Comments on Revision of Standard for GR Titled "Structured LAN Cabling"

(Draft GR No. TEC 52010 : 2025)

Name of Manufacturer/Stakeholder:

Organization:

Contact Details:

Clause No.	Clause	Comments	Justification

Note: The comments on the revision of Standard for GR titled "Structured LAN Cabling" may be provided in the above format vide Email to adic1.tec@gov.in , adit2.tec-dot@gov.in , diri.tec@nic.in

वर्गीय आवश्यकताओं के लिए मानक
टीईसी ५२०१० : २०xx

(पूर्व सं: ५२०१० : २००५ है |)

STANDARD FOR GENERIC REQUIREMENTS
TEC 52010 : 20xx

(Earlier No. 52010 : 20xx)

स्ट्रक्चर्ड लेन केबलिंग

Structured LAN Cabling

ISO 9001:2015

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FOREWORD

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

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

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

ABSTRACT

This Standard for Generic Requirements is for Structured LAN Cabling to be deployed by the service providers in their Routing and aggregation layers

xxx 20xx

GENERIC REQUIREMENTS

Structured LAN Cabling

(TEC 52010 : 20xx)

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Sl.No.	Standard/document *No.*	*Particulars*	*Remarks*
1.	No. GR/SLC-01/01.FEB 2001	GR for Structured LAN Cabling	1st issue
2.	GR/SLC-01/02 SEP 2005	Review of Generic Requirement for Structured LAN Cabling. Incorporation of Modified EMC Requirements and addition of standards for CAT 6 cable	2nd issue
3	Standard Number TEC 52010:2025	Standard for Generic Requirements of Structured LAN Cabling. New inputs and Modified Quality, Safety, EMC Requirements	3rd issue

Reference

1. **TEC Standard**
   SD/EMI-02/02 SEP 2001

2. **BSNL QA Document**
   QM-118, QM-205, QM-206, QM-210, QM-301, QM-333, QM-324.

3. **IEC Document**

IEC/CISPR	Euro Norm
CISPR22	EN55022
IEC61000-4-2	EN61000-4-2
IEC61000-4-3	EN61000-4-3
IEC61000-4-4	EN61000-4-4
IEC61000-4-5	EN61000-4-5
IEC61000-4-6	EN61000-4-6

4. **Other Documents**
   TIA/EIA TSB 75
   TIA/EIA TSB 95
   TIA/EIA T568 A
   TIA/EIA T568 B
   ISO 11081
   ISO 11801

Part -1

GR No. GR/SLC-01/02 SEP 2005

Structured LAN Cabling

Chapter 1

Requirements of Structured LAN Cabling

1.0 SCOPE: This chapter defines the different structured LAN cabling methods that shall be deployed in the LAN cabling for different applications of Indian Telecom network. The structured LAN cabling is one of the important requirements to allow the usage of multimedia and to support speeds upto 1 Gbps in the LAN environment. The structured cabling consists of elements like cables, faceplates, patch panels, outlets and frames, etc. which shall conform to the standards mentioned in this document so that they can be used for Gigabit transmissions.

1.1 Conformity to Standard: The Structured Cabling System shall meet the following standards:

a) ISO/IEC ISO 11081: International standard for generic cabling for customer premises
b) TIA/EIA TSB 75: Additional horizontal cabling practices for open office (August 1996)
c) TIA/EIA TSB 95: Additional transmission performance guidelines for 100 ohm 4 pair Category 5 Cabling
d) TIA/EIA–T568 – B Commercial Building Telecommunications cabling Standard (Category 5e cabling) – for characteristics specified up to 100MHz and supports full duplex 1000 Base-T, 100 Base-TX, 10 Base-T.
e) TIA/EIA-T568-B.2.1 Telecommunications cabling Standard (Category 6 cabling) – for characteristics specified up to 250MHz and supports full duplex 1000 BaseT, 100 Base-TX, 10 Base-T.

1.2 Structured Cabling: The cabling design to the department LAN cabling shall be as per the TIA/EIA-T568-A standards/ TIA/EIA-T568-B standards.

1.2.1 The structured cabling system design considerations is concerned with the following six sub-systems:

(a) Building Entrance: Building entrance shall be the place where-in the interface equipment to the public network is positioned. The example for this is interface to the WAN through Routers/Leased lines etc.

(b) Equipment Room: The equipment room shall house the Active components for data i.e. the Server and in case of voice the EPABX. The equipment room shall also house the Main Building Cross Connect connecting various floors of the building.

