IEC 60794-1-21-E10.	Check and observation to be noted in Table below.

Test Results:

Colour of	Colour of	Initial Reading	Final Reading	Change in Attenuation (dB)	Observation / Remarks

Loose tube	Fibre	1310 nm	1550 nm	1310 nm	1550 nm	1310 nm	1550 nm	

Note :

1. Please state the type & number of fibres in the cable.
2. The manufacturer shall specify with the maximum and minimum values of the fibre during bulk production.

Clause No.	Clause	Type of Test / Test No. etc. *
4.8	**Cable Bend Test:** The cable shall withstand repeated flexing when wrapped and unwrapped 10 times with 4 complete turns around a mandrel having diameter of 20 D, where D is the diameter of the cable and there shall be no cracks on the outer sheath of the cable. The change in attenuation of each fibre after the test shall be ≤ 0.05 dB, both for 1310 nm and 1550 nm wavelength. **Test Method:** IEC 60794-1-2-E11 (Procedure-I).	Check and observation to be noted in Table below.

Test Results:

Colour of Loose tube	Colour of Fibre	Initial Reading		Final Reading		Change in Attenuation (dB)		Observation / Remarks
		1310 nm	1550 nm	1310 nm	1550 nm	1310 nm	1550 nm	

Note :

1. Please state the type & number of fibres in the cable.
2. The manufacturer shall specify with the maximum and minimum values of the fibre during bulk production.

Clause No.	Clause	Type of Test / Test No. etc. *
4.9	**Cable bend Test at High & Low Temp.:** Test Temperature : - 20°and + 70° C Mandrel Diameter : 20D (D- Diameter of cable). No. of turns : 4	Check and observation to be noted in Table below.

	Conditioning Time Duration : 24 hours at each temperature. There shall be no permanent physical damage to the cable. The change in attenuation of each fibre after the test shall be ≤ 0.05 dB, both for 1310 nm and 1550 nm wavelength. **Test Method:** EIA RS-455-37/ FOTP 37 /IEC 60794-1-22-F1	

Test Results:

A) Cable length code:

Temperature: Ambient

Colour of Loose tube	Colour of Fibre	Initial Reading		Final Reading		Change in Attenuation (dB)		Observation / Remarks
		1310 nm	1550 nm	1310 nm	1550 nm	1310 nm	1550 nm	

B) Cable length code:

Temperature: - 20 °C

Colour of Loose tube	Colour of Fibre	Initial Reading		Final Reading		Change in Attenuation (dB)		Observation / Remarks
		1310 nm	1550 nm	1310 nm	1550 nm	1310 nm	1550 nm	

B) Cable length code:

Temperature: +70 °C

Colour of Loose tube	Colour of Fibre	Initial Reading		Final Reading		Change in Attenuation (dB)		Observation / Remarks
		1310 nm	1550 nm	1310 nm	1550 nm	1310 nm	1550 nm	

C) Cable length code:

Temperature : Ambient

Colour of Loose tube	Colour of Fibre	Initial Reading		Final Reading		Change in Attenuation (dB)		Observation / Remarks
		1310 nm	1550 nm	1310 nm	1550 nm	1310 nm	1550 nm	

Note :

1. Please state the type & number of fibres in the cable.
2. The manufacturer shall specify with the maximum and minimum values of the fibre during bulk production.

Clause No.	Clause	Type of Test / Test No. etc. *

4.10	**Temperature Cycling:** **Parameters:** Standard cable length of drum: 4Km/2 Km/1Km + 5 % Temperature Range for Storage: -20°C Temperature Range for Operation: -20°C to +70°C. Rate of change of temperature: 1° per minute Temperature Cycling: 12 hrs. each at temp. given below: TA2 temp.: - 20°C TA1 temp.: - 10°C. TB1 temp.: + 60°C. TB2 temp.: + 70°C. Nos. of temperatures cycle : 2 The change in attenuation of each fibre after the test shall be ≤ 0.05 dB, both for 1310 nm and 1550 nm wavelength for the entire range of temperature. **Test Method:** IEC 60794-1-22-F1.	Check and observation to be noted in Table below.

