PROVISONAL TEST SCHDULE AND TEST PROCEDURE FOR OPTICAL FIBRE JUMPERS

(Type-I to Type-IV)

&

ADAPTERS

(Type-I to Type-IV)

AND

HYBRID JUMPERS

(Type-I to Type-VI)

&

HYBRID ADAPTERS

(Type-I to Type-VI)

No. TEC/ TSTP /GR/TX/OFJ-01/05/OCT-09

(GR No. TEC/GR/TX/OFJ-01/05/OCT-09)

TEC

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TEST SCHEDULE AND TEST PROCEDURE
FOR
OPTICAL FIBRE JUMPERS (Type-I to Type-IV)
&
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No. TEC/TSTP/GR/TX/OFJ-01/05/OCT-09

Introduction :

This document enumerates the detailed test schedule and test procedure for evaluating the performance of Optical fibre Jumpers (Type-I-to Type-IV), Adapters (Type-I-to Type-IV), Hybrid Jumpers (Type-I-to Type-VI) and Hybrid Adapters (Type-I-to Type-VI) as per the GR (clause wise). The test procedure will serve as guidelines for the testing officers and will provide uniform and standard method of testing.

Before the evaluation is undertaken, the following points are to be verified from the documents already supplied by the manufacturer:

1. Infrastructure assessment of the factory (Infrastructure assessment of the manufacturer/ Trader shall be carried out to check the availability of the instruments and other accessories required for the testing of Optical fibre Jumpers (Type-I-to Type-IV), Adapters (Type-I-to Type-IV), Hybrid Jumpers (Type-I-to Type-VI) and Hybrid Adapters (Type-I-to Type-VI), which is mandatory).
2. Compliance Report as per the GR.
3. Construction details of the Jumpers and Adapters.
4. Specifications of materials used for manufacturing the Jumpers and Adapters.
5. Source of supply of the materials.

Selection of Samples: Any five samples shall be selected from the lot of 25 samples offered by the manufacturer for evaluation.

List of instruments required for the proper quality check of the items during type approval & bulk production:

1. Interferometer measuring Instrument to check the Surface topography of the fibre connector (clause no. 4.1)
2. Concentricity measuring Instrument to check the Concentricity of the fibre connector (clause no. 4.1)
3. Stabilized Light Source (with stability $\pm$ 0.05 dB and wavelength 1310 nm and 1550 nm)
4. Power meter (with resolution 0.01 dB and wavelength 1310nm and 1550nm)
5. Tensile strength measuring apparatus
6. Force generator capable of smoothly applying the specified force at the specified rate;
7. Torque measuring instrument
8. Torque generator
9. Torque wrench.
10. Patch cords
11. Adapters
12. Reference patch cord with known insertion loss.
13. Reference connector set of the plug-adapter-plug configuration with known insertion loss.
14. Directional Coupler (Return Loss Bridge with measurement range upto 60 dB)
15. Refractive Index Matching Liquid.
16. Clamping Device
17. Adjustable clamp or fixture
18. Fixed clamp and a rotating clamp
19. Suitable clamp or a panel mounting adapter
20. Suitable cable clamping fixture
21. Load cell with a maximum error of $\pm$ 3% of its maximum range.
22. Mandrel of 2.5 times cable diameter
23. Shallow box or tray, nominally 300 mm $\times$ 300 mm, capable of housing of a representative ground or floor surface;
24. A pad of resilient or rigid material, nominally 100 mm $\times$ 100 mm $\times$ 12 mm thick, bonded to a non-yielding plate;
25. Rigid metal plate to mount the specimen securely.
26. Impact surface.

Physical Parameters of the Optical Fibre Jumper/Adapter: Before taking the physical measurements, the following information is to be recorded for each sample.

1. No. of samples of the Jumper/Adapter taken for test =
2. Length of each jumper =
3. Type of Connectors used =
4. Material used in the Jumper/Adapter =
5. Colour of the Patch cord cable =

PART I – TECHNICAL SPECIFICATION

Clause No.	TEC Requirement	Observation and Remarks
1.0	**Introduction:** This document describes generic requirements for Single mode Optical Fibre Jumpers (Patch cords and Pigtails) (Type-I to Type-IV), Adapters (Type-I to Type-IV), Hybrid Jumpers (Type-I to Type-VI) and Hybrid Adapters (Type-I to Type-VI). These are used for terminations, connecting the Optical Line Systems to outdoor / Indoor optical fibre cables and other optical measurement purposes. Note: No tests are required. Verify manufacturer compliance for the requirement as stated in the clause. Pigtails shall be obtained by cutting patch cord for all types.	
2.0	**Functional Requirements:**	
2.1	The Optical fibre jumper and Hybrid Jumpers shall be manufactured with secondary coated optical fibre reinforced with Aramid yarn equally distributed over the periphery and with overall protective sheathing Note: Check the manufacturer's compliance for the construction as per the requirement of the clause. A cross section diagram with dimensions may be attached.	
2.2	The mechanical design and construction of the component parts of each sub-assembly shall be inherently robust and rigid under all conditions of operation, adjustment, replacement, storage and transport. Note: Check the manufacturer's compliance for • Mechanical design and construction of the component parts of each sub-assembly • A cross section of the assembled connector and the cable to be checked and attach the cross section diagram in the test results along-with dimensions.	
2.3	Special tools required, if any, for handling & maintenance of the Optical Fibre Jumper, hybrid jumpers, Adapters and Hybrid Adapters shall be clearly indicated and supplied. Note: Check of various operations and the list of special tools required for operation and supplied, if any, other than the tools specified in optical tool kit wide GR No. GR/OFT–01/03 MAR 2006.	

2.4 The manufacturer shall also have maintenance/repair facilities. Trader seeking TAC shall be fully equipped with all test facilities which shall be mandatory. Note: Check the maintenance/repair facility in India with the manufacturer. Check the minimum testing facilities available as below comment. 1) Back reflection meter to measure 1310 & 1550 nm. 2) Interferometer 3) Concentricity meter 4) Repeated bending machine 5) Torsion testing Machine 6) Tensile testing machine 7) Drop tester 8) Impact testing machine. 2.5 The detail of source of the components/accessories, from where these have been procured shall be submitted by the manufacturer. Note: Check the manufacturer compliance for source of the components / accessories from where these have been procured 2.6 The component parts which are available from multiple sources shall be used. Note: Check the manufacturer's compliance for : • use of proprietary component parts • list of such parts • component parts from multiple sources • Check the total components parts from the list supplied. 2.7 The optical fibre jumper shall be flame retardant and meet the requirement of UL-94-V-0 / ISI 10810 (Part 53) specifications. Note: Check the manufacturer compliance for: • Flame retardant • ISI specification No. UL-94-V-0 / ISI 10810 (part 53) Flame retardant test certificate along with test report, to be submitted from the recognised laboratory.	

3.0 Technical Requirements of Optical Fibre Jumper:

Single Mode Optical Fibre used in manufacturing Optical Fibre Jumper (Optical patch cords and pigtails) and Hybrid jumpers shall have the following characteristics:

Note: Each of the following parameters shall be checked and measured with the help of Automatic Fibre Characterisation system. If the test facilities do not exist, certificate along with the test reports may be accepted from the manufacturer of the simplex cable and the fibre manufacturer.

Cl No.	TEC Requirement	Observation/Remarks
3.1	**Type of fibre** (Wavelength band optimized nominal 1310 nm): Single mode Optical fibre as per ITU-T Rec. G.657 A	

3.2 Geometrical Characteristics:

3.2.1	Mode Field Diameter : 8.2– 9.4 µm	
3.2.2	Cladding Diameter : 125 ± 0.7 µm	
3.2.3	Cladding non circularity : ≤ 0.8 %	
3.2.4	Core Clad Concentricity Error : ≤ 0.5 um	

3.2.5 Diameter over Primary coating with double UV cured acrylate.
(This shall be measured on uncoloured fibre)

Specified Value: 245µm ± 10µm

Procedure : Primary coating diameter shall be measured with the help of Geometry Test set, Screw gauge, Micrometer or any other suitable instrument. Measurement shall be taken at three places on each sample and worst reading will be final reading.

S. No.	S. No. of Patch cord	Primary coating diameter (mm)		
		1	2	3
1.				
2.				
3.				
4.				
5.				

Result : Primary Coating Diameter shall be better than 235 um

Remarks:

Cl No. TEC Requirement	Observation/Remarks
3.2.6 Coating / Cladding Concentricity: ≤ 12 μm	
3.2.7 Primary coating material : UV Acrylate	

3.2.8 Secondary coating Diameter
(The secondary coating shall be natural in colour)

Specified Value : 900 μm ± 5 %

Procedure: Secondary coating diameter shall be measured with the help of Screw gauge, Micrometer or any other suitable instrument. Measurement shall be taken at three places on each sample and worst reading will be final reading.

S. No.	S. No. of Patch cord	Secondary coating diameter (mm)		
		1	2	3
1.				
2.				
3.				
4.				
5.				

Result : Secondary Coating Diameter shall be within specified value i.e. 900 μm ± 5 %

Remarks:

Cl No. TEC Requirement	Observation/Remarks
3.2.9 Secondary coating Material: Polyamide -12. Note: Test certificate along with test report, to be submitted from the recognised laboratory.	

3.3 Transmission Characteristics:

Each of the following parameters shall be checked and measured. If the test facilities do not exist, certificate along with test report may be accepted from the manufacturer of the simplex cable and the fibre manufacturer.

Cl No. TEC Requirement	Observation/Remarks
3.3.1 Attenuation:	

a) Fibre attenuation before Cabling

i) At 1310 nm	:	≤ 0.34 dB/Km
ii) Between 1285 to 1360 nm	:	≤ 0.37 dB/Km
iii) Between 1360 – 1480nm	:	≤ attenu. at 1310nm
iv) Between 1480 to 1525 nm	:	≤ 0.34 dB/Km
v) At 1550 nm	:	≤ 0.21 dB/Km
vi) Between 1525 to 1625 nm	:	≤ 0.24 dB/Km

b) Fibre attenuation after cabling

i) At 1310 nm	:	≤ 0.36 dB/km
ii) At 1383nm	:	≤ attenu. at 1310nm
iii) At 1550 nm	:	≤ 0.23 dB/Km
iv) At 1625 nm	:	≤ 0.26 dB/Km

Note:

1. Attenuation in the band 1380-1390nm shall be checked at every 2nm 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.
2. Sudden irregularity in attenuation shall be less than 0.1 dB
3. The spectral attenuation shall be measured on un-cabled fibre.
4. The Spectral attenuation in the 1250 nm–1625 nm band shall be measured at an interval of 10nm and the test results shall be submitted

Note: The fiber (G 657 A) used in patch cord/pig tails should be approved by CACT. The Hydrogen aging test is to be conducted during fiber approval. The test reports from source approved fiber manufacturer should be submitted at the time of source approval of patch cords.

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 on un-cabled fibre at an interval of 10nm and the test results shall be submitted.

b) Polarization mode dispersion at 1310 & 1550 nm

i) Fibre	:	≤ 0.2 ps/√ km
ii) Cabled Fibre	:	≤ 0.3 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 3.3.3 Cut off wavelength For fibres used in Patch cords & Pig-tails: 1240 nm Max. **Note -** The above cut off wavelength is w.r.t. 2M sample length of fibre. 3.3.4 Cable Cut off wavelength : 1260nm Max.	

3.4 Mechanical Characteristics:

Note: Each of the following parameters shall be checked and measured. If the test facilities do not exist, certificate along with test report may be accepted from the manufacturer of the simplex cable and the fibre manufacturer.

Cl No. TEC Requirement	**Observation/Remarks**
3.4.1 Proof test for minimum strain level : 1% (Test method IEC-60793-1-30) Note: The parameter shall be checked and measured.	
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 1.3 N. Note: Check the force to remove the primary coating of the fibre	
3.4.3 Strippability force to remove secondary coating of fibre: $\geq$ 5.0 Newton (The secondary coated fibre shall be easily strippable so that primary and secondary coating can be removed separately) Note: Check the force to remove the secondary coating of the fibre	
3.4.4 Dynamic Tensile Strength (Test method IEC- 60793-1-31)	

a) Un-aged : ≥550 KPSI (3.80 Gpa) b) Aged : ≥440 KPSI (3.00 Gpa) Note: The parameter shall be checked and measured.	
3.4.5 Dynamic Fatigue (Test method IEC- 60793-1-33) : ≥ 20 Note: The parameter shall be checked and measured.	
3.4.6 Static Fatigue (Test method IEC- 60793 - 1 - 33) : ≥ 20 Note: The parameter shall be checked and measured.	
3.4.7 Fibre Macro bend (Test method FOTP-62/ IEC- 60793 -1 -47) a) Change in attenuation when fiber is coiled with 10 turns on 15 mm radius mandrel : ≤ 0.25dB at 1550nm : ≤ 1.0 dB at 1625nm b) Change in attenuation when fiber is coiled 1 turn around 10 mm radius mandrel : ≤ 0.75 dB at 1550nm : ≤ 1.5 dB at 1625nm Note: The parameter shall be checked and measured.	
3.4.8 Fibre Curl (Test method as per IEC 60793-1 - 34): ≥4 meter radius of Curvature Note: The parameter shall be checked and measured.	

3.5 Material Properties:

Note: Each of the following parameters shall be checked and measured. If the test facilities do not exist, certificate along with test report may be accepted from the manufacturer of the simplex cable and the fibre manufacturer.

