



वर्गीय अपेक्षाओं के लिए मानक

टीईसी ८८३२०:२०२६

STANDARD FOR GENERIC REQUIREMENTS

TEC 88320:2026

पोन ऑप्टिकल टाइम डोमेन रिफ्लेक्टोमीटर
(एफटीटीएच एप्लिकेशन के लिए)

PON OPTICAL TIME DOMAIN REFLECTOMETER
(For FTTH Applications)



ISO9001:2015

दूरसंचार अभियांत्रिकी केंद्र

खुरशीदलाल भवन, जनपथ, नई दिल्ली-११०००१, भारत

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इस सर्वाधिकार सुरक्षित प्रकाशन का कोई भी हिस्सा, दूरसंचार अभियांत्रिकी केंद्र, नई दिल्ली की लिखित स्वीकृति के बिना, किसी भी रूप में या किसी भी प्रकार से जैसे -इलेक्ट्रॉनिक, मैकेनिकल,फोटोकॉपी, रिकॉर्डिंग, स्कैनिंग आदि रूप में प्रेषित, संग्रहीत या पुनरुत्पादित न किया जाए ।

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FOREWORD

Telecommunication Engineering Centre (TEC) is the technical arm of Department of Telecommunications (DOT), Government of India. Its activities include:

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

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

ABSTRACT

This document pertains to Standard for Generic Requirements of PON Optical Time Domain Reflectometer for FTTH applications. The instrument shall be capable of dark fibre testing of FTTH networks as well as live fibre testing of FTTH networks.

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HISTORY SHEET

<i>SN</i>	<i>GR No.</i>	<i>Title</i>	<i>Remarks</i>
1.	TEC 88320:2026	Standard for Generic Requirements of PON Optical Time Domain Reflectometer (For FTTH Applications)	Release 1

REFERENCES

<i>SL.No</i>	<i>Document No.</i>	<i>Title/Document Name</i>
1.	QM-333 (or TEC 14016:2010) {Latest issue}	Standard for Environmental Testing of Telecommunication Equipment
2.	TEC/SD/DD/EMC-221/05/OCT-16 (or TEC 11016:2016) (Latest release)	Electromagnetic Compatibility Standard for Telecommunication Equipment
3.	IEC 60529	Testing & measurement techniques for the intrusion of dust and liquids
4.	CISPR 11 and CISPR 32	Limits and methods of measurement of radio disturbance characteristics of Industrial, Scientific, and Medical (ISM) RF equipment : Multimedia equipment (MME)
5.	IEC 61000-4-2	Testing and measurement techniques of Electrostatic discharge immunity test
6.	IEC 61000-4-3	Testing and measurement techniques- Radiated RF Electromagnetic Field Immunity test
7.	IEC 61000-4-4	Testing and measurement techniques of electrical fast transients/burst immunity test
8.	IEC 61000-4-5	Testing & Measurement techniques for Surge immunity test
9.	IEC 61000-4-6	Testing and measurement techniques- Immunity to conducted disturbances, induced by radio frequency fields
10.	IEC 61000-4-11	Testing & measurement techniques- voltage dips, short interruptions and voltage variations immunity tests
11.	IEC 61000-4-29	Testing & measurement techniques- voltage dips, short interruptions and voltage variations on d.c. input power port immunity

		tests
12.	IEC 61010-1	Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory use
13.	ISO 9001:2015 or latest issue	International Quality Management System
14.	SR-4731 (latest issue)	Telecordia document
15.	ITU-T G.652.B, G. 652.D, G.655, G.656 & G.657	ITU-T Recommendations
16.	IEC 60825-1	Safety of laser products - Part 1: Equipment classification and requirements
17.	ASTM D 2794 and ASTM D 2197	ASTM Standards
18.	IS 8437	Guide on the effects of current passing through the human body[equivalent to IEC publication 60479]

Note: The ITU-T/CISPR/IEC/EN etc. standards and recommendations referred to in this document shall imply their latest versions.