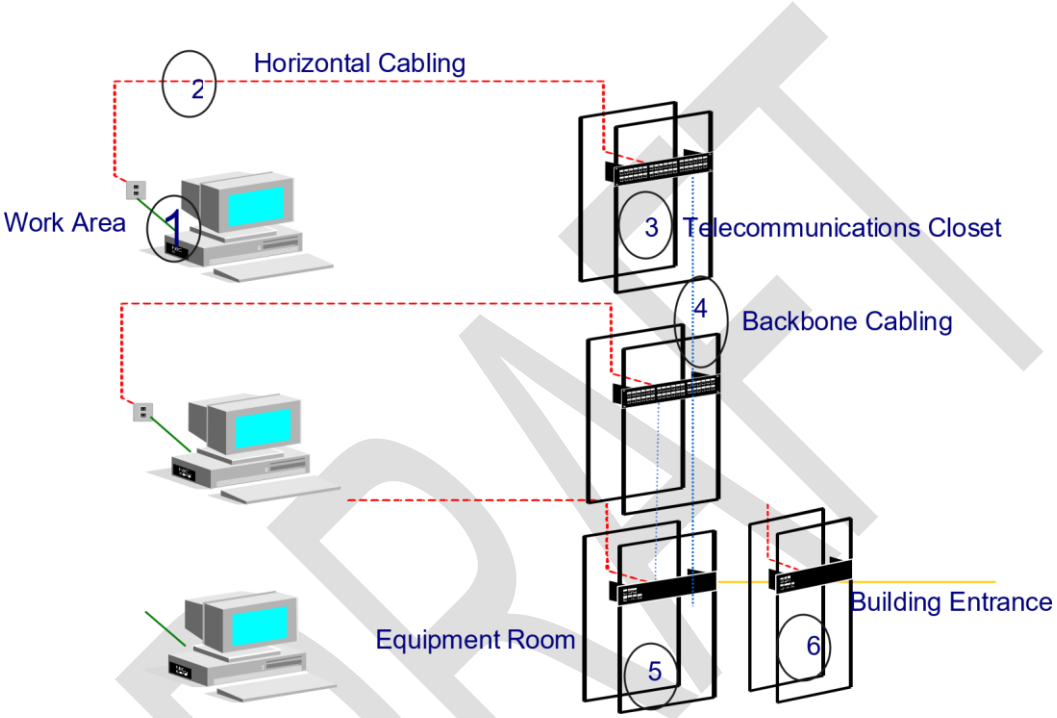
(c) Backbone Cabling: The backbone cabling shall consist of cables connecting the various floors of the building. The type of cable used shall be either Category -5e 25 pair UTP Cable or preferably be of Fiber optic cable.

(d) Telecommunications Closet: The telecommunications Closet shall be placed in each floor which is a consolidation point for the Horizontal Cabling termination that interfaces with the Backbone cabling. The telecommunication closet shall also house the active equipment such as the Hubs/Switches catering to that particular floor.

(e) Horizontal Cabling: The horizontal Cabling shall consist of cables connecting the Telecommunications Closet to the Work Area Telecommunication Outlet/Information Out let. The cable type used shall be Category 6 4 pair UTP cable, Category 5e, 4 Pair UTP cable or a 2-core 62.5 / 125 □m or 50/125 □m multi-mode fiber optic cable.

(f) Work Area: The work area shall consist of the Telecommunications Outlet/Information Outlet wherein the horizontal cabling is terminated. The patch cord connecting the Telecommunication outlet/Information outlet to the node shall also form the part of the Work Area.

Refer figure given below.



1.2.1 Category 6 Cables: The Transmission performance of Cat 6 is better than Cat 5e Cable.

a) The characteristics for Cat 6 Channel are specified (requires a positive PSACR) up to 200 MHz.and tested to 250 MHz. (ref.: Annex 1)

a-2) Characteristics for Cat 6 Cable are specified (requires a positive PSACR) up to 250 MHz.. (ref: Annex 2)

b) The Cat 6 link and channel requirements are backward compatible to Cat 5e.

c) The Category 6 standard has specifications for patch cords and connectors that are intended to assure interoperable Cat 6 performance. (ref.: Annex 3)

d) Category 6 cables are covered under TIA/EIA-T568-B standards.