Test Results:

A) Cable length code:

Temperature: Ambient

Colour of Loose tube	Colour of Fibre	Initial Reading		Final Reading		Change in Attenuation (dB)		Observation / Remarks
		1310 nm	1550 nm	1310 nm	1550 nm	1310 nm	1550 nm	

B) Cable length code:

Temperature: - 20 °C

Colour of Loose tube	Colour of Fibre	Initial Reading		Final Reading		Change in Attenuation (dB)		Observation / Remarks
		1310 nm	1550 nm	1310 nm	1550 nm	1310 nm	1550 nm	

C) Cable length code:

Temperature : - 10 °C

Colour of Loose tube	Colour of Fibre	Initial Reading		Final Reading		Change in Attenuation (dB)		Observation / Remarks
		1310 nm	1550 nm	1310 nm	1550 nm	1310 nm	1550 nm	

D) Cable length code:

Temperature : + 60 °C

Colour of Loose tube	Colour of Fibre	Initial Reading		Final Reading		Change in Attenuation (dB)		Observation / Remarks
		1310 nm	1550 nm	1310 nm	1550 nm	1310 nm	1550 nm	

E) Cable length code:

Temperature : + 70 °C

Colour of Loose tube	Colour of Fibre	Initial Reading		Final Reading		Change in Attenuation (dB)		Observation / Remarks
		1310 nm	1550 nm	1310 nm	1550 nm	1310 nm	1550 nm	

F) Cable length code:

Temperature : Ambient

Colour of	Colour of	Initial Reading	Final Reading	Change in Attenuation (dB)	Observation / Remarks

Loose tube	Fibre	1310 nm	1550 nm	1310 nm	1550 nm	1310 nm	1550 nm	

Note :

1. Please state the type & number of fibres in the cable.
2. The manufacturer shall specify with the maximum and minimum values of the fibre during bulk production.

Clause No.	Clause	Type of Test / Test No. etc. *
4.11	**Cable Aging test (Type Test):** After Temperature cycle test, the cable shall be exposed to 85 + 2 degree C for 168 hours. The change in attenuation of each fibre after the test shall be ≤ 0.05 dB, both for 1310 nm and 1550 nm wavelength. Test Method: IEC 60794-1-2-F9 **Note:** The attenuation measurement to be made	Check and observation to be noted in Table below.

	after stabilization of the test cable at ambient temperature for 24 hours. The attenuation changes are to be calculated with respect to the base line attenuation values measured at room temperature before temperature cycling.	

Test Results:

Colour of Loose tube	Colour of Fibre	Initial Reading		Final Reading		Change in Attenuation (dB)		Observation / Remarks
		1310 nm	1550 nm	1310 nm	1550 nm	1310 nm	1550 nm	

Note :

1. Please state the type & number of fibres in the cable.
2. The manufacturer shall specify with the maximum and minimum values of the fibre during bulk production.

Clause No.	Clause	Type of Test / Test No. etc. *
4.12	**Water Penetration Test (Type Test):** A circumferential portion of the cable end (loose	Check and observation to be

	tube) shall be supported horizontally facing the one meter water head, containing sufficient quantity of water soluble fluorescent dye, for seven days at ambient temperature. No dye shall be detected at the end of 3m cable length when examined with ultraviolet light detector. **Test Method:** IEC 60794-1-2-F5 (Fig. B) 1999. **Note:** For bulk testing, WPT test may be conducted for 24 hours.	noted in Table below.

Test Results:

Length code No.	End	Date	Time In	Date	Time Out	Observation / Remarks
Sample no 1	Top					
	Bottom					
Sample no 2	Top					
	Bottom					

Note :

1. Please state the type & number of fibres in the cable.
2. The manufacturer shall specify with the maximum and minimum values of the fibre during bulk production.

Clause No.	Clause	Type of Test / Test No. etc. *
4.13	**Test of Figure of 8 (Eight) on the cable (Type Test):** It shall be possible to make figure of 8 (Eight) of minimum 1000 meter length of the cable uncoiled	Check and observation to be noted in Table below.

	from the cable reel, without any difficulty. The diameter of each loop of the figure of 8 shall be maximum 2 meters. There shall be no visible damage.	

Test Results:

Length Code No.	Observation	Remarks

Clause No.	Clause	Type of Test / Test No. etc. *
4.14	**Flexural Rigidity Test (Type Test):** The cable shall withstand the Flexural Rigidity test as per the method and no cracks shall be visible on sheath of cable. The change in attenuation of each fibre after the test shall be ≤ 0.05 dB at both 1310 nm and 1550 nm wavelengths **Test Method:** ASTM D 790	Check and observation to be noted in Table below.