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CHAPTER - 1

1.0 Introduction:

This document describes the Standard for Generic requirements of PON optimised Optical Time Domain Reflectometer for FTTH applications. The instrument allows the testing of fibre through splitters with overall split ratios of upto 1:128. It should be capable of detecting and displaying optical splitters used in FTTH networks. It should support distributed PON architectures, including balanced and un-balanced splitters. The instrument shall be capable of dark fibre testing of FTTH networks as well as live fibre testing of FTTH networks. The instrument is intended to be used for locating faults and irregularities on single mode optical fibre cable during Installation and service activation of Fibre to the Home networks etc. at 1310nm and 1550nm. The instrument is intended to also be used for troubleshooting & maintenance of live Fibre (in-service troubleshooting) of FTTH networks at 1625nm/1650nm. The instrument is essentially used to measure Splice loss, Connector loss, Fibre attenuation, Reflectance of points, Link optical return loss and distance to fibre events through the active and passive network elements. It can also be used for estimating the length of O.F. cable and attenuation attributed by the same. This instrument is envisaged to be handy and lightweight.

2.0 Functional Requirements:

- 2.1 The instrument shall be equipped with controls that enable the signature (fibre trace) to be expanded with respect to the return power and distance axis. It shall be able to locate an event easily. There shall be provision for zoom on event and full span zoom of the fibre on X and Y Axis.
- 2.2 The instrument shall be capable of "Real-time" operation during which it shall display the current fibre trace and the current 2-point loss between two user selected points. The instrument shall be capable of saving multi-wavelength traces. There shall be provision for comparison of a main trace with the

respective reference trace. The instrument must have the possibility to save trace under Bellcore 2.0 format for universal use. Apart from this, the OTDR shall have onboard report generation feature in user-desired format.

- 2.3 The instrument shall provide controls, processing and output to determine the reflectance of fibre events such as connectors and splices and to determine the optical return loss of the user selected portion of the fibre link to which the OTDR is connected.
- 2.4 On connecting the fibre by the user and by actuating a single control to start the measurement, the test set shall automatically measure the attenuation coefficient of all continuous sections of fibre separated by discrete loss discontinuities plus sum of the cumulative loss to each discontinuity for the entire span, within the instrument's measurement range. It shall list all events of the fibre under measurement and shall provide the results in tabular form, which shall include distance to events, splice position, splice loss, return loss, end of fibre distance, fault position, section loss, total span ORL, macro-bend location and other items including total loss calculation etc.
- 2.5 If the instrument encounters a case for which the reflectance is clipped (the reflective pulse saturates the test set detector), the test set shall report the measurement as the lower bound reflectance for the point.
- 2.6 The instrument shall provide an indication that the end of the fibre has been found if it detects a break in the fibre or if the attenuation at a point exceeds a user-selectable loss threshold. The instrument shall be able to detect a reflective end of the fiber even if the noise ratio is too high for user information only. The analysis must be performed in a range where the SNR is sufficient in order to provide valuable results.
- 2.7 The manufacturer shall provide the calibration report of the instrument which covers all the essential optical performance parameters. The manufacturer shall

also provide the detail method to check the level of optical power launched into the fibre.

- 2.8 All Software (Emulation software) shall be provided for all applications of personal computers for recalling stored trace information and doing trace analysis.
- 2.9 The instrument should locate all fibre events with respect to convenient reference and relative marking facility.
- 2.10 Data storage system should be available for the instrument, to store in internal as well as external memory the complete trace information and settings. The instrument shall allow cloud file storage to enable instant sharing of measurement reports.
- 2.11 The instrument should be equipped with the necessary software, and/or hardware to read, write, and interact with the OTDR data standard as per Telecordia document No.SR-4731 (latest issue).
- 2.12 Equipment suppliers should provide supplementary software to the end user of the test set that will convert files from the suppliers existing file output format to the OTDR data standard as per Telecordia document No.SR-4731 (latest issue).
- 2.13 The software function shall provide waveform display; manual measurement, auto search auto zoom, event editing, printing, waveform comparison, waveform difference and both end measurements.
- 2.14 It shall have facility to measure splice loss in Auto and Manual modes.
- 2.15 The instrument shall have its own simple GUI and menu-driven setup for performing measurements.