Cl No. TEC Requirement	**Observation/Remarks**
3.5.1 Fibre Materials: a) The substances of which the fibres are made Note: 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. Note**:** It shall meet the requirement of fibre stripping force as per clause No. 3.4.2 ii) The best way of removing protective coating material. Note: To be indicated by the manufacturer. c) Group refractive Index of fibre **Note**: The manufacturer shall indicate the variation in group refractive index of fibre during bulk production Note: To be indicated by the manufacturer. Certificate for the fibre material shall be obtained from the manufacturer. **3.6 Environmental Characteristic of Fibre (Type test):** **3.6.1 Operating Temperature** (Test Method IEC – 60793 – II - 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 EIA/TIA-455-73) Induced Attenuation at 1550 nm at -10°C to +85°C and 95% relative humidity: ≤ 0.05dB/km **3.6.3 Water Immersion 23°C** (Test method IEC- 60793 – I – 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 – I – 51)	

Induced Attenuation at 1550 nm due to temperature Aging at 85 ± 2°C: ≤ 0.05dB/km **3.6.5 Retention of Coating Color** (Test method IEC- 60793 – I – 51) Coated Fiber shall show no discernible change in color when aged for relative humidity : 30 days at 85°C & 95% Humidity and then 20 days in dry 85°C heat. Note: Check as per the requirement of clause. **3.7 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. Note: Check as per the requirement of clause. **3.8 Fibre Reinforcement:** Secondary coated fibre shall be covered with Aramid yarn and shall be distributed equally over the entire periphery. The manufacturer shall indicate the Detex value and quantity of the Aramid yarn used in the patch cord and pigtails. The specification for Aramid yarn shall be as per GR No. TEC/GR/TX/ORM-01/04/SEP-09 (Section–XVII). Note: Verify the manufacturer compliance and check the equal distribution over the periphery of the secondary coated fibre	

3.9 Outer Jacket Sheath:

A circular sheath of suitable low smoke zero halogen (LSZH) grade of material and of yellow in colour free from pinholes and scratches and other defects etc. shall be provided. The specification for Low smokes zero halogen (LSZH) shall be as per GR No. TEC/GR/TX/ORM-01/04/SEP-09 (Section–XX).

a) Outer sheath diameter : 2.90 mm $\pm$ 0.15 mm (FC-PC & SC)
2.00mm $\pm$ 0.2 mm (LC)

Procedure: Outer sheath diameter shall be measured with the help of Screw gauge, Micrometer or any other suitable instrument. Measurement shall be taken at three places on each sample and worst reading will be final reading.

S. No.	S. No. of Patch cord	Outer sheath diameter (mm)		
		1	2	3
1.				
2.				
3.				
4.				
5.				

Result: Outer sheath diameter shall be within specified value i.e. 2.90mm $\pm$ 0.15 mm

Remarks:

b) Thickness of sheath : 0.45 mm to 0.55 mm (FC-PC & SC)
(Refer to test method IEC – 189 0.30mm to 0.35 mm (LC)
para 2.2.1 and para 2.2.2)

Procedure: Thickness of sheath shall be measured with the help of Geometry Test set, Screw gauge, Micrometer or any other suitable instrument. Measurement shall be taken at three places on each sample and worst reading will be final reading.

S. No.	S. No. of Patch cord	Thickness of sheath (mm)		
		1	2	3
1.				
2.				
3.				
4.				
5.				

Result: Thickness of sheath shall be within 0.45 mm to 0.55 mm

Remarks: Comments for:
1. Type of material ----------
2. Colour of the cable. ----------
3. Quality and finish of the cable. ----------

3.10 Length of Patch cord and pigtails. : 5 meter +10cm / -5 cm | or as per order
: 10 meter +10cm / -5 cm |
: 20 meter +10cm / -5 cm

Procedure: Length of patch cords and pigtails shall be measured for three different lengths with the help of a standard measuring tape.

S. No.	S. No. of Patch cord	Length of patch cord / pigtails		
		5 meter	10 meter	20 meter
1.				
2.				
3.				
4.				
5.				

Result: Length of patch cord / pigtail should be within the specified value

Remarks:

3.11 CONNECTOR:

Cl No. TEC Requirement	**Observation/Remarks**
3.11.1 Type of connector: i) Type-I (FC-PC) ii) Type-II (SC-PC) iii) Type-III (SC-APC) iv) Type-IV (LC) **Note:** Design of each connector to be specified by manufacturer along with the diagram showing the dimensions. Note: Check as per the requirement of the clause and record the type of connector. Diagram showing the dimensions of each type of patch cords & adapters shall be provided by manufacturer. 3.11.2 Polish i) Type-I (FC-PC) : Convex (PC) ii) Type-II (SC– PC) : Convex (PC) iii) Type-III (SC- APC) : Angled polish (Ferrule shall be polished to 8°± 0.2° angle) v) Type-IV (LC) : Convex (PC) Note: It shall be checked with interferometer and observation may be recorded. 3.11.3 Ferrule with metallic flange: Zirconia ceramic/ Conical Zirconia ceramic (spring loaded anti-rotation keyed)	

Note: Type of ferrule used for each type of connector to be specified by manufacturer. Note: Check and certificate from the recognised laboratory regarding the material of ferrule and type i.e. spring loaded anti-rotation keyed shall be acceptable. 3.11.4 Ferrule Hole diameter : 125µm -126 µm **Note:** Length of the ferrule to be specified by manufacturer. Note: Check as per the requirement of clause. 3.11.5 Connector Body: a) FC-PC : Ni plated brass body (Ni plating shall be as per BIS Standards.) b) SC-PC & SC-APC: Engineering thermoplastic (Glass filled PBT) c) LC: PEI (Polyetherimide) / PPS (Polyphenylene Sulphide)" Note: Check and certificate from the recognised laboratory regarding the material of connector body conforming to the standards shall be acceptable. The certificate from the recognised laboratory for Glass filled PBT shall be produced. 3.11.6 Colour of connector body a) FC-PC connector : Ni plated Brass b) SC-PC connector : Blue c) SC-APC connector : Green d) LC connector : Blue Note: Check as per the requirement of the clause. 3.11.7 Strain Relief Boot a) Material: Polyester (Modified Thermo polyester Ethylene) **Note:** Check and certificate from the recognised laboratory regarding the material of strain Relief Boot shall be accepted. b) Length: ≥ 35mm for FC-PC & SC connector ≥ 25 mm for LC connector.	

Sample No.	Length:	Remarks
1		
2		
3		
4		
5		

3.12 ADAPTER (COUPLING)

3.12.1 FC-PC to FC-PC (Type-I)

a) Housing design: Square Flanged (screwed)

Note: Check and state the type of design

b) Material
   i) Alignment Sleeve: Zirconia Ceramic Split sleeve.

Sample No.	Length of Sleeve.	Inner Dia of Sleeve.	Outer Dia of Sleeve	Split Width
1				
2				
3				
4				
5				

   ii) Housing: Ni plated brass body

Note: Mounting screws are to be provided for FC-PC Adapter.

Note: Check for quality and finish of the adapter.

3.12.2 SC- PC to SC- PC (Type-II) and SC–APC to SC-APC (Type III)

a) Housing design: Rectangular Flanged (snap fit type)

Note: Check and state the type of design

b) Material
   i) Alignment Sleeve: Zirconia Ceramic Split sleeve

Sample No.	Length of Sleeve.	Inner Dia of Sleeve.	Outer Dia of Sleeve	Split Width
1				
2				
3				
4				
5				

ii) Housing: Glass filled PBT ultrasonic welded

Note: Check for quality and finish of the adapter.

3.12.3 LC to LC (Type-IV)

a) Housing design: Rectangular Flanged (snap fit type)

Note: Check and state the type of design

b) Material
   i) Alignment Sleeve: Zirconia Ceramic Split sleeve

Sample No.	Length of Sleeve.	Inner Dia of Sleeve.	Outer Dia of Sleeve	Split Width
1				
2				
3				
4				
5				

ii) Housing : PEI / PPS

Note: Check for quality and finish of the adapter.

3.12.4 Colour

a) FC-PC connector adapter : Ni plated Brass
b) SC-PC connector adapter : Blue
c) SC-APC connector adapter : Green
d) LC connector adapter : Blue

Note: Check as per the requirement of the clause.

Note 1: The connector and adapter shall be compatible with NTT-FC or JIS-FC connectors or Telcordia GR 326 standards. FC and SC Connector shall be supplied with dual dust covers (Ferrule cap and hanging type dust cover), while LC connector shall be supplied with Ferrule dust cover. FC adapter shall have threaded type dust covers and SC & LC adapters shall have compatible dust covers meeting the requirements of vibration test (clause no. 4.6).

Note: Check as per the requirement of the clause.

Note 2: The body of the FC-PC connector and connector adapter shall be made by machining alone using machine grade brass. It shall not be made by forging, pressure die casting, casting, power metallurgy or moulding methods. The parts such made shall have composition of brass material as per specifications given below:

1. Material : Brass Extruded Type
2. Specifications : BS 249
3. Chemical composition
   - i) Copper : 56.5 to 58.5 %
   - ii) Lead : 2.5 to 3.5 %
   - iii) Iron : 0.33 % (Max)
   - iv) Zinc : Remainder
   - v) Impurities : 0.7% (MAX)
4. Physical Properties
   - i) UTS : 42.0 Kg /mm^2
   - ii) Elongation on 50 mm: 8% (MIN)

Note: Check as per the requirement of the clause.

Note 3: The manufacturer supplying the parts of the optical connector and optical connector adapter shall also are required to have ISO 9001-2000 accreditation/ISO certified manufacturing facility. The infrastructure of such vendor shall be checked and approved by the evaluation / testing team. In case of such vendor, being outside India, it is essential to have an ISO 9001:2000 certified manufacturing facility The complete quality plan of such vendors from whom the parts are being procured by the manufacturer seeking type approval shall also be required to be submitted along with the drawings & dimensions of each parts clearly marked with tolerances of individual parts.. Manufacturer/

Vendor marking shall also be provided. Change in supplier of connector and connector adapter parts will have to be intimated to CACT for approval. Note: Check as per the requirement of the clause. **Note 4**: The test certificate of Ceramic Zerconia Sleeve used along with its drawing & dimensions and the test report shall also be required to be submitted which shall be mandatory. The material for screws shall be of suitable copper alloy or stainless steel. The mounting screws of M2 (NTP) size are to be provided for FC adapters and may be separately ordered for SC adapters, if required by the buyer. Ceramic Zerconia Sleeve shall be tested for following parameters: 1. Material of Zirconia Sleeve: Min. 94% Zirconia ceramic 2. Withdrawal Force: . 2Kg to 0.6Kg for FC and SC sleeves; 0.1Kg to 0.250 Kg for LC sleeves 3. Durability : Change in attenuation after 500 mating shall be less than 0.05 dB Note: Check the manufacturer compliance for adapter conforming to Bell core spec and the type of dust covers. The test certificate along with test report shall be submitted by manufacturer. **Note 5:** The applicable tests shall be conducted on the connector adapters (as per Annexure-I) Note: Check as per the requirement of the clause. **3.13 Hybrid Jumpers:** a) FC-PC to SC-PC (Type –I) Note: FC-PC & SC-PC connector shall meet the requirements requirement stated in this GR). b) FC-PC to SC- APC (Type–II) Note: FC-PC & SC-APC connector shall meet the requirements stated in this GR c) FC-PC to LC (Type –III) Note: FC-PC and LC connectors shall meet the requirements stated in this GR	

d) SC-PC to SC-APC (Type –IV) Note: SC-PC and SC-APC connectors shall meet the requirements stated in this GR e) SC-PC to LC (Type –V) Note: SC-PC and LC connectors shall meet the requirements stated in this GR f) SC-APC to LC (Type –VI) Note: SC-APC and LC connectors shall meet the requirements stated in this GR **3.14 HYBRID ADAPTER:** a) FC-PC to SC-PC (Type –I) Note: FC-PC & SC-PC connector shall meet the requirements requirement stated in this GR). g) FC-PC to SC- APC (Type–II) Note: FC-PC & SC-APC connector shall meet the requirements stated in this GR h) FC-PC to LC (Type –III) Note: FC-PC and LC connectors shall meet the requirements stated in this GR i) SC-PC to SC-APC (Type –IV) Note: SC-PC and SC-APC connectors shall meet the requirements stated in this GR j) SC-PC to LC (Type –V) Note: SC-PC and LC connectors shall meet the requirements stated in this GR k) SC-APC to LC (Type –VI) Note: SC-APC and LC connectors shall meet the requirements stated in this GR **Note:** The applicable tests shall be conducted on the Hybrid connector adapters (as per Annexure-I).	

4.0 Testing of Optical & Mechanical Parameters of the Optical connector, Optical connector adapter and Patch cord:

Note: 1 Measurement is to be taken for both 1310 nm and 1550 nm wavelength

Note: 2 Five specimens randomly selected from the offered specimens shall be subjected to tests including Environmental test.

Note: 3 The reference Master patch cord used as a standard shall have the following characteristics:

1)	Ferrule outer diameter	:	2.499 ± 0.0003 mm
2)	Eccentricity	:	0.00020 mm (max) or 0.2 micron
3)	Deviation of angle	:	$\leq 0.2^{o}$
4)	Dome offset	:	$\leq$ 30 microns
5)	Insertion Loss	:	$\leq$ 0.05 dB against an identical reference plug.
6)	Return Loss	:	≥ 60 dB (SC), ≥ 70 dB (APC)

Note: Check the above characteristics of the reference master patch cord to be used as standard and submit the certificate along with the test report.

4.1 Quality of the pre-domed ferrule End face of the connector, radius of curvature and Concentricity / Eccentricity of the connectors.

Purpose : To check the surface topography of the fibre connector and the fibre core and ferrule eccentricity measurement, to check ferrule roundness error measurement., to check angular mismatch fibre/ferrule. The concentricity of the fibre core axis with outer diameter of the ferrule of a Connector set and the examination and measurement of the angular misalignment between fibre and ferrules axes.

Method : IEC 60874-1 (1994-03 Clause 4.4.16) and instrument (Interferometer) to monitor surface topography.

Requirement:

(a)	Under cut		:	- 0.10 µm
(b)	Protrusion		:	+ 0.05 µm
(c)	Radius of curvature			
	i)	FC-PC	:	10 to 25 mm
	ii)	SC-PC	:	10 to 25 mm
	iii)	SC-APC	:	10 to 30mm
	iv)	LC	:	10 to 25 mm
(d)	Offset of Polish		:	Maximum 50 Microns off centre
(e)	Concentricity (X = 2D)		:	$\leq$ 1.3 microns

where X is Concentricity and D is Eccentricity, which is distance between axis of the fibre and the axis of the ferrule or Eccentricity is distance between centre of the fibre core and ideal centre of the ferrule, (Concentricity = 2 X Eccentricity).