1.2.2 Backbone Cabling: The backbone cabling for the EIA / TIA-T568-A 5e or EIA/TIAT568-B.2.1 Cat 6 provide interconnection between telecommunications closets, equipment rooms, and entrance facilities. It consists of the backbone cable, intermediate and main cross-connects, mechanical terminations and patch cords or jumpers for backbone-to-backbone cross connection. The types and distances are referred in the following table:

Cabling Types	Backbone distance maximum
100 ohm UTP 22 AWG to 26 AWG	800 meters for Voice
(American Wire Gauge),100 Ohm	90 meters for Data Multi-mode
62.5/125□m Optical fiber	2,000 meters
Single-mode 8.3 / 125□m Optical Fiber	3,000 meters

1.2.3 Horizontal Cabling: The Horizontal Cabling system for the TIA / EIA-T568-A Cat 5e or Cat 6 Standard extends from the telecommunications outlet in the work area (or workstation) to the horizontal cross-connect in the telecommunications closet. The following media types shall be used as options for horizontal cabling, each extending a maximum distance of 90 meters:

a) 4-pair 100 Ohm UTP cable (24 AWG or 23 AWG solid conductors).

b) 2 fiber 62.5 / 125 □ meter Optical fiber cable.

1.2.3.1 The horizontal cable shall meet the following requirements:

(a) Horizontal cables shall be NEXT compliant - 4 pair UTP cable (unshielded Twisted Pair-UTP) of Category 5e or category 6 standard, to connect each telecommunication outlet (TO) or consolidation point (CP) to the backbone sub-system on the same floor.

(b) The UTP cable shall be of 24 AWG minimum for cat 5e and 23 AWG minimum for cat 6 cable bare solid copper conductors insulated with high density, PE sheath, jacketed with Fire retardant PVC. The insulated conductors shall be twisted into pairs, with pairs balanced for attenuation. The twist ratio should be between 12 twist per feet to 30 twist per feet; with different for all the pairs.

(c) The UTP cable shall be run using a star topology format from the cross connect at the floor distributor (FD) administration subsystem on each floor to every individual telecommunication outlet. A 25 pair UTP cable shall be run from the cross connect at the floor distributor (FD) administration subsystem on each floor to a consolidation point (CP) on the same floor.

(d) The 4-pair UTP cable shall be able to meet EIA/TIA 568 B Cat 6 Specification, it must be proven to ensure connectivity for any application as mentioned in Annex 4 from the Floor Distributor (FD) wiring closet to the telecommunications outlet at the work area.

(e) Each run of cable from the cross connect at the floor distributor (FD) and the telecommunication outlet shall be continuous without any joints or splices except for the open office design, when a consolidation point (CP), is proposed.

(f) The length of each individual run of fixed horizontal cable from the administration subsystem (FD) on each floor to the telecommunication outlet shall not exceed 90 meters (at 20 degrees Celsius, if the temperature is 40 degrees the length shall not cross 84 meters).

(g) The Cable design should be such that they are installation stress proof.

(h) The 4 pair UTP cable shall meet or exceed the following specifications

i. TIA/EIA 568-A Commercial Building Telecommunications Cabling Standard ii. TIA/EIA 568-B.2 Cat 6 Cable Specifications mentioned in Annex 2 iii. All applications as per Annex 4ICEA S8)-S76, 9/88 iv. Conductor DC Resistance (Max): 28.6 □/1kft@20C v. DC Resistance unbalanced (Max): 5% vi. Insulation Resistance (Min): 500M□/1kft@20C vii. Mutual Capacitance (Typical): 15pF/ft; viii. Characteristics impedance: 100+/-5%□@100 MHz ix. Typical Cable Skew: 15 neck/100 Meters.

x. lame retardancy: as per IEC 332 - 1

1.2.4. Telecommunication closet: Each piece of UTP cabling connecting a device to a hub shall be no longer than 90 meters for the reasons given below:

a) Atténuation
b) Interférence
c) Noise

1.2.4.1 The UTP connecting hardware used in the patch cords per 100 meters @ 20□C shall meet the Attention and NEXT (Near End Cross Talk) specifications defined in the TIA / EIA recommendations.

1.2.4.2 The termination method for UTP connecting hardware shall utilize the Insulation Displacement Contact (IDC) method.

1.2.4.3 Outlets shall be securely mounted. Outlet boxes with un-terminated cables must be covered and marked. Performance markings shall be provided to show the applicable transmission category and shall be visible during installation (to Cat 6) in addition to safety markings. Installed connectors shall be protected from physical damage and moisture by dust cover.

1.2.5 Work Area System: Work Area system shall consist of wiring or interconnect that connects active terminal devices to telecommunication outlets such as face plates, connectors, patch cards and terminal leads needed to make connections.

1.2.5.1 Faceplate: Faceplate shall meet the following requirements:

a) Shall have the ability to fit a dust cap or shutter to prevent dust and dirt getting into the outlet for single, dual, Quad or Hexa outlets.
b) Shall have clear label for application identification
c) Shall be able to have 1,2,3,4,6 or 12 outlets
d) Shall have options for vertical style or horizontal style.
e) The faceplate housing the UTP connector modules shall have no visible mounting screws.
f) The faceplate housing the UTP connector modules shall have aperture plugs to cover any unused openings in the faceplate.
g) The faceplate housing the UTP connector modules shall provide flexibility in configuring multimedia workstation outlets that respond to present of future network needs such as audio, video, coaxial and optical fiber applications.