- 2.16 It shall have facility to label the characteristic of the fibre traces on the screen and file name, titles, header and event comments and calendar, clock etc.
- 2.17 The instrument shall provide a help menu or troubleshooting facility.
- 2.18 It shall have the facility to compare the traces of all the selectable wavelengths.
- 2.19 It shall have sufficient number of markers for marking the events, distance and loss measurements.
- 2.20 It shall protect the detector overload and fast ageing of detector resulting in high accuracy and improved resolution. It shall warn the user of a possible damage to the detector in case the tests are performed on live fibre to protect the input port.
- 2.21 All controls shall be clearly marked or labelled with an easy to understand symbol or key word to indicate its intended use
- 2.22 Spectral width for each source shall be specified by manufacturer.
- 2.23 The OTDR shall be capable to measure the distance between two events on the fibre trace.
- 2.24 The instrument shall be capable of dark fibre testing of FTTH networks as well as live fibre testing of FTTH networks
- 2.25 The instrument should have the function to automatically find and locate macro-bend to speed up construction (splicing) and troubleshooting.
- 2.26 The instrument shall be able to perform multi-pulses acquisitions.
- 2.27 The instrument's test solution shall be able to convert OTDR trace into an icon-based map that makes OTDR results interpretation quick and easy.

- 2.28 The instrument shall be able to detect and identify the PON splitter types. The instrument shall be able to detect all events before and after the splitter.
- 2.29 The user shall be able to create and save any specific test set-up configuration for recalling it in the subsequent testing. The instrument may support some pre-installed dedicated FTTH setup menus, as well.
- 2.30 The OTDR should have pre-set thresholds for pass/fail detection of the events.
- 2.31 The instrument should support facility to transfer the records of traces/data.

3.0 Technical Requirements of PON OTDR:

- 3.1 Type of Fibre : Single Mode as per ITU-T G.652.B, G.652.D, G.655, G.656 & G.657
- 3.2 Central Wavelength : a) $1310 \pm 20\text{nm}$
b) $1550 \pm 20\text{nm}$
c) $1625/1650 \pm 20\text{nm}$

Note: The instrument shall be switch-able to any of these wavelengths.

- 3.3 Dynamic Range : a) $\geq 40\text{ dB}$ at 1310nm
b) $\geq 40\text{ dB}$ at 1550nm
c) $\geq 39\text{ dB}$ at 1625nm/1650nm

Note: The dynamic range shall be as measured at SNR = 1. Pulse width is to be defined by manufacturer for PON optimized OTDR which have high dynamic range at short pulse width.

- 3.4 Pulse Width: 3ns to 20 μs

- 3.5 Near end Dead Zone : $\leq 4\text{m}$ (at -45dB reflectance)
 (Back Scattered Dead Zone) (To be decided by purchaser)
 (pulse width to be defined by manufacturer)
- 3.6 Event Dead Zone : $\leq 0.8\text{ m}$ (at -45dB reflectance)
 (Fresnel reflection) (pulse width to be defined by manufacturer)
- 3.7 Splitter Dead Zone or PON Dead Zone: To be defined by manufacturer
- 3.8 Distance Measurement
- a) Distance Range : Settable
 (Horizontal Scale settings) (To be specified by manufacturer)
- b) Sampling Resolution : $\leq 4\text{ cm}$
- c) Accuracy
 i) Up to 1 Km: $< \pm 1\text{ Meter}$
 ii) Up to 20 Km: $\leq \pm 1.5\text{ Meter}$
- d) Data sampling point : $\geq 256,000$
- 3.9 Attenuation Measurement : LSA, 2 points
- a) Vertical scale : Settable (To be specified by manufacturer)
 b) Readout (Display) resolution : 0.001 dB
 c) Accuracy : 0.04 dB/dB
- 3.10 Refractive Index : 1.40000 to 1.60000
 (Adjustable in steps of 0.00001)
- 3.11 Reflectance measurement accuracy : $\pm 2.0\text{ dB}$ for reflectance better than -40dB