Note: IEC test methods 61300-3-26, IEC 61300-2-41, IEC 61300-3-18,IEC 61300-3-24, IEC 61300-3-19, IEC 61300-3-25 IEC61300-3-17 may be referred

Test Procedure: As per procedure No. 1

Sample No	Under cut	Protrusion	Radius of curvature: 10 to 25 mm (FC-PC)	Offset of Polish: Max. 50 Microns off centre	Concentricity: ≤ 1.3µm (X= 2D)
	-10 µm	+ 0.05 µm			
1					
2					
3					
4					
5					

Sample No	Under cut	Protrusion	Radius of curvature: 10 to 25 mm (SC-PC)	Offset of Polish: Max. 50 Microns off centre	Concentricity: ≤ 1.3µm (X= 2D)
	-10 µm	+ 0.05 µm			
1					
2					
3					
4					
5					

Sample No	Under cut	Protrusion	Radius of curvature: 10 to 30 mm (SC-APC)	Offset of Polish: Max. 50 Microns off centre	Concentricity: ≤ 1.3µm (X= 2D)
	-10 µm	+ 0.05 µm			
1					
2					

3					
4					
5					

Sample No	Under cut	Protrusion	Radius of curvature: 10 to 25 mm (LC)	Offset of Polish: Max. 50 Microns off centre	Concentricity: ≤ 1.3µm (X= 2D)
	-10 µm	+ 0.05 µm			
1					
2					
3					
4					
5					

4.2 a) Insertion loss of complete patch cord including adapter when tested from each direction in all conditions of operations : ≤ 0.3 dB

Procedure : As per procedure No. 3.1

i) At 1310nm

SL. No.	S. No. of Patch cord	Reference Reading (dBm)	Patch cord Reading (dBm) A1	A2	Mean of A1 & A2 (2+3)/2	Loss per connector dB
		1	2	3	4	(1-4)+I/L of Ref./2
1.						
2.						
3.						
4.						
5.						

Remarks:

ii) At 1550 nm

SL. No.	S. No. of Patch cord	Reference Reading (dBm)	Patch cord Reading (dBm) A1 A2	Mean of A1 & A2 (2+3)/2	Loss per connector dB
		1	2 3	4	(1-4)+I/L of Ref./2
1.					
2.					
3.					
4.					
5.					

Result : Insertion loss should be less than 0.3 dB including fibre loss

Remarks:

(b) Insertion loss of Adapters : $\leq$ 0.1 dB

Test method : IEC 60874 - 1 (clause no. 4.4.7) or any other suitable test method

Test procedure : As per procedure No. 3.2

i) At 1310 nm

SL. No.	S. No. Adapter	Reference Reading (dBm)	Adapter Reading (dBm) A1 A2	Mean of A1 & A2 (2+3)/2	Loss of adapter (dB)
		1	2 3	4	(1-4)+I/L of Ref./2
1.					
2.					
3.					
4.					
5.					

ii) At 1550 nm

SL. No.	S. No. Adapter	Reference Reading (dBm)	Adapter Reading (dBm) A1 A2	Mean of A1 & A2 (2+3)/2	Loss of adapter (dB)
		1	2 3	4	(1-4)+I/L of Ref./2
1.					
2.					
3.					
4.					
5.					

Remarks:

4.3 Return loss for each connector of patch cord

a) Type - I FC-PC : $\geq$ 50 dB
b) Type - II SC - PC : $\geq$ 50 dB
c) Type - III SC- APC : $\geq$ 65 dB
d) Type - IV LC : ≥ 50 dB.

Test method: IEC 60874 -1 Clause no. 4.4.12 or any other suitable test method.

Test procedure : As per procedure No. 4

i) At 1310 nm

S. No.	S. No. of patch cord	Reference reading (dBm) A1	Final reading (dBm) A2	Return loss (dB) (Ref. – final) A1- A2
1.				
2.				
3.				
4.				
5.				

ii) At 1550 nm

S. No.	S. No. of patch cord	Reference Reading (dBm) A1	Final reading (dBm) A2	Return loss (dB) (Ref. – final) A1- A2
1.				
2.				
3.				
4.				
5.				

Result : Return loss should be better than 50/65 for each connector.

Remarks:

4.4 Change in insertion loss of the patch cords due to change in environmental conditions : $\leq$ 0.10 dB.

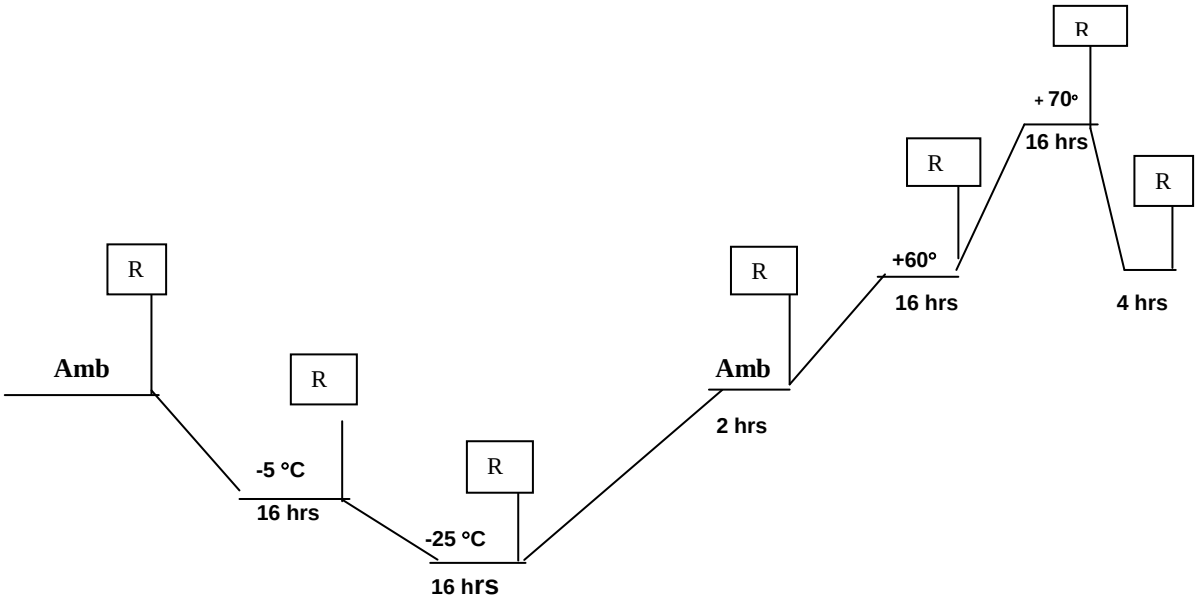
a) (Cold & Heat test)

Purpose: To check the stability behaviour and attenuation of on optical fibre cable & on the connector set due to temperature changes.

Method : IEC 6074-1 (clause no.4.5.17and 4.5.18)

Temperature	: TA1	- ($-5^{o}C$)
	: TA2	- ($-25^{o}C$)
	: TB1	- ($+60^{o}C$)
	: TB2	- ($+70^{o}C$)
Time Duration	: 16 Hrs.	
Rate of change of temp.	: 1 degree per minute	
Number of cycles	: 2 (Two).	

Requirement: Change in the attenuation of the patch cord during the test shall be $\leq$0.10 dB (each sample shall be checked separately**)**. After the recovery period of 30 minutes, insertion loss shall not exceed the specified value of clause no. 4.2 of GR.



At 1310 nm

S. No	S. No. of Patch cord	Initial Reading at Ambient Temp.	Reading at TA1 (–5° C)	Reading at TA2 (- 25° C)	Reading at Ambient Temp	Reading at TB1 (+60°C)	Reading at TB2 (+70°C)	Final reading at Ambient Temp.
1.								
2.								
3.								
4.								
5.								

(II) At 1550 nm

S. No	S. No. of Patch cord	Initial Reading at Ambient Temp.	Reading at TA1 (–5° C)	Reading at TA2 (- 25° C)	Reading at Ambient Temp	Reading at TB1 (+60°C)	Reading at TB2 (+70°C)	Final reading at Ambient Temp.
1.								
2.								
3.								
4.								
5.								

Result : Change in the attenuation shall be $\leq$ 0.10 dB. After the recovery, insertion loss shall not exceed the specified value i.e., 0.1 dB.

b) Damp Heat test

Purpose : To check the effects on the sample 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^{o}C
b) Relative Humidity : 93% to 95%
c) Exposure time : 4 days.

Requirement: Change in the attenuation during the test shall be $\leq$ 0.10 dB. After the recovery period of 30 minutes, insertion loss shall not exceed the specified value of clause no. 4.2 of this GR.

i) At 1310 nm

S. No	S.No. of Patch cord	Initial Reading at Ambient Temp.	Reading after 1 day	Reading after 2 days	Reading after 3 days	Reading after 4 days	Final reading at Ambient Temp.
1.							
2.							
3.							
4.							
5.							

i) At 1550 nm

S. No	S.No. of Patch cord	Initial Reading at Ambient Temp.	Reading after 1 day	Reading after 2 days	Reading after 3 days	Reading after 4 days	Final reading at Ambient Temp.
1.							
2.							
3.							
4.							
5.							

4.5 High Temperature Endurance test:

Purpose: The purpose of this test is to check the suitability of the connector for use and / or storage at high temperature for extended period.

Method: IEC 60874-1 (clause no. 4.5.33)

1. Temperature of test : $70^{o}C$
2. Duration of test : 100 hours

Requirement: Change in the attenuation during the test shall be $\leq$ 0.10 dB. After the recovery period of 30 minutes, insertion loss shall not exceed the specified value of clause no. 4.2 of this GR

Test procedure: As per procedure No. 6

i) At 1310 nm

S. No.	S. No. of Patch cord	Initial Reading of Ambient Temp.	Reading at 70° C after 100 hrs	Final reading at Ambient Temp.
1.				
2.				
3.				
4.				
5.				

ii) At 1550 nm

S. No.	S. No. of Patch cord	Initial Reading of Ambient Temp.	Reading at 70° C after 100 hrs	Final reading at Ambient Temp.
1.				
2.				
3.				
4.				
5.				

Remarks:

4.6 Vibration Test for Terminated Connector set

Purpose: To check the effects of the vibration on the samples at the predominant frequency ranges and magnitudes that may be encountered during field service.

Method: FC of IEC 68-2-6.

Frequency Range: 10 to 55 Hz
Vibration Amplitude: 0.75 mm constant Displacement (up to 60 Hz)
Endurance duration per: 10 Min in each specified axis direction.

Requirement: Change in the attenuation during the test shall be ≤ 0.10 dB. After the recovery period of 30 minutes, insertion loss shall not exceed the specified value of clause no. 4.2 of this GR.

(**Note**: The specimen shall be subjected to vibration in three mutually perpendicular directions, one of which shall be parallel to the optical axis. The test shall be conducted on complete set of two connectors and one adapter connected together.)

Test procedure: As per procedure No. 7

i) At 1310 nm

S. No.	S. No. of Patch cord	Initial Reading .	Final Reading	Remarks
1.				
2.				
3.				
4.				
5.				

ii) At 1550 nm

S. No.	S. No. of Patch cord	Initial Reading .	Final Reading	Remarks
1.				
2.				
3.				
4.				
5.				

Remarks:

4.7 Mechanical endurance test:

Purpose : The purpose of this test is to evaluate the effects of successive cycles of engagement and separation on a specific coupling mechanism.

Method : IEC 60874-1 (Clause no. 4.5.32)

Number of connection and disconnection: 500

Requirement: Change in the attenuation shall not exceed 0.05 dB.

Test procedure : As per procedure No. 8

i) At 1310 nm

S. No.	S. No. of Patch cord	Initial Reading .	Final Reading	Remarks
1.				
2.				
3.				
4.				
5.				

ii) At 1550 nm

S. No.	S. No. of Patch cord	Initial Reading.	Final Reading	Remarks.
1.				
2.				
3.				
4.				
5.				

Remarks:

4.8 Tensile Test (Connectorized Cable Pulling Test) :

Purpose : The purpose of this test is to ensure that the captivation attachment of the cable to the specimen will withstand the load during normal service.

Method	:	IEC 60794-1-E1
Diameter of chuck drums and transfer devices	:	250 mm approx.
Velocity of transfer device	:	100 mm/min
Magnitude of load	:	8 Kg (FC-PC) 0.8 Kg (SC). 0.36 Kg for LC
Length of the sample	:	As per the requirement .
Point of the application of the load	:	After the chuck drum

Requirement: Change in the attenuation during the test shall be $\leq$ 0.10 dB. After the recovery period of 30 minutes, insertion loss shall not exceed the specified value of clause no. 4.2 of this GR.

(Note: The observation is to be taken before the start of the test and after the recovery period of 30 minutes).

Test procedure: As per procedure No. 9

i) At 1310 nm

SL. No.	SL. No. of Patch cord	Initial reading (dBm) A1 A2	After 5 min. reading (dBm) A1 A2	Relaxed reading (dBm) A1 A2	Difference reading (dBm) A1 A2
		(1)	(2)	(3)	(1-3)
1.					
2.					
3.					
4.					
5.					

ii) 1550 nm

SL. No.	SL. No. of Patch cord	Initial reading (dBm) A1 A2	After 5 min. reading (dBm) A1 A2	Relaxed reading (dBm) A1 A2	Difference reading (dBm) A1 A2
		(1)	(2)	(3)	(1-3)
1.					
2.					
3.					
4.					
5.					

4.9 Effectiveness of clamping device against cable nutation with a Connector set:

Purpose: To check the ability of the cable clamping and boots of optical fibre connectors to withstand the severe mechanical stresses associated with cable nutation and maintain their role in preventing damage to the fibre in the vicinity of the connector and of the fibre termination.

Method : IEC 60874-1 (1993-02 Clause 4.5.35)

Load : 8 kg (FC-PC & SC)
0.36 Kg (LC)
No. of cycles : 10

Requirement:

1) Check the visual signs of damage to the cable structure in the vicinity of the connector.
2) There should be no fibre break.
3) There shall be no perceptible disturbance of the fibre termination.
4) There shall be no axial movement of the cable relative to the connector.
5) The attenuation shall not exceed the specified value i.e. $\leq$ 0.3 dB.