1.2.5.2 Telecommunication Outlets- The telecommunication outlets shall meet the following requirements:

a) All telecommunication outlets shall be universal RJ45 type
b) The outlet shall be NEXT compliant (as per Annex 3) ISDN 8-position/ 8conductor standard type and shall be capable of receiving conventional 4,6 and 8 pin jack/plug of 23/24 AWG solid wire.
c) Shall have Surface or flush mounted single or dual sockets
d) Shall be able to support all application as per Annex 4
   i.
e) Shall be made from high-impact, flame-retardant, UL-rated 94 VO thermoplastic
f) Shall meet or exceed ISO/IEC 11801 Class E, EN 50173 Cat.6 components Specifications

g) Shall apply the cross-over lead concept using cross talk techniques to provide superior Near End Crosstalk (NEXT) performance of 43 dB @100 MHz for Cat 5E and 54 dB @ 100 MHz.

h) The telecommunication outlet shall be of the insulation displacement connector (IDC) wiring termination. IDC termination shall have as Straight configuration when connecting with the cable conductor to improve termination hold

i) The Outlet should have a built in mechanism to prevent pair un-twist of more than ¼ inch as specified by TIA/EIA.

j) The IDC contact element shall be spring special brass with 5□m Nickel plating to reduce Oxidation of IDC & contact and sharper termination of copper cable, angularity arranged across the axis of conducting wire to maximize the gas tight connection. The contact range shall be 5 □m Nickelplated to ensure minimum oxidization impact.

k) The insulation displacement connectors of the outlets shall accept two insulated solid conductors of 22 to 24 AWG of the same size.

l) The RJ45 jack offered shall confirm to EIA-T568A or EIA-T568B wiring schemes.

m) The RJ45 jack technology should be Lead-frame type to have high reliability and better frequency compensation.

n) The telecommunication outlet shall meet the following electrical performances:

i. RJ Interface resistance: 20 m□ ii. Insulation resistance 100 M□ at 500 VDC iii. Contact resistance of 20 m□ maximum (1 m□typical) iv. Current rating of 2A at 20 deg.C per IEC Publication 512-3. Test 5b.

m) The telecommunication outlet shall meet the following mechanical performance:

I) Insertion life of Level B reliability to IEC 603-7

II) Plug/Jack contact force: 100g minimum per contact using FCC-approved plug.

III) Plug rétention force; 30 lb (133 N) minimum. IV) Temperature range: -20 to 70 deg.C.

1.2.6 Modular Jack connector: TIA / EIA-T568-A defines four basic modular jack styles. The 8-position and 8-position keyed modular jacks are commonly referred as RJ45 (Registered Jack) connector and keyed RJ45. The 6-position modular jack is commonly refereed as RJ11. RJ45 is the standard connector for unshielded twisted pair cabling. RJ 45 is a plastic connector with eight pins. It allows insertion in only one way. The jack wiring specification is as per the Universal Service Ordering Codes (USOC).

1.2.7 Patch Cord: The Patch cord shall meet the following requirements:

(a) Shall consist of 8 Solid copper conductors terminated with RJ 45 plugs at both ends.

(b) Shall meet transmission performance and comply to EIA/TIA 568-B.2 and ISO/IEC 11801- CAT 6 minimum standard for patch cord testing (as per Annex 3)

(c) Factory terminated with options for 1.2 meter, up to 12.8 meters with a long flexible boot and in different colors. The boot material should be injected into the plug to retain the position of the conductors. The Boot should be at least 2” long with built-in bend radii maintaining technology.

(d) Shall have Characteristics impedance of 100□ +/- 5%@ 100 MHz.

(e) The Patch cord should have a central cross web to reduce cross talk and improve strength.

1.2.8 Patch Panel: Rack mounted patch panels shall be used for termination of copper cables or rack mount fiber termination unit shall be used for termination of optical fiber cable.

1.2.8.1Patch cords shall be provided for cross-connections to facilitate Moves, Adds and Changes (MACs). They shall be able to support up to Category 6 applications and shall be NEXT compliant.

1.2.8.2 The cross connect module shall be

(a) Fire -retardant, molded plastic modules UL 94 VO rate, consisting of horizontal index strips for termination of Cat5 25 pair module to ensure ease of re-termination in case of wrong pair termination or (b) NEXT compliant RJ 45 Modular jack panel.

(c) 10/25 pair disconnection module for incoming voice or 8/10/25 pair disconnection module for all data services.