- 3.12 Nominal pulse duration : To be specified by manufacturer
- 3.13 Averaging time update : ≤ 180 seconds in auto mode
- 3.14 Auto Measurements
- Measurements Items : Event distance, Loss, return loss, Loss from near end and total return loss, discovery and detection of splitter and split ratio
- a) Threshold
- i) Connection loss : 0.01 to 5.0 dB (in suitable steps)
- ii) Return loss : 20 to 60 (in suitable steps)
- b) Automatic setting : Pulse width, distance range averaging times
- c) Event registration : Registration of event points, section Loss, return loss, splitters etc. for event points shall be measured and shall be used to create the event table.
- d) Connection check : On / Off switchable
- e) Testing through Splitters (upto 1:128) : The instrument should be able to test the fiber through splitters without misreading the same as fiber break.

- f) Two splice measurement range : It shall allow two splice measurement range for measuring two non-reflective events of 0.5dB loss spaced by 75m even after splitter.
- 3.15 Manual measurements : Real time sweeping, point to point distance / loss measurement, point to point loss measurement per unit length, Return loss measurement, splitter discovery and detection and split ratio, Splice / connection loss measurement and the total return loss with selectable averaging time
- 3.16 Calendar Clock : Display of year, month, day, hour, minute (power back up).
- Note:** The software/hardware in instrument shall not pose any problem in normal functioning of the instrument due to changes in date and time caused by events such as leap year etc.
- 3.17 Distance unit : Meters / Kilometers
- 3.18 Display size : ≥ 4 inches (diagonally)
- 3.19 Display of Results : It should display :
- Fibre signature for viewing
 - Splitter
 - Attenuation between two selected points
 - Distance between two selected points
 - Loss due to connector/connectors in the section
 - Loss due to splice/splices in the section

- Average loss/Km. & total loss in the fibre
- Reflection of each events & its location,
total return loss
- A break in fibres & location of break
- End of fibre & length of fibre

Note: The actual display content should be same as in the stored information and data should be transferred in non-editable format.

3.20 Optical connector : OTDR Optical connector should be either of PC or APC(with 2.5 mm ferrule diameter) suitable for FC or SC adapter as per user requirements or as per order

Note: OTDR Optical connector (being factory fitted option) would be either of PC or APC as per order

3.21 Interface : a) USB
b) Wi-Fi
c) RJ-45, Bluetooth etc. (optional or if required by the purchaser/user)

3.22 Storage:
Internal Memory : ≥ 1000 traces (printable and in native format)

3.23 Environment conditions : As per clause 8.0 of this document

3.24 Power Supply:

- a) The instrument shall work, without any degradation from the single phase AC power supply with nominal 230V AC with voltage variation from 100V to 240V at 50Hz ± 2 Hz.

or

The instrument shall work, without any degradation from AC/DC adapter with input voltage from 100V to 240V AC, 50Hz $\pm$ 2Hz. The manufacturer shall furnish the output DC voltage of the AC/DC adapter and safe operating input voltage for the instrument.

Note: High voltage cut-off shall be provided for voltage beyond 240V AC.

- b) The instrument shall also be operative continuously for a period of minimum Six hours from internal battery and shall have charging facility. Indication of low battery shall be provided at remaining 10% battery capacity. Battery Charge status indicator shall be provided. It shall be protected against battery reversals, overvoltage, short circuit, overload etc.
- c) The power consumption shall be minimal and its consumption shall be furnished by the manufacturer.

3.25 Additional measurement tools:

- a) Fibre inspection Probe: Video inspection probe for inspection of connectors. Screens capture function for documentation
- b) In-built Visible Light Source : 635nm/650nm $\pm$ 20 nm, CW,
Typical P_{out} : - 3 dBm $\pm$ 1 dBm

Note: It should have port for visual fault locator for easy fiber identification and macro-bend location.

4.0 Additional Items to be supplied:

- a. AC/DC adapter : One no.
- b. Dummy Fibre /Launch Fibre : 50 metres launch cable
- c. Universal Connector adapter : Two nos. for each type of connector

- d. Pen drive / Flash Memory : One no. of at least 16GB
- e. Carrying case : 1 no.