Test Procedure: As per procedure No. 2

Remarks:

4.10 Minimum Bending Radius of the cable:

i) Loaded : 50 mm.
ii) Unloaded : 30 mm.

Requirement: The jumper cable shall meet the above requirement and shall not suffer any physical damage under the above conditions. Change in the attenuation during the test shall be $\leq$ 0.10 dB. After the recovery period of 30 minutes, insertion loss shall not exceed the specified value of clause no. 4.2 of this GR.

Note: Check and verify the bending radius of cable as per requirement

Remarks:

4.11 Flexibility Test for cable:

Purpose: To check the flexibility on the jumper cable.

Method: The fibre and the component part of the optical fibre & jumper cable shall not suffer permanent damage when the cable is repeatedly wrapped and unwrapped 4 complete turns of 10 complete cycles around a mandrel of 24 D.

Requirement:

1. Change in the attenuation during the test shall be $\leq$ 0.10 dB. After the recovery period of 30 minutes, insertion loss shall not exceed the specified value of clause no. 4.2 of this GR.
2. Sheath of the optical jumper cable shall not show any damage.

Test procedure: As per procedure No. 10

i) At 1310 nm

S. No.	S. No. of Patch cord	Initial reading (dBm)		Final reading (dBm)		Difference (dBm)	
		A1	A2	A1	A2	A1	A2
1.							
2.							
3.							
4.							
5.							

ii) At 1550 nm

S. No.	S. No. of Patch cord	Initial reading (dBm)		Final reading (dBm)		Difference (dBm)	
		A1	A2	A1	A2	A1	A2
1.							
2.							
3.							

4.							
5.							

Remarks:

4.12 Repeated Bending test of the connectorised cable:

Purpose : To check the ability of optical fibre connectorised cable to withstand repeated bending.

Method : IEC 60794-1-E8

Number of cycles : 1000
Carrier speed : 10 cycle per min.
Pulley Diameter : 100 mm.
Load : 2 Kg
Length of the sample : As per the requirement of the test.

Requirement: Change in the attenuation during the test shall be $\leq$ 0.10 dB. After the recovery period of 30 minutes, insertion loss shall not exceed the specified value of clause no. 4.2 of this GR

Test procedure: As per procedure No. 11

i) 1310 nm

S. No.	S. No. of Patch cord	Initial reading (dBm)		Final reading (dBm)		Difference (dBm)	
		A1	A2	A1	A2	A1	A2
1.							
2.							
3.							
4.							
5.							

ii) 1550 nm

S. No.	S. No. of Patch cord	Initial reading (dBm)		Final reading (dBm)		Difference (dBm)	
		A1	A2	A1	A2	A1	A2
1.							
2.							
3.							
4.							
5.							

Remarks:

4.13 Cable bend test under tension

Purpose: To check the ability of a small diameter Optical Fibre Cable to withstand bending around the test mandrel.

Method : IEC 60794-1-E11

Mandrel diameter : 50 mm.
Number of turns : (1 cycle) 6.
Number of cycles : 10
Bending speed : 1 revolution in 5 sec.
Load : 10 N
Length of the sample : As per the requirement of the test.

Requirement: Change in the attenuation during the test shall be $\leq$ 0.10 dB. After the recovery period of 30 minutes, insertion loss shall not exceed the specified value of clause no. 4.2 of this GR.

Test procedure: As per procedure No. 12

i) At 1310 nm

S. No.	S. No. of Patch cord	Initial reading (dBm)		Final reading (dBm)		Difference (dBm)	
		A1	A2	A1	A2	A1	A2
1.							
2.							
3.							
4.							
5.							

ii) At 1550 nm

S. No.	S. No. of Patch cord	Initial reading (dBm)		Final reading (dBm)		Difference (dBm)	
		A1	A2	A1	A2	A1	A2
1.							
2.							
3.							
4.							
5.							

Result: $\leq$ 0.10dB & after recovery it should not exceed specified value i.e. $\leq$ 0.3dB.

Remarks:

4.14 Cable bend at low temperature:

Method : IEC 60794-1-E11.

Bending radius : 2.5 times cable diameter.
Length of the sample : Short.
Test temperature : 25^{o}C.
Number of bends : 10

Requirement:

1) Change in the attenuation during the test shall be $\leq$ 0.10 dB. After the recovery period of 30 minutes, insertion loss shall not exceed the specified value of clause no. 4.2 of this GR.
2) There shall be no fibre break.

Test procedure: As per procedure No. 13

i) 1310 nm

SL. No.	SL. No. of patch cord	Initial reading (dBm)	At –25° C Reading (dBm)	Final reading (Relaxed) dBm	Diff. reading (dBm)
		1	2	3	(1-3)
1.					
2.					
3.					
4.					
5.					

ii) 1550 nm

SL. No.	SL. No. of patch cord	Initial reading (dBm)	At –25° C Reading (dBm)	Final reading (Relaxed) dBm	Diff. reading (dBm)
		1	2	3	(1-3)
1.					
2.					
3.					
4.					
5.					

Remarks:

4.15 Torsion Test of the cable

Purpose: To check the ability of an Optical Fibre Cable to with stand torsion.

Method : IEC 60794-1-E7.

Number of rotations : 20
(± 180^{o}, not less than 30 per min.)
Distance between fixed and the rotating clamp : 50 mm.
Length of the sample : As per the requirement of the test.
Axial load : 20 N

Requirement: Change in the attenuation during the test shall be $\leq$ 0.10 dB. After the recovery period of 30 minutes, insertion loss shall not exceed the specified value of clause no. 4.2 of this GR.

Test procedure: As per procedure No. 14

i) At 1310 nm

S. No.	S. No. of Patch cord	Initial reading (dBm)		Final reading (dBm)		Difference (dBm)	
		A1	A2	A1	A2	A1	A2
1.							
2.							
3.							
4.							
5.							

ii) At 1550 nm

S. No.	S. No. of Patch cord	Initial reading (dBm)		Final reading (dBm)		Difference (dBm)	
		A1	A2	A1	A2	A1	A2
1.							
2.							
3.							
4.							
5.							

Remarks:

4.16 Bending moment test of the Coupling mechanism of the connector:

Purpose: To check the coupling mechanism of a connector to with stand the bending moment to be applied in the field.

Method : IEC -60874-1 Clause No. 4.5.7

Force : 10 N
Rate of force : It shall be applied slowly and smoothly.
Duration of force to be applied : 1 minute

Requirement: Change in the attenuation during the test shall be $\leq$ 0.10 dB. After the recovery period of 30 minutes, insertion loss shall not exceed the specified value of clause no. 4.2 of this GR.

Test procedure: As per procedure No. 15

i) At 1310 nm

S. No.	S. No. of Patch cord	Initial reading (dBm)		Final reading (dBm)		Difference (dBm)	
		A1	A2	A1	A2	A1	A2
1.							
2.							
3.							
4.							
5.							

ii) At 1550 nm

S. No.	S. No. of Patch cord	Initial reading (dBm)		Final reading (dBm)		Difference (dBm)	
		A1	A2	A1	A2	A1	A2
1.							
2.							
3.							
4.							
5.							

Remarks:

4.17 Crush Test (Axial compression)

Purpose: To check the capacity of the cable for the compressive loads likely to be applied on the cable during normal service.

Method : IEC 60794-1-E3

Load : 50 Kg.
The edges of the movable plate shall have a radius of curvature of at least : 5 mm.
Duration : 1 min.

Requirement:

1) Change in the attenuation during the test shall be $\leq$ 0.10 dB. After the recovery period of 30 minutes, insertion loss shall not exceed the specified value of clause no. 4.2 f this GR.
2) No permanent physical damage to the cable.

Note:- The observation is to be taken before the start of the test and after the recovery period (30 minutes).

Test procedure: As per procedure No. 16

i) At 1310 nm

S. No.	S. No. of Patch cord	Initial reading (dBm)	Final reading (dBm)	Difference (dBm)
1.				
2.				
3.				
4.				
5.				

ii) At 1550 nm

S. No.	S. No. of Patch cord	Initial reading (dBm)	Final reading (dBm)	Difference (dBm)
1.				
2.				
3.				
4.				
5.				

Remarks:

4.18 Impact test of the cable

Purpose: To check the impact resistance of the single fibre cable.

Method : IEC 60794-1-E4.

Radius of intermediate piece. : 12.5mm
Starting energy : 1.0 Nm
Number of impacts : 3
Length of sample : As per the requirement of the test.

Requirement: Change in the attenuation during the test shall be $\leq$ 0.10 dB. After the recovery period of 30 minutes, insertion loss shall not exceed the specified value of clause no. 4.2 of this GR.

Test procedure: As per procedure No. 17

i) At 1310 nm

S. No.	S. No. of Patch cord	Initial reading (dBm)	Final reading (dBm)	Difference (dBm)
1.				
2.				
3.				
4.				
5.				

ii) At 1550 nm

S. No.	S. No. of Patch cord	Initial reading (dBm)	Final reading (dBm)	Difference (dBm)
1.				
2.				
3.				
4.				
5.				

Remarks:

4.19 Crush Resistance test of the connector

Purpose: To evaluate the effect of loads on the connectors when exposed to critical situations such as being stepped on, being run over by vehicle tyres etc.

Method: IEC -60874-1 Clause No. 4.5.10

Duration of the load to be applied : 10 sec.
load : 1000 N

Requirement:
1) Change in the attenuation during the test shall be $\leq$ 0.10dB. After the recovery period of 30 minutes, insertion loss shall not exceed the specified value of clause no. 4.2 of this GR.
2) No physical deformation to the cable.

Test procedure: As per procedure No. 18

i) At 1310 nm

S. No.	S. No. of Patch cord	Initial reading (dBm)	Final reading (dBm)	Difference (dBm)
1.				
2.				
3.				

4.				
5.				

ii) At 1550 nm

S. No.	S. No. of Patch cord	Initial reading (dBm)	Final reading (dBm)	Difference (dBm)
1.				
2.				
3.				
4.				
5.				

Remarks:

4.20 Static load of the connector.

Purpose: To check the effects of shearing forces likely to be applied on the connector during the normal field operations.

Method : IEC 60874-1 (Clause 4.5.3)

Time Duration : 1 minute.

Load : 8 Kg (FC-PC)
0.8 Kg (SC)
0.45 Kg (LC)

Direction of the force : Vertical direction to optical axis

Rate of application of the load : 10 mm / minute.

Requirement: Change in the attenuation during the test shall be $\leq$ 0.10 dB. After the recovery period of 30 minutes, insertion loss shall not exceed the specified value of clause no. 4.2 of this GR.

Test procedure: As per procedure No. 19

i) At 1310 nm

S. No.	S. No. of Patch cord	Initial reading (dBm)	Final reading (dBm)	Difference (dBm)
1.				
2.				
3.				
4.				
5.				

ii) At 1550 nm

S. No.	S. No. of Patch cord	Initial reading (dBm)	Final reading (dBm)	Difference (dBm)
1.				
2.				
3.				
4.				
5.				

Remarks:

4.21 Drop Test

Purpose : To evaluate the ability of a connector to with stand impacts to be encountered during usage.

Method : IEC -60874-1 Clause no. 4.5.14
Number of drops : 25
Drop height : 1500 mm

Requirement: The insertion loss shall not increase the specified value of clause no. 4.2 of this GR after the test.

Test procedure : As per procedure No. 20

i) At 1310 nm

S. No.	S. No. of Patch cord	Initial reading (dBm)	Final reading (dBm)	Difference (dBm)
1.				
2.				
3.				
4.				
5.				

ii) At 1550 nm

S. No.	S. No. of Patch cord	Initial reading (dBm)	Final reading (dBm)	Difference (dBm)
1.				
2.				
3.				
4.				
5.				

Remarks:

4.22 Strength of coupling mechanism (coupling proof torque)

Purpose: To check the effects of axial loads likely to be applied on the coupling mechanism of a connector.

Method : IEC 60874-1 (Clause 4.5.15)

Load	:	8Kg (FC-PC)
	:	0.8Kg (SC)
	:	0.36Kg (LC)
Time Duration	:	5 minutes
Direction of the force	:	Optical Axis

Requirement: Change in the attenuation during the test shall be $\leq$ 0.10 dB. After the recovery period of 30 minutes, insertion loss shall not exceed the specified value of clause no. 4.2 of this GR.

Test procedure: As per procedure No. 21

i) At 1310 nm

S. No.	S. No. of Patch cord	Initial reading (dBm)		Final reading (dBm)		Difference (dBm)	
		A1	A2	A1	A2	A1	A2
1.							
2.							
3.							
4.							
5.							

ii) At 1550 nm

S. No.	S. No. of Patch cord	Initial reading (dBm)		Final reading (dBm)		Difference (dBm)	
		A1	A2	A1	A2	A1	A2
1.							
2.							
3.							
4.							
5.							

Remarks :

4.23 Sealing

(Water immersion for connector set with cable)

Purpose : To check the integrity of the seals when the samples shall be subjected to immersion under water.

Method : IEC 60874-1 (Clause 4.5.24)

Procedure : IEC 68 -2-17 (test Qf)
Water head : 1 meter
Duration : 24 hrs.

Requirement: Change in the attenuation during the test shall be $\leq$ 0.10 dB. After the recovery period of 30 minutes, insertion loss shall not exceed the specified value of clause no. 4.2 of this GR.

Test procedure : As per procedure No. 22

i) At 1310 nm

S. No.	S. No. of Patch cord	Initial reading (dBm)		Final reading (dBm)		Difference (dBm)	
		A1	A2	A1	A2	A1	A2
1.							
2.							
3.							
4.							
5.							

ii) At 1550 nm

S. No.	S. No. of Patch cord	Initial reading (dBm)		Final reading (dBm)		Difference (dBm)	
		A1	A2	A1	A2	A1	A2
1.							
2.							
3.							
4.							
5.							

Remarks :

4.24 Corrosive atmosphere (Salt mist)

Purpose : To check the resistance of samples from deterioration when it shall be exposed to salty environment.