1.2.9 Termination Module: The termination module shall be able to accommodate over 200 repeated insertions without incurring permanent deformation and it shall pass the reliability test of no more than one contact failure in 1000 connections.

1.2.9.1The termination module shall be of the disconnection type to minimize wiring termination and allow test cords to isolate the cabling system for testing purposes.

1.2.9.2The wiring module shall be able to accommodate 22-26 AWG cable conductors. The termination module shall be accessible from front without any contact element exposed.

1.2.9.3The components of the wire termination module shall meet the Category 5e standards.

1.2.9.4The termination module shall be 25 pair module with IDC contact element and fully compliant to TIA/EIA 568 B.2 Category 6 requirement.

1.2.9.5The IDC contact element shall be spring special brass with 0.5-micron Nickel plating.

1.2.9.6The Termination module should have the option of mounting on wall or a 19’ rack.

1.2.9.7The Termination module should be able to accept Category 6 Jumper wire solution for Cross connect or Modular patch cords.

1.2.10 Modular Jack Panel: Modular Jack panel shall meet the following requirements:

a) Should be Fully flexible and able to accept Category 6, Category 5e RJ45 jacks, Multi media Outlets, and Fiber modules.
b) Should have a mechanism to hold the cable at the back, like a metal bar or plate.
c) The panel should come empty and can be loaded as per the requirement.
d) The Panel should be able to accept up to 24 RJ45 jacks in a 1U space.
e) It should be mountable on a 19” rack
f) The Panel shall have a large front labeling space to facilitate port identification.
g) The Panel shall have a 16-gauge sheet metal construction and the module holder shall be of UL 94V-0, black, fire-retardant plastic construction.

1.2.11 Rack Mount Fiber Termination Unit: The 19" rack mount fiber termination unit shall provide cross-connect, interconnect or splicing capabilities.

1.2.11.1The 19” rack mount fiber termination unit shall consist of a frame mountable housing for terminating and / or splicing fiber optic cables and allow for organization of the fiber optic interconnects. The assembly shall have rear slots for cable entry, with grommets fiber retainers for holding buffered fiber in place and fiber storage guide for maintaining bend radius.

1.2.11.2The 19" rack mounting unit shall be either 12 or 24 ports for one rack unit (1RU) and come with a removable lid for access and can be either a fixed position unit or have a Swingable tray to improve access.

1.2.11.3The adapter plates are pre-loaded for ST (Straight Tip), SC (Subscriber Connector) Simplex, SC duplex and LC Simplex or Duplex couplings, and the adapter plates should be installed to angled through adapters to the left or to the right of the panel, this improves the patch cord management and provides safety from possible damage to the eye from active fibers.

1.2.12 Patch Cords: patch cords shall be used for cross-connection and interconnection of termination modules, patch panels and fiber termination unit.

a) The patch cord shall be available in 1, 2 and 4 pair versions with lengths of 1.2 through 12.8 meters.
b) The type of patch cord shall depend on the termination module used, i.e. 8-pair termination module, patch panel or a rack mount fiber termination unit.
c) The patch cord shall have built in exclusion features to prevent accidental polarity reversals and split pairs. It shall have a latching mechanism to prevent accidental dislodging of the plug for the termination module or modular jack panel (e.g. RJ45)
d) The patch cord shall provide air-tight connection for cross-connection and shall comply with proposed Cat.5E and/or Cat 6 requirement and Power SUM NEXT requirement. (ref.: Annex 3)
e) Patch Cords for Patch panel shall be used for the Moves, Adds and Changes and only hard wire jumper shall be needed for the permanent wring of the modules, thereby providing better cable management.

1.2.13 Fiber Patch Cord: Fiber Patch Cord shall meet the following requirements:

a) Shall consists of one or two single, tight buffered, multi-mode graded index fibers with a 62.5 micron or OM3 core and 125-micron cladding.
b) The fiber patch shall be used for optical fiber cross connects and interconnects.
c) The fiber cladding shall be covered by aramid yarn and jacket of flame retardant PVC.
d) The fiber patch cord shall be factory terminated with ST (Straight Tip), SC (Subscriber Connector), LC or hybrid ceramic connectors at each end.
e) The fiber patch cord shall meet the following specifications:
    i. Minimum band radius 90□ at min 25.4 mm.
    ii. Operating temperature :-42to +75□C. iii. Loss: 5 db / mated connectors. iv. Return loss maximum – 45db. v. Cable Outer diameter: 3mm.
    vi. Tip material: Ceramic.