5.0 Engineering Requirements:

- 5.1 The instrument shall be manufactured as per latest state of the art technology.
- 5.2 The instrument shall be compact and light weight in order to provide a reasonable degree of portability and simplicity of operation.
- 5.3 The instrument shall be compact and composite in construction. It shall be portable and light weight. The actual dimensions and weight of the instrument shall be furnished by the manufacturer.
- 5.4 All connectors and switches shall be reliable and of standard type to ensure failure free operation over 5000 mating for connectors and 1000 on-off operations for switches under the specified environmental conditions.
- 5.5 All connectors and cables used shall be of low loss type and suitably shielded.
- 5.6 The mechanical design and construction of each unit shall be inherently robust and rigid under all conditions of operation, adjustment, replacement, storage and transport.
- 5.7 The instrument shall have self cooling arrangement including usage of internal fans, if required. On failure of internal fan, if used, an alarm or some status shall be indicated.
- 5.8 Important Do's and Don'ts about the operation of the instrument shall be clearly indicated at a convenient place on the instrument.

6.0 Operational Requirements:

- 6.1 The instrument shall be designed for continuous operation. The manufacturer shall indicate the period of continuous operation for which it shall be checked.
- 6.2 The instrument shall be able to perform satisfactorily without any degradation at an altitude up to 3000 metres above mean sea level. A Test certificate from the manufacturer shall be acceptable.
- 6.3 Power cord shall have molded plugs.
- 6.4 Visual indication to show power ON and OFF status shall be provided.
- 6.5 Provision for self-check of the instrument shall be provided.
- 6.6 The software/hardware in instrument shall not pose any problem in the normal functioning of the instrument due to changes in date and time caused by events such as changeover of leap year etc.

7.0 Quality Requirements:

- 7.1 The manufacturer shall furnish the MTBF values. Minimum value of MTBF shall be 10000 hours including fans.
- 7.2 The instrument shall be manufactured in accordance with international quality management system ISO 9001: 2015 or latest issue for which the manufacturer should be duly accredited. A quality plan describing the quality assurance system, being followed by the manufacturer, should be submitted.

8.0 Environmental Requirements:

- a) The instrument shall conform to the requirements for Environment specified in TEC document SD:QM-333(or TEC 14016:2010) {latest issue} "Standard for

Environmental Testing of Telecommunication Equipment”. The applicable tests shall be for environmental category “B2” including Drop, Topple, Vibration tests (instrument kept in carrying case) and Corrosion test.

- b) The instrument is required to work in Indoor environments like Central offices, equipment huts and outside environments like manhole, open trench and a splicing van. It is required to work in bright sunlight, poorly lit or dark areas.
- c) The instrument shall comply with Ingress Protection Rating IP 34 as per IEC 60529.
- d) The instrument shall be able to work without any degradation in performance in coastal areas and should be protected against corrosion.

9.0 Maintenance Requirements:

- 9.1 The instrument shall have facility for power on self-test. All the calibration parameters shall be valid for a minimum calibration period of one year.
- 9.2 The instrument shall have easy access for servicing and maintenance. It may be specifically noted that replacement of fuses etc. can be done quickly and conveniently. This is essential as these items may go faulty during operation and quick replacement helps in early restoration.

Note: Rating and types of fuses, if used, are to be indicated by the manufacturer.

10.0 General Electromagnetic Compatibility (EMC) Requirements:

The instrument shall conform to the EMC requirements as per the following standards and limits indicated therein. A test certificate and test report shall be furnished from an accredited test agency.

- a) **Conducted and radiated emission:**

Name of EMC Standard: CISPR 11 (2024) {latest issue} and CISPR 32(2015) {latest issue} – “Limits and methods of measurement of radio disturbance characteristics of Industrial, Scientific, and Medical (ISM) RF equipment : Multimedia equipment (MME)”.