Method : IEC 60874-1 (Clause 4.5.26) Or as per QM 333

Procedure : IEC 68-2-11 (Test Ka).
Temperature : 35^{o}C
Duration : 16 hrs.

Requirement:

1) Change in the attenuation during the test shall be ≤0.10 dB. After the recovery period of 30 minutes, insertion loss shall not exceed the specified value of clause no. 4.2 of this GR.
2) No corrosion observed

Test procedure: As per procedure No. 23

i) At 1310 nm

S. No.	S. No. of Patch cord	Initial reading (dBm)		Final reading (dBm)		Difference (dBm)	
		A1	A2	A1	A2	A1	A2
1.							
2.							
3.							
4.							
5.							

ii) At 1550 nm

S. No.	S. No. of Patch cord	Initial reading (dBm)		Final reading (dBm)		Difference (dBm)	
		A1	A2	A1	A2	A1	A2
1.							
2.							
3.							
4.							
5.							

Remarks:

4.25 Effect of Dust on Connector set:

Purpose : To check the effects of dust on the connectors.

Method : IEC 60874-1 (Clause 4.5.27)

Temperature	:	35°C ±2 °C
Relative humidity	:	< 60 %
Rate of dust concentration	:	25 g ±5g for 5 minutes.
Size of the dust	:	Capable to pass through a sieve of 150 um aperture
Duration	:	10 minutes.

Requirement: Change in the attenuation during the test shall be ≤ 0.10 dB. After the recovery period of 30 minutes, insertion loss shall not exceed the specified value of clause no. 4.2 of this GR.

Test procedure: As per procedure No. 24

i) At 1310 nm

S. No.	S. No. of Patch cord	Initial reading (dBm)	Final reading (dBm)	Difference (dBm)
1.				
2.				
3.				
4.				
5.				

ii) At 1550 nm

S. No.	S. No. of Patch cord	Initial reading (dBm)	Final reading (dBm)	Difference (dBm)
1.				
2.				
3.				
4.				
5.				

Remarks:

4.26 Shock Test

Purpose: To check the mechanical weakness and or degradation after samples subject to non-repetitive mechanical shocks encountered on the connector during the normal field operations.

Method : IEC 60874-1 (Clause Nos. 4.5.8 & 4.5.9)

Procedure : IEC 68-2-29 (Test Eb) & IEC-68-2-27 (Test Ea)

Severity
a) No. of Shocks : 5
b) Peak acceleration : 294 m/s^2
c) Pulse duration : 18 ms

Requirement: Change in the attenuation during the test shall be $\leq$ 0.10 dB. After the recovery period of 30 minutes, insertion loss shall not exceed the specified value of clause no. 4.2 of this GR.

Test procedure : As per procedure No. 25

i) At 1310 nm

S. No.	S. No. of Patch cord	Initial reading (dBm)	Final reading (dBm)	Difference (dBm)
1.				
2.				
3.				
4.				
5.				

ii) At 1550 nm

S. No.	S. No. of Patch cord	Initial reading (dBm)	Final reading (dBm)	Difference (dBm)
1.				
2.				
3.				
4.				
5.				

Remarks :

PART II –GENERAL REQUIREMENTS

Clause No.	TEC Requirement	Observation and Remarks
5.0	**Marking and Packing:**	
5.1	**Identification and Marking:**	
5.1.1	Marking on the optical fibre jumpers and hybrid jumpers shall be of durable quality and it shall withstand the rubbing (20 times) with dry tissue paper in both the directions.	
Note:	Check the quality of marking.	
5.1.2	Marking on Jumpers shall include the following: a) Name of cable manufacturer b) Name of Jumper manufacturer c) Type of fibre d) LSZH material e) Manufacturer's identification mark f) Manufacturer's part number. g) Manufacturing date code (year/month etc.) h) Variant identification number(s)/ (Sr. No. of product) i) Any other additional marking required. j) TEC GR. No.	
Note:	Check the marking and sub clauses (a) to (j) as above and any other additional marking like Patch cords & Pig tails, if provided.	
5.1.3	Marking on the adapters shall include the following: a. Type of adapter b. (FC-PC to FC-PC, SC-PC to SC-PC, SC- APC to SC-APC or LC-LC) c. Manufacturer‘s name/ model no. d. Manufacturer's part number. e. Manufacturer's identification mark. f. Manufacturing date code (year/month etc.) **Note:** Additional information if required by the buyer may be provided on the packing or as separate test report.	
Note:	Check the marking and sub clauses (a) to (f) as above.	
5.2	**Packing**	
5.2.1	Each Optical Fibre Jumper (Patch cord/Pigtail) and Hybrid jumpers shall be packed separately in transportable packing with the test report on manufacturer’s letter head which shall include the following:	

(a) Insertion loss at 1310 nm and 1550 nm (b) Return loss at 1310 nm & 1550 nm. (c) Length of the patch cord/pigtail. (d) Precautions for handling and cleaning. (e) Radius of curvature in mm of the optical connecter. (f) Under cut or protrusion of fibre in optical connector in microns. (g) Linear off set of polish of connecter in microns (h) Concentricity details. (i) Refractive Index of fibre (j) Interference diagram **Note:** The test report for the parameters (e to j) shall be provided batch-wise and individual batch may be decided by the user. Note: Check the following: • Separate packing of each jumper cable. • The test report of patch cord or pigtail. 5.2.2 Each connector adapter shall be packed separately and supplied with following details: a) Insertion loss at 1310 nm and 1550 nm Note **:** Check the test report of connector adapter. 5.2.3 Each connector and Adapter shall be covered with dust cover. FC and SC connectors will be supplied with Dual dust covers (Ferrule cap and hanging type dust cover), while LC connector shall be supplied with Ferrule dust cover. FC adapter shall have threaded type dust cover and SC & LC adapters shall have compatible dust covers. Note**:** Check and record the comments • Dust cover for each connector and adapter **6.0 Quality requirements:** 6.1 The Optical Fibre Jumpers, Hybrid jumpers, Adapters and Hybrid Adapters should be manufactured in accordance with International Quality Standards ISO 9001-2000 for which the manufacturer should be duly accredited. A quality manual shall be submitted by the manufacturer Note: Check and comments on the manufacturer compliance for: • Manufacturing of Optical fibre jumper as per International standard ISO 9001-2000 and accreditation for the same. • Quality manual describing quality assurance system and followed by the manufacturer. • Check the ISO Certificate.	

6.2 The Optical Fibre Jumper, Hybrid jumpers, Adapters and Hybrid Adapters shall conform to the requirements for Environment test specified in IEC Document No. 60874-1 (1993-02), IEC 60874-1 (1994-03) and IEC 60794-1. The requirements of the particular test has been specified in the relevant test.

Note: Check the manufacturer compliance for the requirement of the clause and the same to be tested as per the requirement of the clause nos. 4.4, 4.5, 4.14, 4.24 & 4.25 of this GR.

7.0 Documentation:

Complete technical literature in English with detailed construction diagram of various sub components with dimensions & test data of optical fibre jumper and the optical connector and optical connector adapter and its parts shall be provided. The details of the ferrule used shall also to be submitted. All aspects of installation, operation and maintenance shall also be covered in the manual. The manual shall include the following:

a) Safety measures to be observed in handling the Optical fibre Jumper.
b) Cleaning method of optical fibre connectors and adapters / ferrule end face using lens paper and Ethanol (Ethyl Alcohol lab grade)
c) Precautions during measurements.
d) Test equipment required for routine maintenance and calibration including their procedures.
e) Each sub-assembly/component shall be clearly marked to show its function, schematic reference so that they are identifiable from the assembly/component layout diagram in the manual.
f) List of components used, including their sources and the approving authority.
g) Detailed ordering specifications for all the components, sub-assemblies, shall be listed in the manual to facilitate re-ordering as and when required.

Note: Check the manufacturer compliance for :

- Complete technical literature in English with detailed construction diagram of various sub components with dimensions & test data of optical fibre jumper and the requirement of the sub-clauses (a) to (g) above.
- Manual covering all details of installation, operation, maintenance.

8.0 Safety Requirements: 8.1 The manufacturer shall make available sufficient information to alert the user about the potential hazard and shall indicate the required precautions and working practice. Note: Check the manufacturer compliance for • sufficient information to alert the user about the potential hazard • required precautions and working practice **9.0 Issue of Type/TSEC Approval:** The manufacturer may seek Type Approval Certificate/TSEC on following basis: **Case I Optical Fibre Jumper (Patch Cord & Pig Tail)** Manufacturer may offer one or all types of Jumpers and testing shall be carried out for one or all types. A common TAC shall be issued for all types of Jumpers. **Case II Adapter** Manufacturer may offer one or all types of Adapters and testing shall be carried out for one or all types. A common TAC shall be issued for all types of Adapters. **Case III Hybrid Jumper** Manufacturer may offer one or all types of Jumper and testing shall be carried out for one or all types. A common TAC shall be issued for all types of Hybrid Jumpers. **Case IV Hybrid Adapter** Manufacturer may offer one or all types of Adapters and testing shall be carried out for one or all types. A common TAC shall be issued for all types of Hybrid Adapters.	

Note:

1. Manufacturer shall submit 25 samples with all in house test reports for evaluation and testing officer shall select five numbers of samples for testing randomly.
2. Raw Material tests shall be conducted during Bulk Production.
3. The fibre (G.657 A) used in simplex cable shall be CACT approved.
4. The Optical fibre cable used for the optical fibre Jumpers shall be CACT approved.
5. Separate approval shall be obtained for patch cords using 2.00 mm diameter simplex cable & 3.00 mm diameter simplex cable.

ANNEXURE - I

TESTS FOR ADAPTER

1. Return Loss Test
2. Cold & Heat Test
3. Damp Heat Test
4. High Temp. Endurance Test
5. Vibration Test
6. Mech. Endurance Test
7. Bending Moment Test
8. Crush Resistance Test
9. Static Load Test
10. Drop Test
11. Strength of Coupling Mechanism Test
12. Salt Mist Test
13. Shock Test
14. Dimensional Test

Note: The following tests are required to be taken for Adapters along with the reference patch cords and reference adapters. These tests are in addition to the requirements of Adapters mentioned in the GR.

1.0 Return loss for each connector of Adapter

a) Type - I FC-PC : $\geq$ 50 dB
b) Type - II SC - PC : $\geq$ 50 dB
c) Type - III SC- APC : $\geq$ 65 dB
d) Type - IV LC : ≥ 50 dB.

Test method: IEC 60874 -1 Clause no. 4.4.12 or any other suitable test method.

Test procedure : As per procedure No. 4

i) At 1310 nm

S. No.	S. No. Adapter	Reference reading (dBm) A1	Final reading (dBm) A2	Return loss (dB) (Ref. – final) A1- A2
1.				
2.				
3.				
4.				
5.				

ii) At 1550 nm

S. No.	S. No. of Adapter	Reference Reading (dBm) A1	Final reading (dBm) A2	Return loss (dB) (Ref. – final) A1- A2
1.				
2.				
3.				
4.				
5.				

Result : Return loss should be better than 50/65 for each connector.

Remarks:

2.0 Cold & Heat test

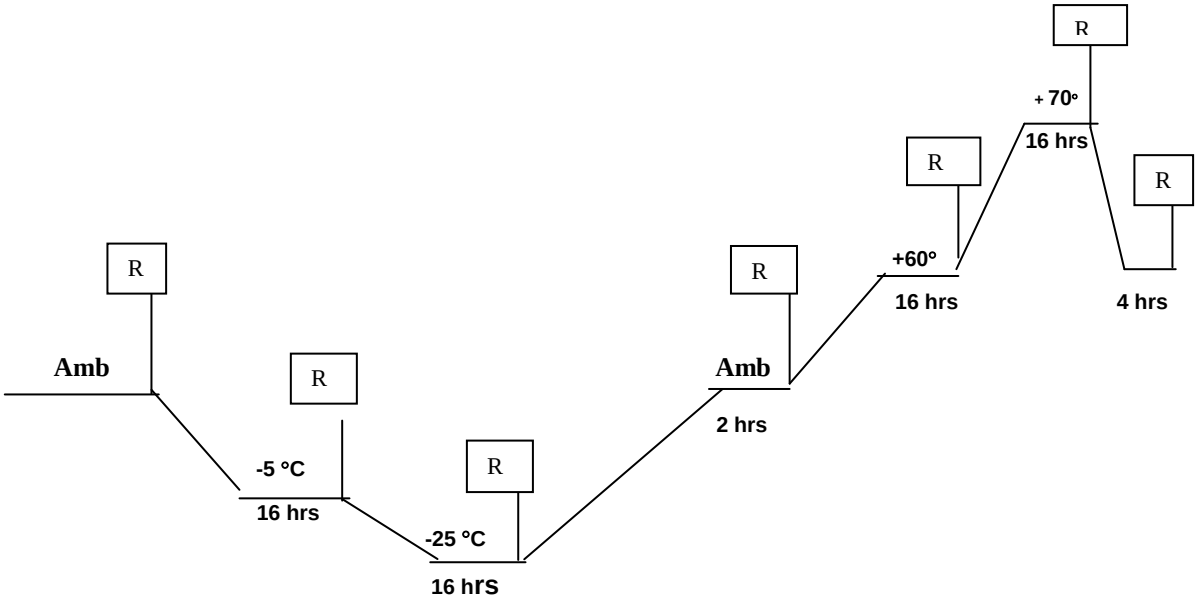
Purpose:
The purpose of this procedure is to determine the suitability of adapters for use in different environments.

Method: IEC 874-1 (clause no. 4.5.17 and 4.5.18)

Temperature		: TA1 - (-5^{o}C)
		: TA2 - (-25^{o}C)
		: TB1 - (+60^{o}C)
		: TB2 - (+70^{o}C)
Duration :	Time (t_1)	: 16 Hrs.
	Rate of change of temp.	: 1 degree per minute
	Number of cycles	: 2 (Two).

Test procedure no. 5

The specimen shall be subjected to test for the following environment test conditions :
Temperature condition as applicable.
Initial and final reading shall be recorded as per temperature condition calls for.



Requirement : Change in the attenuation during the test shall be $\leq$ 0.10 dB. After the recovery period of 30 minutes, insertion loss shall not exceed the specified value i.e., 0.1 dB.