1.3 The UTP copper cables: The UTP copper cables meet the following requirements:

(a) Shall be CMR, LSZH, CMP, or MPR rated form.
(b) Shall consists of 23-24 AWG, twisted pair copper conductor with UL approved insulator.
(c) Fire retardant PVC Sheath shall have improved frictional properties, allowing it to be pulled through conduit without the use of lubricants. (d) The insulation should be made from Polyolefin for ruggedness (e) Available in the form of 25 pairs. - minimum Cat5 UTP cable.
(f) The UTP multi pair cable shall meet the following electrical specifications: -
    i. EIA / TIA 568 A commercial wiring standard.
    ii. All applications as per annex 4 iii. Mutual capacitance (at) 1Khz: 22 nF / 1000 feet.
    iv. Dc resistance (Ohms/1000 feet: 28.6
    v. Characteristics Impedance: 100 ohms +/- 15 % @ 100Mhz (except 4 Pr) vi. Electrical specification as per Annex 2

1.4 Optical fiber requirements:1.4.1 Cable must be Armored Single Mode (OM1), Multi-mode (OM1, OM2 or OM3) color coded fibers, jelly filled color coded loose tubes, around the dielectric central strength member, jelly filled, plastic tape, dielectric strength member and outer PE jacket for outdoor use and shall be tight buffered with color-coded PVC for identification for multi-core fiber optic cable (OM1, OM2, OM3 and OS1) for Indoor use.

1.4.2 Fiber Specification OM1 (62.5/125 Multimode)

ITEMS	UNITS	SPECIFICATION
		62.5/125 Multi-Mode
Attenuation	**dB/km**	□ 3.5 at 850nm □1.0 at 1300nm
Bandwidth	MHz.km	□ 200 at 850nm □ 500 at 1300nm
Numerical Aperture	-	0.275 □ 0.015
Core Diameter	□m	62.5 □ 3.0
Core Non-circularity	%	□ 6.0
Cladding Diameter	□m	125 □ 2.0
Cladding Non-circularity	%	□2.0
Core/Cladding Concentricity Error	□m	□3.0
Coating Diameter	□m	245 □ 15
Proof Test	Kpsi	□100

1.4.3 Fiber Specification OM2 (50/125 Multimode)

ITEMS	UNITS	SPECIFICATION 50/125 Multi-Mode
Attenuation	**dB/km**	□ 3.5 at 850nm □1.0 at 1300nm
Bandwidth	MHz.km	□ 500 at 850nm □ 500 at 1300nm
Numerical Aperture	-	0.20 □ 0.015
Core Diameter	□m	50 □ 3.0
Core Non-circularity	%	□ 6.0
Cladding Diameter	□m	125 □ 2.0
Cladding Non-circularity	%	□2.0
Core/Cladding Concentricity Error	□m	□3.0
Coating Diameter	□m	245 □ 15
Proof Test	Kpsi	□100

1.4.4 Fiber Specification OM3 (50/125 Multimode)

ITEMS	UNITS	SPECIFICATION OM3 Multi Mode
Typical Attenuation	**dB/km**	□ 2.8 at 850nm □0.9 at 1300nm
Bandwidth	MHz.km	□ 2000 at 850nm □ 500 at 1300nm
10 Gigabit Ethernet Link length.	meters	300
Operating Temperature	□C	-40 to +70.
Core/Cladding Concentricity Error	□m	□3.0
Coating Diameter	□m	245 □ 15
Proof Test	Kpsi	□100

1.4.5 Fiber Specification OS1 (9/125 Single mode)

ITEMS	UNITS	SPECIFICATION
Attenuation	dB/km	□ 0.4 at 1310nm □ 0.25 at 1550nm
Chromatic Dispersion	Ps/nm.km	□ 3.2 at 1285nm ~ 1330nm □ 18 at 1550nm
Zero Dispersion Wavelength	nm	1300 ~ 1324
Zero Dispersion Slope	Ps/nm 2 .km	□ 0.093
Cut-off Wavelength (þ cc, 22m of a cabled fiber)	nm	□1270
Mode Field Diameter	□m	9.3 □ 1.0
Mode Field Concentricity	□m	□ 0.8
Cladding Diameter	□m	125 □ 1.0
Cladding Non-circularity	%	□1.0
Coating Diameter	□m	245 □ 15
Proof Test	kpsi	□ 100

1.4.6 CABLE CONSTRUCTION – Outdoor Armored Type

The construction of the cable shall be in accordance with Table below.