Limits:-

- i) To comply with Class A as per the specific requirement of CISPR 11 (2024) {latest issue} and CISPR 32 (2015) {latest issue}.

b) Immunity to Electrostatic discharge:

Name of EMC Standard: IEC 61000-4-2 (2025) {latest issue} – “Testing and measurement techniques of Electrostatic discharge immunity test”.

Limits: -

- i) Contact discharge level 2 { ± 4 kV} or higher voltage;
Compliance Criteria: Performance Criteria-B
- ii) Air discharge level 3 { ± 8 kV} or higher voltage;
Compliance Criteria: Performance Criteria-B

c) Immunity to radiated RF:

Name of EMC Standard: IEC 61000-4-3 (2020) {latest issue} – “Testing and measurement techniques-Radiated RF Electromagnetic Field Immunity test”

Limits:-

- i) Under Test level 2 {Test field strength of 3 V/m} for general purposes in frequency range 80 MHz to 1000 MHz, and
Compliance Criteria: Performance Criteria-A
- ii) Under test level 3 (10 V/m) for protection against digital radio telephones and other RF devices in frequency ranges 800 MHz to 960 MHz and 1.4 to 6.0 GHz.

Compliance Criteria: Performance Criteria-A

For Telecom Terminal Equipment without voice interface (s)

Under Test level 2 {Test field strength of 3 V/m} for general purposes in frequency range 80 MHz to 1000 MHz, and for protection against digital radio telephones and other RF devices in frequency ranges 800 MHz to 960 MHz and 1.4 GHz to 6.0 GHz.

d) Immunity to fast transients (burst):

Name of EMC Standard: IEC 61000-4-4 (2012) {latest issue} – “Testing and measurement techniques of electrical fast transients/burst immunity test”

Limits:-

Test Level 2 i.e. a) 1 kV for AC/DC power lines; b) 0.5 kV for signal / control / data / telecom lines;

Compliance Criteria: Performance Criteria-B

e) Immunity to surges:

Name of EMC Standard: IEC 61000-4-5 (2014) {latest issue} – “Testing & Measurement techniques for Surge immunity test”

Limits:-

- i) For mains power input ports : (a) ± 2 kV peak open circuit voltage for line to ground coupling (b) ± 1 kV peak open circuit voltage for line to line coupling
- ii) For telecom ports : (a) ± 2 kV peak open circuit voltage for line to ground

Compliance Criteria: Performance Criteria-B

f) Immunity to conducted disturbance induced by Radio frequency fields:

Name of EMC Standard: IEC 61000-4-6 (2023) {latest issue} – “Testing & measurement techniques-Immunity to conducted disturbances induced by radio- frequency fields.”

Limits:-

Under the test level 2 {3 V r.m.s.}in the frequency range 150 kHz-80 MHz for AC / DC lines and Signal /Control/telecom lines.

Compliance Criteria: Performance Criteria-A

g) Immunity to voltage dips & short interruptions (applicable to only ac mains power input ports, if any)

Name of EMC Standard: IEC 61000-4-11 (2020) {latest issue} – “Testing & measurement techniques- voltage dips, short interruptions and voltage variations immunity tests”

Limits:-

- i) A voltage dip corresponding to a reduction of the supply voltage of 30% for 500ms (i.e. 70 % supply voltage for 500 ms)
- ii) A voltage dip corresponding to a reduction of the supply voltage of 60% for 200ms (i.e. 40% supply voltage for 200ms)
- iii) A voltage interruption corresponding to a reduction of supply voltage of > 95% for 5s.
- iv) A voltage interruption corresponding to reduction of the supply voltage of >95% for 10 ms

h) Immunity to voltage dips & short interruptions(applicable to only dc power input ports, if any)

Name of EMC Standard: IEC 61000-4-29:2000: Electromagnetic compatibility (EMC)-Part 4-29: Testing & measurement techniques- voltage dips, short interruptions and voltage variations on d.c. input power port immunity tests

Limits:-

- i) A voltage interruption with 0% of supply for 10ms
- ii) A voltage interruption with 0% of supply for 30ms, 100ms, 300ms and 1000ms
- iii) A voltage dip corresponding to 40% & 70% of supply for 10ms, 30ms
- iv) iv) A voltage dip corresponding to 40% & 70% of supply for 100ms, 300ms and 1000ms
- v) A voltage variation corresponding to 80% and 120% of supply for 100ms to 10s

Note-1: The test agency for EMC tests shall be an accredited agency and details of accreditation shall be submitted.