(I) At 1310 nm

S. No	S.No. of Adapter	Initial Reading at Ambient Temp.	Reading at TA1 (–5° C)	Reading at TA2 (- 25° C)	Reading at TB1 (+60°C)	Reading at TB2 (+70°C)	Final reading at Ambient Temp.
1.							
2.							
3.							
4.							
5.							

(II) At 1550 nm

S. No	S.No. of Adapter	Initial Reading at Ambient Temp.	Reading at TA1 (–5° C)	Reading at TA2 (- 25° C)	Reading at TB1 (+60°C)	Reading at TB2 (+70°C)	Final reading at Ambient Temp.
1.							
2.							
3.							
4.							
5.							

Result : Change in the attenuation shall be $\leq$ 0.10 dB. After the recovery, attenuation shall not exceed the specified value.

3) Damp Heat test

Purpose : To check the effects on the sample 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 : $40^{o}C$
b) Relative Humidity : 93% to 95%
c) Exposure time : 4 days.

Requirement : Change in the attenuation during the test shall be $\leq$ 0.10 dB. After the recovery period of 30 minutes attenuation shall not exceed the specified value i.e., 0.3 dB per connector plus fibre loss

(I) At 1310 nm

S. No	**S.No. of Adapter**	**Initial Reading at Ambient Temp.**	**Reading after 1 day**	**Reading after 2 days**	**Reading after 3 days**	**Reading after 4 days**	**Final reading at Ambient Temp.**
1.							
2.							
3.							
4.							
5.							

(II) At 1550nm

S. No	**S.No. of Adapter**	**Initial Reading at Ambient Temp.**	**Reading after 1 day**	**Reading after 2 days**	**Reading after 3 days**	**Reading after 4 days**	**Final reading at Ambient Temp.**
1.							
2.							
3.							
4.							
5.							

Result : Change in the attenuation shall be $\leq$ 0.10 dB. After the recovery attenuation shall not exceed the specified value.

4.0 High Temperature Endurance test

Purpose : The purpose of this test is to check the suitability of the adapter for use and / or storage at high temperature for extended period.

1. Temperature of test : $70^{o}C$
2. Duration of test : 100 hours

Method : IEC 874-1 (clause no. 4.5.33)

Requirement : Change in the attenuation during the test shall be $\leq$ 0.10 dB. After the recovery period of 30 minutes attenuation shall not exceed the specified value i.e., 0.1 dB per adapter.

Test procedure : As per procedure No. 6

(I) At 1310 nm

S. No.	S. No. of Adapter	Initial Reading of Ambient Temp.	Reading at 70° C after 100 hrs	Final reading at Ambient Temp.
1.				
2.				
3.				
4.				
5.				

(II) At 1550 nm

S. No.	S. No. of Adapter	Initial Reading of Ambient Temp.	Reading at 70° C after 100 hrs	Final reading at Ambient Temp.
1.				
2.				
3.				
4.				
5.				

Result : $\leq$ 0.1 dB & after recovery it should not exceed 0.1 dB.

5.0 Vibration Test

Purpose : To check the effects of the vibration on the samples at the predominant frequency ranges and magnitudes that may be encountered during field service.

Method : FC of IEC 68-2-6.

Frequency Range : 10 to 55 Hz
Vibration Amplitude : 0.75 mm constant Displacement (up to 60 Hz)
Endurance duration : 10 Min in each specified axis direction.

Requirement :
Change in Attenuation due to vibration : $\leq$ 0.1 dB

Note : The specimen shall be subjected to vibration in three mutually perpendicular directions, one of which shall be parallel to the optical axis).After test the insertion loss shall be $\leq$ 0.1db for each adapter.

Test procedure : As per procedure No.7

(I) At 1310 nm

S. No.	S. No. of Adapter	Initial Reading .	Final Reading	Remarks
1.				
2.				
3.				
4.				
5.				

(II) At 1550 nm

S. No.	S. No. of Adapter	Initial Reading .	Final Reading	Remarks
1.				
2.				
3.				
4.				
5.				

6.0 Mechanical endurance test :

Purpose : The purpose of this test is to evaluate the effects of successive cycles of engagement and separation on a specific coupling mechanism.

Method : IEC 874-1 (Clause no. 4.5.32)

Number of connection and disconnection: 500

Requirement : Change in the insertion loss shall not exceed the specified value i.e., 0.1dB per adapter.

Test procedure : As per procedure No. 8

(I) At 1310 nm

S. No.	S. No. of Adapter	Initial Reading From side A	B	Final Reading From side A	B	Remarks From side A	B
1.							
2.							
3.							
4.							
5.							

(II) At 1550 nm

S. No.	S. No. of Adapter	Initial Reading From side A	B.	Final Reading From side A	B	Remarks From side A	B
1.							
2.							
3.							
4.							
5.							

7.0 Bending moment test of the Coupling mechanism of the connector:

Purpose: To check the coupling mechanism of a connector adapter to with stand the bending moment to be applied in the field.

Method : IEC -60874-1 Clause No. 4.5.7

Force : 10 N
Rate of force : It shall be applied slowly and smoothly.
Duration of force to be applied : 1 minute

Requirement: Change in the attenuation during the test shall be $\leq$ 0.10 dB. After the recovery period of 30 minutes, insertion loss shall not exceed the specified value of clause no. 4.2 of this GR.

Test procedure: As per procedure No. 15

i) At 1310 nm

S. No.	S. No. of Adapter	Initial reading (dBm)		Final reading (dBm)		Difference (dBm)	
		A1	A2	A1	A2	A1	A2
1.							
2.							
3.							
4.							
5.							

ii) At 1550 nm

S. No.	S. No. of Adapter	Initial reading (dBm)		Final reading (dBm)		Difference (dBm)	
		A1	A2	A1	A2	A1	A2
1.							
2.							
3.							
4.							
5.							

Remarks:

8.0 Crush Resistance test of the connector

Purpose: To evaluate the effect of loads on the connector adapter when exposed to critical situations such as being stepped on, being run over by vehicle tyres etc.

Method: IEC -60874-1 Clause No. 4.5.10

Duration of the load to be applied : 10 sec.
load : 1000 N

Requirement:
1) Change in the attenuation during the test shall be $\leq$ 0.10dB. After the recovery period of 30 minutes, insertion loss shall not exceed the specified value of clause no. 4.2 of this GR.
2) No physical deformation to the cable.

Test procedure: As per procedure No. 18

i) At 1310 nm

S. No.	S. No. of Adapter	Initial reading (dBm)	Final reading (dBm)	Difference (dBm)
1.				
2.				
3.				
4.				
5.				

ii) At 1550 nm

S. No.	S. No. of Adapter	Initial reading (dBm)	Final reading (dBm)	Difference (dBm)
1.				
2.				
3.				
4.				
5.				

Remarks:

9.0 Strength of coupling mechanism (coupling proof torque)

Purpose: To check the effects of axial loads likely to be applied on the coupling mechanism of a connector adapter.

Method : IEC 60874-1 (Clause 4.5.15)

Load	:	8Kg (FC-PC)
	:	0.8Kg (SC)
	:	0.36Kg (LC)
Time Duration	:	5 minutes
Direction of the force	:	Optical Axis

Requirement: Change in the attenuation during the test shall be $\leq$ 0.10 dB. After the recovery period of 30 minutes, insertion loss shall not exceed the specified value of clause no. 4.2 of this GR.

Test procedure: As per procedure No. 21

ii) At 1310 nm

S. No.	S. No. of Adapter	Initial reading (dBm)		Final reading (dBm)		Difference (dBm)	
		A1	A2	A1	A2	A1	A2
1.							
2.							
3.							
4.							
5.							

ii) At 1550 nm

S. No.	S. No. of Adapter	Initial reading (dBm)		Final reading (dBm)		Difference (dBm)	
		A1	A2	A1	A2	A1	A2
1.							
2.							
3.							
4.							
5.							

Remarks :

10. Static load test on adapter.

Purpose : To check the effects of shearing forces likely to be applied on the adapter during the normal field operations.

Method : IEC 874-1 (Clause 4.5.3)

Time Duration : 1 minutes.
Load : 8 Kg.
Direction of the force : Vertical direction to optical axis
Rate of application of the load : 10 mm / minute.

Requirement : Change in the attenuation during the test shall be $\leq$ 0.10 dB. After the recovery period of 30 minutes attenuation shall not exceed the specified value i.e., 0.1 dB per adapter.

Test procedure : As per procedure No. 19

(I) At 1310 nm

S. No.	S. No. of Adapter	Initial reading (dBm)	Final reading (dBm)	Difference (dBm)
1.				
2.				
3.				
4.				
5.				

(II) At 1550 nm

S. No.	S. No. of Adapter	Initial reading (dBm)	Final reading (dBm)	Difference (dBm)
1.				
2.				
3.				
4.				
5.				

Result : $\leq$ 0.10 dB & after recovery it should not exceed by 0.1 dB per adapter .

11.0 Drop Test

Purpose : To evaluate the ability of a adapter to with stand the impacts of drop to be encountered during usage.

Method : IEC -874-1 Clause no. 4.5.14

Number of drops : 25
Drop height : 1.5 meters

Requirement : The attenuation shall not increase the specified value (0.1 dB per adapter) after the test.

Test procedure : As per procedure No. 20

(I) At 1310 nm

S. No.	S. No. of Adapter	Initial reading (dBm)	Final reading (dBm)	Difference (dBm)
1.				
2.				
3.				
4.				
5.				

(II) At 1550 nm

S. No.	S. No. of Adapter	Initial reading (dBm)	Final reading (dBm)	Difference (dBm)
1.				
2.				
3.				
4.				
5.				

Result : $\leq$ 0.1 dB per adapter.

12.0 Sealing

(Water immersion for adapter)

Purpose : To check the integrity of the seals when the samples shall be subjected to immersion under water.

Method :

Water head : 1 meter

Duration : 24 hrs.

Requirement : Change in the attenuation during the test shall be $\leq$ 0.1 dB. After the recovery period of 30 minutes attenuation shall not exceed the specified value i.e., 0.1 dB per adapter.

Test procedure: As per procedure No. 22

(I) At 1310 nm

S. No.	S. No. of Adapter	Initial reading (dBm)	Final reading (dBm)	Remarks
1.				
2.				
3.				
4.				
5.				

(II) At 1550 nm

S. No.	S. No. of Adapter	Initial reading (dBm)	Final reading (dBm)	Remarks
1.				
2.				
3.				
4.				
5.				

Result : $\leq$ 0.10 dB & after recovery it should not exceed by 0.1 dB per adapter .

13.0 Corrosive atmosphere (Salt mist)

Purpose : To check the resistance of samples from deterioration when it shall be exposed to salty environment.

Method : IEC 874-1 (Clause 4.5.26) Or as per QM 333
Procedure : IEC 68-2-11 (Test Ka).
Temperature : $35^{o}C$
Duration : 24 hrs.

Requirement:

1) Change in the attenuation during the test shall be $\leq$ 0.10 dB. After the recovery period of 30 minutes attenuation shall not exceed the specified value i.e., 0.1 dB per adapter.
2) No corrosion observed

Test procedure: Salt preparation and sample preparation as per the procedure No.23.

(I) At 1310 nm

S. No.	S. No. of Adapter	Initial reading (dBm)	Final reading (dBm)	Remarks
1.				
2.				
3.				
4.				
5.				

(II) At 1550 nm

S. No.	S. No. of Adapter	Initial reading (dBm)	Final reading (dBm)	Remarks
1.				
2.				
3.				
4.				
5.				

Result : $\leq$ 0.10 dB & after recovery it should not exceed by 0.1 dB per adapter .

14.0 Effect of Dust on Adapter:

Purpose : To check the effects of dust on the adapter.

Method : IEC 874-1 (Clause 4.5.27)

Temperature : 35^{o}C $\pm$2 ^{o}C
Relative humidity : < 60 %
Rate of dust concentration : 25 g $\pm$5g for 5 minutes.
Size of the dust : Capable to pass through a sieve of 150 um aperture
Duration : 10 minutes.

Requirement : Change in the attenuation during the test shall be $\leq$ 0.10 dB. After the recovery period of 30 minutes attenuation shall not exceed the specified value i.e., 0.1 dB per adapter.

Test procedure : As per procedure No. 24

(I) At 1310 nm

S. No.	S. No. of Adapter	Initial reading (dBm)	Final reading (dBm)	Difference (dBm)
1.				
2.				
3.				
4.				
5.				

(II) At 1550 nm

S. No.	S. No. of Adapter	Initial reading (dBm)	Final reading (dBm)	Difference (dBm)
1.				
2.				
3.				
4.				
5.				

Result : $\leq$ 0.10 dB & after recovery it should not exceed by 0.1 dB per adapter .

15.0 Shock and bumps

Purpose : To check the mechanical weakness and or degradation after samples subject to non-repetitive mechanical shocks encountered on the adapter during the normal field operations.

Method : IEC 874-1 (Clause Nos. 4.5.8 & 4.5.9)
Procedure : IEC 68-2-29 (Test Eb) & IEC-68-2-27 (Test Ea)
Severity
a) No. of Shocks : 5
b) Peak acceleration : 294 m/s^2
c) Pulse duration : 18 ms

Requirement : Change in the attenuation during the test shall be $\leq$ 0.10 dB. After the recovery period of 30 minutes attenuation shall not exceed the specified value i.e., 0.1 dB per adapter.

Test procedure : As per procedure No. 25

(I) At 1310 nm

S. No.	S. No. of Adapter	Initial reading (dBm)	Final reading (dBm)	Difference (dBm)
1.				
2.				
3.				
4.				
5.				

(II) At 1550 nm

S. No.	S. No. of Adapter	Initial reading (dBm)	Final reading (dBm)	Difference (dBm)
1.				
2.				
3.				
4.				
5.				

Result : $\leq$ 0.10 dB & after recovery it should not exceed by 0.1 dB per adapter plus fibre and connector loss.

16.0 Dimensional Test

Note: Check the dimensions of Adapter as the requirement of clause 3.11 and 3.12.