Test Results:

Colour of Loose tube	Colour of Fibre	Initial Reading		Final Reading		Change in Attenuation (dB)		Observation / Remarks
		1310 nm	1550 nm	1310 nm	1550 nm	1310 nm	1550 nm	

Note :

1. Please state the type & number of fibres in the cable.
2. The manufacturer shall specify with the maximum and minimum values of the fibre during bulk production.

<table>
<tr><th>Clause No.</th><th>Clause</th><th>Type of Test / Test No. etc. *</th></tr>
<tr><td>4.15</td><td>Cable Jacket Yield Strength and Ultimate Elongation:

Parameters:

<table>
<tr><td rowspan="2">Jacket Material</td><td colspan="2">Minimum Yield Strength</td><td rowspan="2">Minimum Elongation (%)</td></tr>
<tr><td>(Mpa)</td><td>(psi)</td></tr>
<tr><td>HDPE unaged</td><td>16.5</td><td>2400</td><td>400</td></tr>
<tr><td>HDPE aged</td><td>12.4</td><td>1800</td><td>375</td></tr>
</table>

The aged sample taken from a completed cable conditioned at 100 + 2°C for 120 hours before</td><td>Check and observation to be noted in Table below.</td></tr>
</table>

	testing at cross-head speed of 50 mm per minute. Test Method: FOTP-89 or ASTM D1248 Type III Class.	

Test Results:

S. No.	Sheath Material	Minimum Yield Strength	
		(16.5 Mpa)	(2400 psi)
Sample No.1	HDPE Unaged		
Sample No.2	HDPE Unaged		

S. No.	Sheath Material	Minimum Yield Strength	
		(12.4 Mpa)	(1800 psi)
Sample No.1	HDPE aged		
Sample No.2	HDPE aged		

S. No.	Sheath Material	Elongation 400 %
Sample No.1	HDPE Unaged	
Sample No.2	HDPE Unaged	

S. No.	Sheath Material	Elongation 375 %
Sample No.1	HDPE aged	

Sample No.2	HDPE aged	

Note :

1. Please state the type & number of fibres in the cable.
2. The manufacturer shall specify with the maximum and minimum values of the fibre during bulk production.

Clause No.	Clause	Type of Test / Test No. etc. *
4.16	**Drip Test:** **Parameters:** Length of cable sample : 30 cm Length of open end of cable sample : 5 cm Temperature : 70° C Period : 24 hours The cable sample shall be 30 cm with one end sealed. Outer sheath, Aramid yarn and FRP shall be removed for 5 cm from open end of sample. The paper placed below the cable sample, kept vertically inside the oven for 24 hours at 70° C, shall be examined for dripping of the jelly after 24 hours and there shall be no jelly drip or oil impression on the paper **Test Method:** TIA/EIA-455-81-A-1992 [B9] or IEC 60794-1-22-F16 or IEC 60794-1-21-E14	Check and note down the observation.

Test Results:

Length Code No.	Observation	Remarks

Clause No.	Clause	Type of Test / Test No. etc. *
4.17	**ESCR (Environmental Stress Cracking Resistance) Test:** The Outer sheath of the optical fibre cable shall be checked and tested for ECSR. There shall not be any visible cracks on the surface of the outer sheath, when examined with the help of a magnifying glass at the end of 48 hours in a 10% Igepal solution. **Test Method:** ASTM D 1693	Check and note down the observation.

Test Results:

Length Code No.	Observation	Remarks

Clause No.	Clause	Type of Test / Test No. etc. *
4.18	**UV radiation Test (Type Test)** The effect of UV radiation shall be checked on the following: i) On the Outer Sheath material (HDPE). ii) On the meter and other legend markings.	Check and note down the observation.

	Parameters: Type of Lamp : 40 Watt UV-B lamp with a peak emission at 313nm. Duration : 500 hours There shall be no fading or change in the colour of the Markings and that of Outer sheath. **Test Method:** ASTM G-53 – 96 (ASTM G 154)	

Test Results:

Length Code No.	Observation	Remarks

Clause No.	Clause	Type of Test / Test No. etc. *
4.19	**Check of the quality of the loose tube (containing optical fibre)** **a) Embrittlement Test of loose Tube** **Parameters:** Minimum length of sample: 85 mm Outside diameter of Tube: ≤ 2.5 mm Speed of movable jaw: 50 mm per minute Safe bend diameter of tube :15 D (D -Outside dia. of the loose tube. The minimum length of the test sample depends	Check and note down the observation.

	on the outside diameter of the loose tube and shall 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 x √ (D2 + d2) / 4 Where Lo = Length of tube under test. D = Outside dia. of loose tube. d = Inside dia. of loose tube. Example: - Fibre optic tube, D = 5mm, d = 3mm Lo > 100 x √(52 + 32) / 4 = 100 x 5.83/4 = 145.8 The tube shall not get embrittled. No ink shall be appeared on the tube up to 15 D. There shall also not be any physical damage or mark on the tube surface. **b) Kink resistance Test on the loose Tube** **Parameters:** Tube sample: Long loose tube with fibre & gel Min. bend radius of tube: 15 D (D -Outside diameter of the loose tube. No. of times : 4 No damage or kink shall be appeared on the surface of the tube.	