Note-2: For checking compliance with the above EMC requirements, the method of measurements shall be in accordance with TEC Standard No. TEC/SD/DD/EMC-221/05/OCT-16(or TEC 11016:2016) (or latest release) and the references mentioned therein unless otherwise specified specifically. Alternatively, corresponding relevant Euro Norms of the above IEC/CISPR standards are also acceptable subject to the condition that frequency range and test level are met as per above mentioned sub clauses (a) to (h) and TEC Standard No. TEC/SD/DD/EMC-221/05/OCT-16(or TEC 11016:2016) (or latest release). The details of IEC/CISPR and their corresponding Euro Norms are as follows:

IEC/CISPR	Euro Norm
CISPR 11	EN 55011
CISPR 32	EN 55032
IEC 61000-4-2	EN 61000-4-2
IEC 61000-4-3	EN 61000-4-3
IEC 61000-4-4	EN 61000-4-4
IEC 61000-4-5	EN 61000-4-5
IEC 61000-4-6	EN 61000-4-6

IEC 61000-4-11	EN 61000-4-11
IEC 61000-4-29	EN 61000-4-29

11.0 Safety requirements:

11.1 The operating personnel should be protected against shock hazards as per IS 8437 {1993} "Guide on the effects of current passing through the human body" [equivalent to IEC publication 60479].

11.2 The instrument shall conform to the relevant clauses of the IEC 61010-1:2017(latest issue) "Safety requirements for Electrical Equipment for Measurement, Control and laboratory use"

11.3 Optical Safety Requirements: The instrument shall meet the optical safety requirements as per IEC 60825-1:2014 Safety of laser products - Part 1: Equipment classification and requirements (latest issue). The instrument shall have visual warnings and controls ensuring danger free operation.

1. Markings: (LASER PRODUCT)

2. Controls: It shall have auto-blocking shutter/ blocking cap (attached to the instrument so that it is not lost in any case.) for the optical input / output port when no fibre is connected.

11.4 Optical Access Port:

a) The optical access ports shall be easy to clean by the operator.

b) The optical access ports should be designed to protect themselves against the entry of dust when they are not occupied by an external fibre optic connection.

c) The optical access ports should be designed with minimum reflectance.

12.0 Protection Requirements

- 12.1 The instrument panel shall have a terminal for grounding the chassis, if required.
- 12.2 The plug-in units, if provided, shall have suitable protection to allow their removal/ insertion while the instrument is in energized condition.
- 12.3 All switches and controls on front panel shall have suitable safeguards against accidental operation.
- 12.4 The instrument shall be adequately safeguarded to prevent entry of even dust, insects etc.
- 12.5 Protection against short circuit and open circuit in the accessible points for measurements shall be provided.

CHAPTER-2

13.0 Accessories:

13.1 The supplier shall provide one complete set of:

- a) All the necessary interfaces, connectors, connecting cables (including power cord) and accessories required for satisfactory and convenient operation of the instrument. Types of connectors, adapters to be used and the accessories of the approved quality shall be clearly indicated in the operating manuals.
- b) Software (if any), along with software version and the arrangement to load the software at site. Any updating of software shall be supplied free of cost. (Additional sets may be ordered optionally). This upgrade shall be done at the site via internet, if required.

13.2 Special tools, extender boards, extender cables and accessories essential for installation, operation and maintenance of the instrument shall be clearly indicated and supplied along with the instrument.

13.3 The source of the components/ accessories, from where these have been procured, is also to be submitted by the manufacturers.