Procedure No. 1

Name of Test: Quality of ferrule End Face of the connector, radius of curvature and concentricity / Eccentricity of the connectors (clause No. 13.1)

Method : IEC 60874-1 (1994-03 clause 4.4.16)

Purpose:
The purpose of this procedure is to determine the concentricity of the inner diameter of a ferrule relative to the outer diameter, or in the case of ferrules with fibre installed, to determine the concentricity of the fibre core axis with the outer diameter of the ferrule.

General:
This procedure describes the measurement of concentricity of ferrules and ferrules with assembled fibres. Concentricity is defined as two times the distance between the axis of the ferrule and the axis of inner diameter of the ferrule (ferrule hole), or in the case of ferrules with installed two times the distance between the axis of the ferrule and the axis of the core installed fibre (see figure 1). When concentricity measurements are made with a fibre installed the results will be affected by the geometry of the fibre and the fit of the outside diameter of the specimen will influence the measurement results.

Measurement shall be made as close as possible to the ferrule end face. The accuracy of the measurement system shall be compatible with the measurement to be made.

Core centre reference measuring in fibre assembled ferrule method:
This method uses a roundness measuring instrument to measure concentricity.
In this method the core axis is fixed at the axis of the measuring instrument and the concentricity is determined by measuring, usually with a probe, the displacement of the outer diameter of the ferrule as the part is rotated.

Apparatus
The following apparatus is required to make the measurement:
a) roundness measuring instrument with microscope;
b) light source;

Procedure:
a) Mount the ferrule assembly on roundness measuring instrument as shown in figure 2 and illuminate the fibre.
b) Using the XY-table on the roundness gauge, the ferrule position is adjusted so that the fibre core is set exactly at the centre of the instrument rotation axis.
c) Contact the pick-up of the roundness measuring instrument to the ferrule outer surface so as to measure the displacement of the outer diameter of the ferrule as the ferrule is rotated.
d) Rotate the specimen a minimum of 360° and record the maximum reading from the roundness gauge as C_1 and the minimum reading as C_2. The concentricity of the part is the difference between the maximum and minimum values. ($C = C_1 – C_2$; see figure 2)

Requirements:
An allowable concentricity is specified in the detail specification.

Procedure No. 2

Name of Test: Effectiveness of clamping device against cable nutation with a connector set (clause No. 13.9)

Method : IEC 60874-1 (1993-02 clause 4.5.35)

Purpose:
The purpose of this test is to assess the ability of the cable clamping devices, anchorages and boots of optical fibre connector is to withstand the severe mechanical stresses associated with cable nutation and maintain their role in preventing damage to the fibre in the vicinity if the connector and of the fibre termination.

General description:
Cable nutation is defined as a rotation, substantially without torque, of the cable adjacent to the connector in a conical path, the apex of the swept cone being at the connector cable clamp.

It is intended to simulate rough handling of a fibre cable at an equipment interface.

Apparatus:
An example of suitable apparatus for the performance of this test is given in figure 3. The connector and cable under test shall be attached to a suitable clamp or a panel mounting adapter which is able to describe a circle without axial rotation i.e. the line xx remains vertical. The remote end of the cable is attached via a pulley to a tensioning mass. Cable load of 8 Kg is selected for tensioning.

The remote cable end should also be properly terminated to prevent unrealistic relative movement of the cable constituents from reducing the effect of the test.

Procedure:
The rotating support member shall preferably through cycles of 360 at a rate of 10 to 20 cycles per minute.

Result:
There shall be no visual signs of damage to the cable structure in the vicinity of the connector; there shall be no fibre breaks; there shall be no perceptible disturbance of the fibre termination(s); there shall be no permanent axial movement of the cable relative to the connector; the required insertion loss level shall be maintained.

Procedure No. 3.1

Name of test: Insertion Loss of each connectors in all conditions of operations

Specified Value: ≤ 0.3 dB

Testing Instruments used:
Stabilized Light Source, Power meter, 2 nos. of patch cords, 2nos. of Adapters, and one reference patch cord with known insertion loss.

Procedure:
Two patch cords are taken. One connector of each cord is connected to the light source and power meter respectively. The other connectors of patch cords are connected to the two adapters. In between the second ports of the adapters, a reference patch cord (with known negligible insertion loss), is connected and reading (1) is taken in the power meter. This is the initial reading. Then the reference patch cord is replaced by the patch cord under test and reading (2) is taken. Then the positions of the connectors of the patch cord, under test, is interchanged and reading (3) is taken. The worst of the later two readings is the final reading (4).

The difference between the initial and final readings(1-4) plus the known insertion loss of the reference patch cord, is the insertion loss of both the connectors of the cord under test. This divided by 2 gives the insertion loss per connector.

Result: It should not exceed the specified value e.g. ≤ 0.3 dB.

Procedure No. 3.2

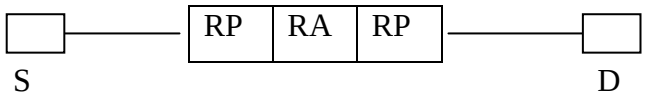
Name of Test : Insertion loss of Adapters

Specified value : ≤ 0.1 dB

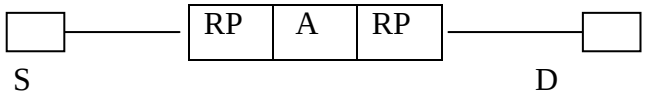
Testing Instruments used : Stabilized Light Source, Power meter, 2 nos. of patch cords and one standard reference connector set of the plug-adapter-plug configuration with known insertion loss.

Procedure :

1. Configure the initial measurement set-up as shown in fig. below.



2. Measure the power reading (1) in power meter.
3. Remove the reference adapter (RA) and replace it with the adapter (A) to be measured as shown in fig below



4. Measure the power reading (2) in power meter.
5. Calculate the insertion loss of the adapter (A) by taking the difference between reading (1) & (2) and adding the insertion loss of reference adapter (RA)

Result : It should not exceed 0.1 dB .

Procedure No. 4

Name of Test : Return loss for each port

Specified value : ≥ 50 dB

Return Loss Measurement : This test shall be taken to determine the return loss of the connectors used in the patch cords / pigtails.

Instrument used : Directional Coupler, Stabilized Light Source, Power Meter & Refractive Index Matching Liquid.

Two reference patch cords are taken. One connector of each cord is connected to the light source and power meter respectively. The second connector of the cord, connected to the light source, is connected at the "Trans" port of the coupler & the second connector of the cord, connected to the Power meter is connected to the "Rec" port of the coupler & initial reading is taken in the power meter. One of the connectors of the patch cord under test, is connected at the "Test" port of the coupler. The tip of the other end connector of the cord is dipped in the refractive index matching liquid which has almost the same reflective index as that of the core of the fibre used in the patch cord. Light source is made "ON". Final reading in the power meter is noted. The difference between the initial & final readings is the return loss of the connector connected to the coupler. The process is repeated by interchanging the positions of the connectors of the cord under test.

Alternatively : The return loss can be measured with the help of an OTDR having facility to measure the return loss directly without using the directional coupler.

Result : The difference in the two readings i.e. the R/L should be better than 50 dB for each port.

Test Procedure No. 5

Name of Test : Environmental test

Method : IEC 874-1(clause no. 4.5.33)

Purpose :
The purpose of this procedure is to determine the suitability of adapters for use in different environments.

General description
The specimen is placed in a suitable environmental chamber and gradually raised to the required temperature. It is allowed to stabilize and is then maintained at the elevated temperature for an extended period of time. Finally, the chamber is allowed to gradually cool.

Requirement - An environmental chamber.

Set up : Two adapters are mounted on a steel plate. One port of each adapter is connected to the light source & power meter respectively. In between the other ports of the adapters, connected to adapter under test with the patch cords. The initial reading is taken in the power meter.

The Adapter under test is then put inside the environmental chamber. The temperature of the chamber shall be increased or decreased as applicable to the environment test conditions and reading is taken on the power meter.

Procedure
This test shall be conducted in accordance with test procedure and reading shall be recoded as when required as per the graph.

Result : After completion of the test :
- There should not be any visible damage to the adapter.
- Change in attenuation during the test shall be ≤ 0.1 dB. After recovery period of 2hrs. attenuation shall not exceed 0.1 dB .

Procedure No. 6

Name of Test : High Temperature Endurance Test

Method : IEC 60874-1(clause no. 4.5.33)

Purpose :
The purpose of this procedure is to determine the suitability of connectors for use and/or storage at high temperature for extended periods.

General description
The specimen is placed in a suitable environmental chamber and gradually raised to the required temperature. It is allowed to stabilize and is then maintained at the elevated temperature for an extended period of time. Finally, the chamber is allowed to gradually cool.

Requirement - An environmental chamber.

Set up : Two adapters are mounted on a steel plate. One port of each adapter is connected to the light source & power meter respectively. In between the other ports of the adapters, the patch cord under test, is connected. The initial reading is taken in the power meter.

The sample patch cord mounted on the steel plate is then put inside the environmental chamber. The temperature of the chamber is raised to +70 ° and kept for 100 hrs. The power meter reading is taken. The chamber is then brought down the ambient temperature and final reading is taken. The difference between the first reading at ambient temp. and final reading at +70 °C is the total loss. This is divided by the number of connector and loss per connector is calculated.

Procedure
This test shall be conducted in accordance with test procedure “Dry heat” (see 4.5.18).

Apparatus
The apparatus consists of a chamber capable of maintaining the specified endurance temperature with a tolerance of $\pm$ 5 °C. The chamber shall be such that the specimen is not subjected to direct radiation from the heating of the chamber.

Result : After completion of the test :
- There should not be any visible damage to the cord.
- Change in attenuation during the test shall be $\leq$ 0.1 dB. After recovery period of 30 minutes attenuation shall not exceed the specified value e.g. $\leq$ 0.3 dB.

Procedure No. 7

Name of Test : Vibration Test for Terminated connector set

Method : IEC 60874-1 clause no.4.5.1 & IEC 68-2-6 (Fc)

Purpose : To check the effects of vibration on the samples at the predominant frequency ranges and magnitudes.

Test set up as per IEC-794-1-F1.

The test set up is made as described in procedure no. 6 & initial reading is taken in the power meter.

The steel plate is fixed over the platform of the vibration machine. The platform is then made to vibrate at frequency 10 to 55 Hz and amplitude 0.75 mm for 10 minutes in each specified axis direction (three mutually perpendicular directions , one of which shall be parallel to the optical axis). After the test, the final reading is taken. Precaution is to be taken to keep sufficient length of cords straight near the adapters & the light source to get the correct readings.

Result : The change in connection loss due to vibration should not exceed 0.05 dB.

Procedure No. 8

Name of Test : Mechanical Endurance Test

Method : IEC 60874-1 (clause no. 4.5.32)

Purpose

The purpose of this procedure is to evaluate the effects of a number of successive cycles of engagement and separation on a specific coupling mechanism of a connector set.

General Description

The specific coupling mechanism under evaluation is subjected to a number of successive cycles of engagement and separation. When the connector set involves more than one coupling mechanism, the cycles are conducted with all other mechanisms properly engaged.

Apparatus

The apparatus consists of:

- suitable clamps, jaws or other means to hold the mating connector halves in proper alignment during the test;
- a means of applying the force or torque to engage and separate the specimen. The force may be applied manually.

Procedure

a) A cycle shall consists of one normal full engagement and separation of the coupling mechanism to be evaluated. When the connector set involves more than one coupling mechanism, the cycles shall be conducted with all other mechanisms properly engaged. The mating shall be accomplished according to the manufacturer's instructions.

b) Cycle the coupling mechanism 500 times. The minimum time between each engagement and separation shall be 3 s.

c) The test is to be taken at both the ports of the connector set/ Adapters

Result : Change in attenuation during the test shall not exceed the specified value e.g. $\leq$ 0.3 dB.

Procedure No. 9

Name of Test : Tensile Test (connectorized cable pulling Test)

Method : IEC-60794-1-E1

Procedure:
Test is to be taken on a connecterised Jumper cable. At one end of the test equipment, a plate with an adapter is fixed. One port of the adapter is connected to the stabilized light source with the help of a patch cord and to other port of adapter, one of the two connectors of the cord under test, is connected. The other end of the patch cord is wrapped round a chuck drum (250 mm dia. approx.) and the connector is connected to the power meter, Initial reading is taken in the power meter. The chuck drum is then made to move slowly at a speed of 100 mm/minute. When the tensile load reading reaches 8 Kg, it is kept stretched for 5 minutes & then reading is taken. After 5 minutes, the load is removed slowly and the patch cord is brought to relaxed position. The reading is taken again. This process is repeated by interchanging the positions of the connectors of the cord under test.(Fig 4)

Results :

Change in attenuation during the test shall be ≤ 0.1 dB. After recovery period of 30 minutes attenuation shall not exceed the specified value e.g. ≤ 0.3 dB. Also there should be no visible damage to the cord.

Procedure No. 10

Name of Test : Flexibility Test for cable

Method : IEC-60794-1-E11.

Purpose :
The purpose of this test is to determine the ability of the patch cord to withstand the wrapping & unwrapping of the cord without any damage to the fibre and change in attenuation.

One connector of the patch cord under test, is connected to the light source & other connector, to the power meter.

The patch cord under test, is then wrapped and unwrapped for 4 turns & 10 such cycles over a mandrel of diameter 24xd i.e. 24 times the diameter of the patch cord cable.

Result : Change in attenuation during the test shall be ≤ 0.1 dB. After recovery period of 30 minutes attenuation shall not exceed the specified value e.g. ≤ 0.3 dB. There should not be any visible damage to the sheath of the optical jumper wire.

Procedure No. 11

Name of Test : Repeated Bending Test of connectorized cable

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

Method : IEC-60794-1-E6

Preparation of sample, termination and the apparatus required :

1. The sample length shall be sufficient to permit the optical measurement (5 meters or more).

2. The sample shall be terminated at such end by connector in a manner such that the fibres sheathings and any strain members are clamped together. The clamp on the bending apparatus may be adequate,or the sample may be long enough that no restraint is needed.

3. The test apparatus shall be prepared as fig 5 (Cable / Connector assembly test set up). The apparatus shall be capable of cycling . Displacing the sample from the vertical position to the extreme right position then oscillating to the extreme left position and returning to the original vertical position in considered to be one cycle.