Test Results:

Length Code No.	Observation	Remarks

Clause No.	Clause	Type of Test / Test No. etc. *
4.20	**Drainage Test for loose Tube:** **Parameters:** Sample Size : 30 cm tube length Tube in horizontal position : 24 hrs. at ambient temperature Tube in vertical position: 24 hrs. at 70° C There shall be no gel or oil in the beaker.	Check and note down the observation.

Test Results:

Length Code No.	Observation	Remarks

Clause No.	Clause	Type of Test / Test No. etc. *
4.21	**Check of easy removal of sheath:** 300mm sheath shall be removed easily by using normal sheath removal tool and no undue extra force shall be applied to remove the sheath. No component part of cable shall be damaged.	Check and note down the observation.

Test Results:

Length Code No.	Observation	Remarks

Clause No.	Clause	Type of Test / Test No. etc. *
4.22	**Check of the effect of aggressive media on the cable (Type Test)** **Parameters:** Aggressive media solution: PH - 4 & PH-10 Length of sample of finished cable: 600 mm Duration of test: 30 days Effect of aggressive media shall be checked by solution of PH4 and PH10 on test samples of the finished cable, each of 600mm in length with sealed ends for 30 days. There shall be no corrosion on the sheath and other markings of the cables. **Test Method :** ISO175	Check and note down the observation.

Test Results:

Length Code No.	Observation	Remarks

Clause No.	Clause	Type of Test / Test No. etc. *
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	The method of imprinting (Indenting) and its quality must be checked as per the requirement of the GR and also the accuracy of the sequential marking shall be checked by standard measuring scale at three different places. It shall meet the requirement of clause.
5.1.2	The marking shall be of clearly contrast colour (White) on the black HDPE sheath and shall be done by hot foil indentation method. The colour used must withstand the environmental influences experienced in the field. The marking on the cable shall be permanent, insoluble in water and shall be legible for duration of cable life.	The contrast colour shall be checked & noted and the method of imprinting (Indenting) must be checked as per the requirement of clause.
5.1.3	The type of legend marking on O.F. cable shall be as follows: a) Company Legend	This shall be checked as per the requirement of

	b) Legend containing telephone mark & international acceptable Laser symbol c) Type of cable i.e. Loose Tube d) Type of Fibre G. 657 A1/A2(Optional) e) Number of Fibres f) Year of manufacture g) Sequential length marking h) User's Identification i) Cable ID	clause.
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 Standard for GR No. TEC 69370:2004 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. The diameter of the cable shall also be marked on the cable drum.	The requirement of the clause shall be checked in detail and the observation to be noted.
5.2.2	An Anti-twist device (Free head hook) shall be provided attached to the both end of the cable	The tensile strength requirement shall be

	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. Note: The requirement of Pulling eyes may be decided by purchaser.	checked with pulling eye and its coupling system along with the anti-twist device shall be checked and noted.
5.3	**The nominal drum length:**	
5.3.1	Length of OF Cable in each drum shall be 1 Km ± 5 % / 2 Km ± 5 % / 4Km ± 5% and shall be supplied as per the order. The variation in length of optical fibre cable, as specified above (in each drum), shall be acceptable.	Check as per the requirement of the clause & comment.
5.3.2	The fibres in cable length shall not have any joint.	This shall be examined for each fibre and observations to be noted. A certificate/ undertaking may be obtained for the bulk production.
5.3.3	The drum shall be marked with arrows to indicate the direction of rotation.	Check as per the requirement of the clause & comment.
5.3.4	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	The packing list shall be checked as per the above requirement and observation to be noted.