13.4 Detailed information for components/module accessories used shall be clearly indicated.

14.0 Documentation:

Technical literature in English language shall be provided in hard copy as well as soft copy. All aspects of installation, operation, maintenance and repair including the illustration of external mechanical parts shall be covered in the manuals. The soft copy or hard copy of the manuals should also be provided in Hindi language for sale/purchase of instrument within India. The manuals shall include the following:

- i) **Installation, operation and maintenance manual** - This manual shall include the following in addition to other details:
 - a) Safety measures to be observed in handling the Testing Instrument.
 - b) Precautions for setting up, measurements and maintenance.
 - c) Test equipment required for routine maintenance and calibration including their procedures.
 - d) Illustration of internal and external mechanical parts.
 - e) The detailed description about the operation of the software used in the equipment including its configuration procedure, installation, loading and debugging etc.

15.0 Surface finish, Marking, Packaging and Shipping:

15.1 Marking:

15.1.1 The carrying case and tool kit of the instrument shall be marked for the following and shall be legible:

- a) The name of the product, manufacturer's model and serial number.
- b) The name of the supplier / manufacturer.
- c) The date of manufacture.
- d) Any other relevant information

15.2 Surface finish:

15.2.1 The inside and out side surfaces shall have uniform colour and texture.

15.2.2 The painted finish on metallic surfaces shall be resistant to impact and shall not exhibit radial cracking when subjected to 2.8 N-meter load and tested as per ASTM D 2794 or any other equivalent International Standard.

15.2.3 The finish and markings shall adhere to the base metal and shall not show any separation of coats when tested as per ASTM D 2197 or any other equivalent International Standard.

15.2.4 The surface finish and markings shall be resistant to chemicals that are normally found in the telephone plant and shall not exhibit any perceivable changes when exposed to ultra violet light.

15.3 Packaging & shipping:

15.3.1 Packaging of the instrument shall be adequate to ensure that no damage will occur under normal shipping, handling and storage in reasonably dry unheated quarters.

15.3.2 Shipping container and packaging of the instrument shall be reusable recyclable and biodegradable.

15.3.3 A suitable carrying case (suitable for air, rail & road transport) for the instrument shall be provided

16.0 Guidelines for Purchaser:

Following guidelines are for the reference of the purchaser only, and are not to be tested during Evaluation/Testing.

- a) The tenderer may ask the supplier to provide the end user with software that will convert files from the OTDR data standard to the suppliers existing file format as per Telecordia document No.SR-4731 (latest issue), if needed.
- b) As and when bugs are found/determined in the software, the manufacturer shall provide patches and firmware replacement if involved free of cost for three years. Modified documents wherever applicable shall also be supplied free of cost.
- c) The manufacturer/supplier shall furnish the list of recommended spares.
- d) The supplier shall have maintenance/repair with calibration facility in India.
- e) Supplier shall guarantee the supply of spares so long as the instrument is in service, at least for ten years from the date of supply. The purchaser would like to stock spares as and when the supplier decides to close down the

production of the offered instrument. In such an event, supplier shall give a two years notice to the purchaser so as to stock the spares.

- f) Purchaser can order additional measurement options separately.
- g) Purchaser may ask for PON OTDR with in-built PON power meter also.
- h) Purchaser may ask for additional optional capability for remote access
- i) Purchaser may ask for additional optional interfaces, if required

ABBREVIATIONS

APC	-	Angled Physical Contact
ASTM	-	American Society for Testing Materials
CISPR	-	International Special Committee on Radio Interference
EMC	-	Electromagnetic Compatibility
FTTH	-	Fibre to the home
IEC	-	International Electro -Technical Commission
IS	-	Indian Standards
ISO	-	International Organization for Standardization
ITU-T	-	International Telecommunication Union – Telecommunication Standardisation Sector
LSA	-	Least Square Approximation
MTBF	-	Mean Time Between Failure
MTTR	-	Mean Time to Restore Service
ORL	-	Optical Return Loss
OTDR	-	Optical Time Domain Reflectometer
QA	-	Quality Assurance
QM	-	Quality Manual
PON	-	Passive optical network
RJ	-	Registered Jack
SNR	-	Signal to Noise Ratio
USB	-	Universal Serial Bus

===== End of the document =====