ITEMS	DESCRIPTION
Number of Fibers	4/6/12/24
Type of Fiber	OM1, OM2, OM3 or OS1
No. of Fibers per Tube	Max. 12
Loose Buffer tube material	PBT (Polybutylene Terephthalate)
Loose Buffer Tube Diameter	Nom. 2.4 mm
Filling Compound in Loose Buffer Tube	Thixotropic Jelly Compound
Filling Compound between Loose Buffer Tubes	Poly buthane Type Jelly Compound
Central Strength Member	FRP (Fiberglass Reinforced Plastic)
Core Wrapping Tape	Plastic Tape (To provide heat barrier and good forming of core)
Dielectric Strength Member	Glass yarn
Water Blocking Material	(To provide the required tensile strength together with the central strength member) Water Swell Able Tape. (To prevent the ingress of water) Steel Tape Armoring.
Armor	
Outer Jacket material	Black HDPE
Thickness	Min.1.25mm, Nom. 1.8mm

1.4.7 FIBER AND LOOSE BUFFER TUBE IDENTIFICATION

The color code of the loose buffer tubes and the individual fibers within each loose buffer tube shall be in accordance with Table below.

The Color Code of the Individual Fibers and Loose Tubes

No. of Fibers/ Loose Buffer Tubes	Color	No. of Fibers/ Loose Buffer Tubes	Color
1	Blue	7	Red
2	Orange	8	Black
3	Green	9	Yellow
4	Brown	10	Violet
5	Gray	11	Pink
6	White	12	Aqua

1 8 Equipment Room System: 25 pair IDC type terminal module to terminate incoming trunk cables, outgoing trunk cables to PABX and PABX Extension lines / cables shall be provided. Each of them shall have lightning over-voltage protection with arrestors, which shall be in 1 pair or 25 pair form. The gas tube protector units shall meet the following standards:

a) DC breakdown voltage (at 100V/sec): 230 V □ 20%
b) Surge Breakdown Voltage (at 100V/micro sec): 500 Volts
c) Insulation Resistance: Min 10,000 M □
d) DC Holdover Voltage: Max 135 Volts
e) Capacitance (1 MHz): Max 3.0 p F

1. 9 Channel performance: Channels based on ISO 11801 Class D and E and Proposed TIA / EIA 568-B.2 Cat 6 channel specifications. (ref.: Annex 1)

Part-2

GR No. GR/SLC-01/02 SEP 2005

Chapter 2

Engineering, Operational and Qualitative Requirements

2. SCOPE:

2.1 This document specifies the generic requirements for the structured cabling components which are to be used for LAN wiring for different applications usage in the Indian Telecom network.

2.2 General Requirements

2.2.1 Engineering Requirements: The system shall meet the following engineering requirements:

a) The equipment shall be fully solid state and adopt state of the art technology

b) The equipment shall be compact, composite construction and lightweight. The actual dimensions and weight of the equipment shall be furnished by the manufacturers.

c) All connectors shall be reliable, low loss and standard type so as to ensure failure free operations over long operations. The connectors and cable shall provide 20 years' standards compliance warranty and 15 to 25 years. On line warranty for one year for the structured cabling system from the certified practical completion date shall be provided.

d) All cables shall be of Gigabit Ethernet ready standards (EiA/TIA 568A/568B – Cat 5e/Cat 6 standards).

e) Each terminal block and individual tags shall be numbered suitably with clear identification code and shall correspond to the associated wiring drawings.

2.2.2 Operational Requirement (OR): The system shall meet the following maintenance & operational requirements:

a) The equipment shall be designed for continuous operation.

b) The equipment shall be able to perform satisfactorily without any degradation at an altitude up to 3000 meters above mean sea level.

c) The design of the equipment shall not allow plugging of a module in the wrong slot or upside down.

d) Special tools required for wiring shall be provided along with the equipment.

e) The Hardware and software components shall not pose any problems in the normal functioning of all network elements wherever interfacing with Indian Telecom network for voice, data and transmission systems, as the case may be.

2.2.3 QUALITATIVE REQUIREMENTS (QR): The system shall meet the following qualitative requirements:

a) The supplier / manufacturer shall manufacture with international quality standards ISO 9002 for which the manufacturer shall be duly accredited. The quality plan describing the quality assurance system followed by the manufacturer shall conform to the guidelines given by CGM QA from time to time and shall be submitted.

b) The equipment locally manufactured in India shall be as per guidelines issued by Chief General Manager, Quality Assurance Wing of the BSNL vide Documents No. QM 118, QM 205, QM 206, QM 210 and QM 301.

c) The equipment shall meet the environmental requirements as per category A of QM-333/Issue-1/Sept 1990.

d) All components used shall be as per approval procedures prescribed by BSNL in document QM – 324.

e) Marking and identification of the equipment, sub-assemblies, PCBs etc. shall be as per guidelines given in para 5.1.7 Quality Assurance Telecom Document QM 351/Issue 2 /Jan.'95.

f) The MTBF (Mean Time Between Failure) and MTTR (Mean Time To Restore) predicted and observed values shall be furnished along with calculations by the manufacturer.