<table>
<tr><td></td><td>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</td><td></td></tr>
<tr><td>5.4</td><td>Colour coding in the OF Cable:</td><td></td></tr>
<tr><td>5.4.1</td><td>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-598C) and also IEC Publication 304 (4).</td><td>Check as per the requirement of the clause & comment.</td></tr>
<tr><td>5.4.2</td><td>Colour Coding Scheme: The individual Optical Fibre shall be colour coded as per Table-IV below:
Table –IV: Colour coding scheme
<table>
<tr><th>Fiber No.</th><th>Fibre Colour</th></tr>
<tr><td>1</td><td>Blue</td></tr>
<tr><td>2</td><td>Orange</td></tr>
<tr><td>3</td><td>Green</td></tr>
<tr><td>4</td><td>Brown</td></tr>
<tr><td>5</td><td>Slate</td></tr>
<tr><td>6</td><td>White</td></tr>
<tr><td>7</td><td>Red</td></tr>
<tr><td>8</td><td>Black</td></tr>
<tr><td>9</td><td>Yellow</td></tr>
</table></td><td>The colour coding identification method shall be checked & observation to be noted as per the requirement of the GR.</td></tr>
</table>

	10	Violet	
	11	Rose/Pink	
	12	Aqua	
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.		Check as per the requirement of the clause and verify the validity of the ISO certificate.
6.2	**Raw Material:**		
6.2.1	The cable shall use the Raw Materials approved against the Standard No. TEC 89010:2021(or latest release) and the subsequent amendment issued, if any.		The list of the Raw Material and its approval shall be checked.
6.2.2	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		The details of material shall be taken & be checked.
6.2.3	The Raw Materials used from multiple sources is permitted and the source / sources of Raw Materials (Type and grade) from where these have been procured shall be submitted by the manufacturer.		The details shall be obtained from the manufacturer & checked.
6.2.4	The manufacturer can change the Raw Materials from one approved source to other approved source with the approval of QA, BSNL. The change of source/grade of SM Optical Fibre and/or design of cable shall call for		This shall be checked as per the requirement of the clause.

	fresh type approval.	
6.2.5	The HDPE Black in colour used for outer sheath shall be UV stabilized and shall withstand UV test for 2000 hrs. (minimum). **Note:** A test certificate from a recognised laboratory or institute may be acceptable for the UV stability of the sheath material	The material specification shall be checked and undertaking/ certificate to be taken for the requirement.
6.2.6	The material used in optical fibre cable must not evolve hydrogen that will affect the fibre loss. **Note:** Test certificate from a recognized laboratory or institute may be acceptable	Check as per the requirement of the clause & comment. Certificate / Undertaking may be obtained.
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. 6.3.3 of Telcordia 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	Check as per the requirement of the clause & comment. Certificate / Undertaking may be obtained.

	make and grade.	
7.0	**Safety Requirement:** The material used in the manufacturing of the optical fibre cables 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 OF Cable to substantiate the statement. Note: 1. Manufacturers having approval certificate against existing TEC GR No. TEC/GR/TX/OFC-026/01/APR-18 can apply for approval certificate against revised Standard for GR No. TEC 85220:2022 but the period of validity shall remain the same as applicable for the earlier certificate. In case there is no change of source/grade of SM Optical Fibre and/or design of cable then all the tests may not be repeated in next approvals and tests will be conducted only for the modified/inserted clauses. However, if the Manufacturer has made any changes in source/grade of Raw material then the case will be considered for fresh Approval against the new Standard for GR. 2. Latest issue of the Standards mentioned in the GR, may be referred.	The details may be obtained & checked. Certificate / Undertaking may be obtained.

CHAPTER – 2

Clause No.	Clause	Type of Test / Test No. etc. *
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.	Details submitted by the manufacturer shall be checked & as per the requirement of the clause.
8.2	All aspects of 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.	Details submitted by the manufacturer shall be checked & as per the requirement of the clause.
9.0	**Information for the Procurer of product:**	
9.1	Purchaser may ask for Aerial drop cable with G.657.A1 fibre or G.657.A2 fibre as per their requirements. Technical comparison of G.657.A1 fibre and G.657.A2 fibre as per TEC standard, is given as below: **Technical Comparison between G.657 A1 Fibre & G.657 A2 Fibre**	