Procedure :

One connector of a patch cord is connected to the stabilized light source & other connectors connected to the cord under test, through an adapter. Then this connector along with the adapter, is clamped firmly and cord is passed in between two vertical pulleys of diameter 100 mm fixed vertically side by side. The second connector of the cord, under test, is connected to the power mete & initial reading is taken.

Below the pulleys, a weight of 2 Kg is attached to the patch cord at suitable height. The lever on which the first connector (with adapter) is clamped is then made to move right & left through 180 °C, thus bending the cord towards extreme let and extreme right, the two extreme positions making an angle of 90o on both sides of the vertical i.e. start position. Starting from vertical position and back constitutes one cycle. The speed of rotation shall be 10 cycles/minute. The test is repeated for 1000 such cycles. The final reading is taken. Same test is repeated for the other connector also.

Result : Change in attenuation during the test shall be ≤ 0.1 dB. After recovery period of 30 minutes attenuation shall not exceed the specified value e.g. ≤ 0.3 dB. There should be no visible damage to the cord.

Procedure No. 12

Name of Test : Cable Bend Test under Tension

Method : IEC 60794-1-E11

Procedure :

This test is to determine the ability of the patch cord to withstand any bend under tension.

One connector of the patch cord under test, is connected to the light source & other to the power meter and initial reading is taken.

The patch cord is held from the centre and is clamped on a mandrel of 50 mm diameter so that equal lengths are available towards both the connectors. A load of 10 N each is then attached to the cord both sides in between at a suitable height.

The mandrel is then rotated slowly to wrap the patch cord over it for 6 turns and then unwrapped slowly (one revolution should be completed in 5 seconds). This wrapping & unwrapping for 6 turns constitutes one cycle. This is done for 10 cycles. Final reading is then taken.(Fig 7)

Requirement & Results :
During the test no fibre shall break . The sheath shall not show any crack visible to the naked eye when examined whilst still wrapped on the mandrel . If relevant any permanent increase in attenuation after the test shall not exceed the value specified in the detail specification. Change in attenuation during the test shall be $\leq$ 0.1 dB. After recovery period of 30 minutes attenuation shall not exceed the specified value e.g. $\leq$ 0.3 dB. There should not be any visible damage to the cord.

Procedure No.13

Name of Test : Cable Bend at low temperature

Method : IEC 60794-1-E11

Requirements – Mandrel of 2.5 times cable diameter. Environmental Chamber.

Test Temperature - -25 °C

Set up : Two adapters are mounted on a steel plate. One port of each adapter is connected to the light source & power meter respectively. In between the other ports of the adapters, the patch cord under test, is connected. The initial reading is taken in the power meter.

The patch cord, along with the steel plate, is then kept in an environmental chamber. The temperature of the chamber is then brought down to -25°C. When the temp. stabilizes, the cord is wrapped & unwrapped 10 times over the mandrel. The final reading is taken after the last unwrapping and after making the patch cord straight.

Alternatively : If the number of the cord under test is large, they may be tested in the following manner :

Required number of adapters are mounted on steel plate. Two patch cords are taken. One connector of each cord is connected to the light source and power meter respectively. The other connectors of the patch cords are connected to the two (first & last) adapters. In between the second ports of the adapters, the patch cords under test, are connected one by one through additional adapters and readings are taken after connecting each cord & finally the cumulative reading of the whole link i.e. all the cords connected in series. This become the initial reading of the link.

The steel plate along with the patch cord, is then kept in the environmental chamber and the temperature is brought down to –25 °C.

When the temperature stabilizes, each patch cord under test, (one by one in the reserved order), is then wrapped & unwrapped 10 times over the mandrel and readings are taken and compared with the corresponding initial readings at every stage.

Result : Change in attenuation during the test shall be ≤ 0.1 dB. After recovery period of 30 minutes attenuation shall not exceed the specified value e.g. ≤ 0.3 dB. There should not be any visible damage to the cord.

Procedure No. 14

Name of Test : Torsion Test of the cable

Method : IEC 60794-1-E7

Purpose & Procedure :

This test is to determine the ability of the cord to withstand torsion.

One connector of a patch cord is connected to the light source & other connector is connected to the patch cord under test, through an adapter. The adapter is clamped in a fixed clamp sufficiently tight. The cord in between is fixed to the rotating clamp & initial reading is taken. The distance between the fixed & rotating clamps shall be 250 mm. The axial load connected at the rotating clamp end shall be 20 N. (Fig no .6)

The rotating clamp is then rotated in a sequence as - clockwise direction - back anti-clockwise direction - back to the starting position at an angle of + 180 °C.

The process is repeated for 20 such rotation with a speed of not less than 30 rotations / minute. The final reading is then taken.

Result : Change in attenuation during the test shall be ≤ 0.1 dB. After recovery period of 30 minutes attenuation shall not exceed the specified value e.g. ≤ 0.3 dB. There should be no visible damage to the cord or the connector .

Procedure No. 15

Name of Test : Bending Moment Test of the coupling mechanism of the connector

Method : IEC-60874-1 (clause no. 4.5.7)

Purpose
The purpose of this procedure is to ensure that coupling mechanism of a connector set to withstand a bending moment applied in the field.

General Description
A bending moment is smoothly applied to a mated connector set so as to bend its longitudinal axis.

Apparatus
The apparatus consists of:
- a force generator capable of smoothly applying the specified force at the specified rate;
- a clamping device;
- a torque wrench.

Procedure
a) Properly mate the connector set.
b) Securely clamp one connector half.
c) Slowly and smoothly apply a force of 10 N to the opposite connector half at the point of application.
d) Maintain the force for 1 minute.

Result : Change in attenuation during the test shall be ≤ 0.1 dB. After recovery period of 30 minutes attenuation shall not exceed the specified value e.g. ≤ 0.3 dB. There should be no visible damage to the cord or the connector .

Procedure No. 16

Name of Test : Crush Test (Axial Compression)

Method : IEC 60794-1-E3

Purpose & Procedure :

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

One connector of the patch cord under test, is connected to the light source & other connector, to the power meter. A sample of the patch cord (in the middle), under test, is placed between a flat steel base plate & a movable steel plate whose edges shall be rounded with a radius of 5mm & initial reading is taken. A crushing force of 50 Kg is then applied gradually over the sample & kept for 1 minute & final reading is taken.(Fig 7)

Result : Change in attenuation during the test shall be ≤ 0.1 dB. After recovery period of 30 minutes attenuation shall not exceed the specified value e.g. ≤ 0.3 dB. There should be no visible damage to the cord

Procedure No. 17

Name of Test: Impact Test

Method: IEC 60794-1-E4

Purpose & Procedure:

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

One connector of the patch card under test is connected to the light source and other connector to the power-meter**.** A sample of the patch cord (in the middle), is fixed over a flat steel base. Another steel plate having a radius of curvature of 12.5 mm, is placed & held over it in position with the help of central rod. Initial reading is taken in the power meter. A weight is then dropped freely over the steel plate (along the same central rod) with the initial energy of 10 N (1Kg), from a height of 100mm. The process is repeated for 3 times and reading is taken.(Fig 8)

Result: Change in attenuation during the test shall be ≤ 0.1 dB. After recovery period of 30 minutes attenuation shall not exceed the specified value e.g. ≤ 0.3 dB & no visible damage to the cord.

Procedure No. 18

Name of Test : Crush Resistance Test of the connector

Method : IEC-60874-1(clause no. 4.5.10)

Purpose
The purpose of this procedure is to evaluate the effect of loads which may occur when connector sets are exposed to critical situations such as being stepped on, being run over by vehicle tyres etc.

General Description
The specimen is exposed to a compressive load which is applied by a pad

Apparatus
The apparatus consists of:
- a shallow box or tray, nominally 300 mm x 300 mm, capable of housing of a representative ground or floor surface;
- A pad of resilient or rigid material, nominally 100 mm x 100 mm x 12 mm thick, bonded to a non-yielding plate;
- A force generator;

Procedure
a) Place the specimen centrally on the test surface contained in the shallow.
b) Smoothly apply the specified load i.e. 1000N
c) Maintain the load for the specified duration i.e. 10 sec.

Result : Change in attenuation during the test shall be ≤ 0.1 dB. After recovery period of 30 minutes attenuation shall not exceed the specified value e.g. ≤ 0.3 dB. There shall be no physical deformation to the cable.

Procedure No. 19

Name of Test : Static Load of the connector

Method : IEC 60874-1 (Clause 4.5.3)

Purpose
The purpose of this test is to ensure a panel-mounted connector set to withstand shearing forces likely to be applied during normal services.

General Description
The specimen is mounted to a metal plate simulating the normal method of mounting. A steady force is applied smoothly to the connector body.

Apparatus
The apparatus consists of:
- a force generator capable of smoothly applying the specified force at the specified rate;
- a rigid metal plate to mount the specimen securely.

Procedure
a) Securely mount the specimen on the metal plate.
b) Smoothly apply the load of 8 Kg to the specified point, at the rate of application of the load as 10 mm/minute in the vertical direction to the Optical axis.
c) Maintain the load for 1 minute.

Result : Change in attenuation during the test shall be ≤ 0.1 dB. After recovery period of 30 minutes attenuation shall not exceed the specified value e.g. ≤ 0.3 dB.

Procedure No. 20

Name of Test : Drop Test

Method : IEC 60874-1 (Clause 4.5.14)

Purpose
The purpose of this procedure is to evaluate the ability of a specimen to withstand impacts likely to be encountered during usage.

General Description
A specimen with an attached length of cable is freely swung in a pendular motion and allowed to strike an impact surface.

Apparatus
The apparatus consists of:
- A suitable cable clamping fixture.
- An impact surface.

Cable clamping fixture
The fixture shall be capable of being mounted to any convenient rigid vertical structure. A swivel shall be provided for attaching the cable to the fixture in such a manner as to allow it to swing freely from a horizontal to a vertical position.

Impact surface
The impact surface shall be a steel plate at least 300 mm x 500 mm x 25 mm thick.

Procedure
a) The test set up is shown in figure 9.
b) Attach the cable clamping fixture at a height of 1500 mm from the impact surface.
c) Attach the cable to the attachment fixture at a distance of 2.25 m from the rear of the connector so that the specimen may swing freely from a horizontal to a vertical position.
d) Hold the specimen in a horizontal position as shown and allow it to drop 25 times on to the impact surface. If the specimen height is important. It shall be specified in the relevant specification.

Result : The attenuation shall not exceed the specified value e.g. ≤ 0.3 dB after the test.

Procedure No. 21

Name of Test : Strength of Coupling mechanism (Coupling proof torque) :

Method : IEC 60874 – 1 (clause 4.5.15)

Purpose
The purpose of this test is to check the effects of axial loads likely to be applied on the coupling mechanism of a connector.

General description
This procedure consists of mating the specimen in the normal fashion and then applying an overload torque to the coupling mechanism.

Apparatus
The apparatus consists of:
- suitable clamps, jaws or other means to hold the specimen in proper alignment during the test;
- a torque measuring instrument;
- a torque generator; the torque may be applied manually.

Procedure
a) Properly mate the specimen in accordance wit the manufacturer's instructions.
b) Apply the specified overload torque i.e. 8 Kg load in the direction of optical axis.
c) Maintain the torque for 5 minute.

Result : Change in attenuation during the test shall be ≤ 0.1 dB. After recovery period of 30 minutes attenuation shall not exceed the specified value e.g. ≤ 0.3 dB.

Procedure No. 22

Name of Test : Sealing (water immersion for connector set with cable)

Method : IEC 60874-1 (clause no.4.5.24)

Purpose : To check the integrity of the seals when the samples shall be subjected to immersion under water (1 meter) for 24 hrs.

Procedure : As per IEC 68-2-17 (Test Qf)

Result : Change in attenuation during the test shall be ≤ 0.1 dB. After recovery period of 30 minutes attenuation shall not exceed the specified value e.g. ≤ 0.3 dB.

Procedure 23

Name of Test : Corrosive atmosphere (salt mist)

Method : IEC 60874-1 (clause no.4.5.26) or QM-333

Purpose : To check the resistance of samples from deterioration when it shall be exposed to salty environment at temperature of 35° C for 16 hrs.

Procedure : As per IEC 68-2-11 (Test Ka).

Result : Change in attenuation during the test shall be ≤ 0.1 dB. After recovery period of 30 minutes attenuation shall not exceed the specified value e.g. ≤ 0.3 dB. No corrosion shall be observed.

Procedure No. 24

Name of Test : Effect of Dust on connector set

Method : IEC 60874-1 (clause no. 4.5.27)

Procedure : As per IEC 68-2-17 (Test Qf).

Purpose
The purpose of this test is to determine the effects of dust on connector sets.

General Description
The specimen is exposed to specified dust concentration within a conditioning chamber in which the air is circulated over a period of time.

Apparatus
The apparatus consists of:
- a test chamber;
- a measuring device;
- dust;

Test chamber
The test chamber shall be capable of being raised to and maintained at a temperature of 35 °C ± 2 °C with a relative humidity not exceeding 60 %. It shall be adjustable so as to produce a dust concentration sufficient to deposit 25 g ± 5 g on the measuring device over a period of 5 minutes.

Procedure
a) Adjust test chamber dust concentration to the operating conditions as given above. The size of the dust is such that it shall be capable to pass through a sieve of 150 um aperture.
a) Place specimen into the test for 10 minutes.

Result : Change in attenuation during the test shall be ≤ 0.1 dB. After recovery period of 30 minutes attenuation shall not exceed the specified value e.g. ≤ 0.3 dB.

Procedure No. 25

Name of Test : Shock

Method : IEC 60874-1 (clause 4.5.9)

Purpose :
The purpose of this test is to check the mechanical weakness and or degradation after samples subject to non-repetitive mechanical shocks encountered on the connector during the normal field operations.

Procedure : As per IEC 68-2-27(Ea) & IEC 68-2-29 (test Eb).

Result : Change in attenuation during the test shall be ≤ 0.1 dB. After recovery period of 30 minutes attenuation shall not exceed the specified value e.g. ≤ 0.3 dB. No corrosion shall be observed.