Attribute	G.657.A1	G.657.A2
Mode field diameter at 1310nm	8.8-9.2 (± 0.4) µm	8.6 ± 0.4 µm
Attenuation at 1310nm	≤ 0.34 dB/km	≤ 0.35 dB/km
Attenuation at 1550nm	≤ 0.20 dB/km	≤ 0.21 dB/km
Attenuation at 1490nm	≤ 0.24 dB/km	≤ 0.24 dB/km
Attenuation at 1625nm	≤ 0.23 dB/km	≤ 0.23 dB/km
Attenuation at 1383 nm ± 3nm	≤ 0.34 dB/km	≤ 0.35 dB/km
Macrobend loss, 10 turns, 15 mm radius, 1550 nm	≤0.25 dB	≤0.03 dB
Macrobend loss, 10 turns, 15 mm radius, 1625 nm	≤1.0dB	≤0.1 dB
Macrobend loss, 1 turn, 10 mm radius,1550 nm	≤0.75 dB	≤0.1 dB
Macrobend loss, 1 turn,	≤1.5 dB	≤0.2 dB

		10 mm radius,1625 nm			
		Macrobend loss, 1 turn, 7.5 mm radius, 1550 nm	Not specified	≤0.5 dB	
		Macrobend loss, 1 turn, 7.5 mm radius, 1625 nm	Not specified	≤1.0 dB	
		PMD	≤ 0.15 ps/√km	≤ 0.2 ps/√km	
9.2	Presently, few manufacturers have started manufacturing G.657 A2 fibre with following specification: Mode file diameter (MFD) at 1310nm for G.657 A2 fibre: 9.1 ± 0.4 µm (Optional) The purchaser may ask for the G.657 A2 fibre as per their requirement with above specifications.				
9.3	It is suggested that the Optical fibre cable supplied in a particular route may be manufactured from a single source of optical fibres.				
9.4	The requirement for Rip cord may be decided by purchaser.				
9.5	The requirement of Pulling eyes may be decided by purchaser.				
10.0	**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 Self-Supported Metal Free Aerial Optical Fibre Cable against this GR and subsequent amendments, if any.	

***** *Physical Check/Declaration/Documentation/ Report from Accredited test lab/ Functional verification / Information / Test No.*

I. SUMMARY OF TEST RESULTS

GR/IR No._____

TSTP No._____

Equipment name & Model No._____

Clause No.	*Compliance* *(Complied /Not Complied / Submitted/Not Submitted / Not Applicable)*	*Remarks /* *Test Report Annexure No.*

[Add as per requirement]

Date:

Place: *Signature & Name of TEC testing Officer /*

** Signature of Applicant / Authorized Signatory*

**** Section J as given above is also to be submitted by the Applicant/ Authorised signatory as part of in-house test results along with Form-A. The Authorised signatory shall be the same as the one for Form 'A'.***

ANNEXURE –A

The following parameters of the component parts of the cable are to be taken into 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.

Table A 1: Cable Design parameters

SN	Parameter	Unit	Design Type			
1	Fiber Count	No.	2F	4F	6F	12F
2	Fiber Per Tube	No.	2	4	6	12
3	Fiber Color		Blue, Orange,	Blue, Orange, Green, Brown	Blue, Orange, Green, Brown, Slate, White,	Blue, Orange, Green, Brown, Slate, White, Red, Black, Yellow, Violet, Pink, Aqua.
4	Tube Internal Diameter	mm	1.4 +/- 0.1	1.4 +/- 0.1	1.7+/- 0.1	1.7+/- 0.1
5	Tube Outer Diameter	mm	2.0 +/- 0.1	2.0 +/- 0.1	2.5 +/- 0.1	2.5 +/- 0.1
6	Loose Tube Color		Natural	Natural	Natural	Natural
7	Loose Tube Material		PBT	PBT	PBT	PBT
8	Embedded Strength Member Material		FRP/ARP	FRP/ ARP	FRP/ ARP	FRP/ARP

9	Diameter of FRP/ARP (Embedded Strength Member)	mm	1.0+0.1	1.0+0.1	1.0+0.1	1.0+0.1
10	Glass Yarns (Peripheral Strength Member)	Kg/ Km	5.0 ± 0.5	5.0 ± 0.5	5.0± 0.5	5.0± 0.5
11	Sheath Material		UV Proof HDPE	UV Proof HDPE	UV Proof HDPE	UV Proof HDPE
12	Colour of Sheath Material		Black	Black	Black	Black
13	Thickness of Sheath Material (Minimum)	mm	2.0	2.0	2.0	2.0
14	Cable Weight	Kg/ Km	45 ± 10%	45 ± 10%	50 ± 10%	50 ± 10%
15	Cable Diameter	mm	7.0 ± 0.5	7.0 ± 0.5	8.0 ± 0.5	8.0 ± 0.5