2.2.4 Other Requirements:

a) Wherever, the standardized documents like ITU-T, IETF, QA and TEC documents are referred, the latest issue and number with the amendments shall be applicable.

2.2.5 Electromagnetic Compatibility (EMC) Requirements:

The equipment shall conform to the EMC requirements as per the following standards and limits indicated therein. A test certificate and test report shall be furnished: -

a) Conducted and radiated emissions: To comply with Class A of CISPR 22 {2003} "Limits and methods of measurement of radio disturbance characteristics of Information Technology Equipment";

b) Electrostatic discharge: To comply with IEC 61000-4-2 {2001}"Testing and measurement techniques of Electrostatic discharge immunity test" under following test levels:
Contact discharge level 2 {± 4 kV};
Air discharge level 3 {± 8 kV};

c) Fast transients common mode (burst): To comply with IEC 61000-4-4 {1995 with Amendment 1 (2000) and Amendment 2 (2001)}" Testing and measurement techniques of electrical fast transients/ burst immunity test" under Level 2 {1 kV for DC power lines; 1 kV for signal control lines};

d) Immunity: IEC 61000-4-3{2002} Radiated RF Electromagnetic Field Immunity test under test level 2 (test field strength 3 v / m) for general purposes in frequency range 80 MHz to 1000 MHz and under test level 3 (10 v / m) for protection against digital radio telephones in frequency ranges 800 MHz to 960 MHz and 1.4 GHz to 2.0 GHz.

e) Surges line to earth coupling and line to line coupling: To comply with IEC 610004-5{2001}Test & Measurement techniques for Surge immunity tests" under test levels of 0.5 kV for line to line coupling and 1kV for line to earth coupling ;

Radio frequency common mode: To comply with IEC 61000-4-6 {2001}"Immunity to conducted disturbances, induced by radio frequency fields" under the test level 2 {3 V r.m.s.} clamp injection method for DC lines and Signal Control lines.

Note (ii): For tests for checking compliance to above EMC requirements, the methods of measurements shall be in accordance with TEC standard No. SD/EMI-02/02 Sep 2001 and the references mentioned therein. Alternatively, corresponding relative 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 (f) and TEC standard No. SD/EMI-02/02 Sep 2001. The details of IEC/CISPR and corresponding Euro Norms are as follows:

IEC/CISPR	Euro Norm
CISPR22	EN55022
IEC61000-4-2	EN61000-4-2
IEC61000-4-3	EN61000-4-3
IEC61000-4-4	EN61000-4-4
IEC61000-4-5	EN61000-4-5
IEC61000-4-6	EN61000-4-6

2.2.6 Safety Requirements:

2.2.6.1 The operating personnel shall be protected against shock hazards as per IS 8473 (1993) – Guide on the effects of current passing through the human body equivalent to IEC publications 479-1 (1984). The manufacturer/supplier shall submit a certificate in respect of compliance to these requirements.

2.2.6.2. The equipment shall conform to IS 13252 (1992) – "Safety of information technology equipment including electrical business equipment" {equivalent to IEC publication 950 (1986) and IEC 215 (1987) "Safety requirements of Radio transmitting equipment" {for Radio equipment only}. The manufacturer/supplier shall submit a certificate in respect of compliance to these requirements.

2.2.7 DOCUMENTATION:

All technical documents shall be in English language both in CD-ROM and in hard copy.

2.2.7.1 The documents shall comprise of:

1. System description documents
2. Installation, Operation and Maintenance documents
3. Training documents
4. Repair manual

2.2.7.2. System description documents: The following system description documents shall be supplied along with the system. a) Cabling and wiring diagrams.

b) Adjustment procedures, if there are any field adjustable units.

c) Spare parts catalogue - including information on individual component values, tolerances, etc. enabling procurement from alternative sources.

2.2.7.3 Operational documents: The following operational documents shall be made available.

a) Installation manuals and testing procedures.

b) Precautions for installation, operations and maintenance

c) Safety measures to be observed in handling the equipment

d) Fault location and troubleshooting instructions including fault dictionary.

e) Test jigs and fixtures required and procedures for routine maintenance, preventive maintenance and unit / card / sub-assembly replacement.

f) Emergency action procedures.

2.2.7 4 Repair Manual:

a) List of replaceable parts used
b) Detailed ordering information for all the replaceable parts
c) Procedure for trouble shooting and sub-assembly replacement
d) Test fixtures and accessories for repair
e) Systematic trouble shooting charts (fault tree) for all the probable faults with their remedial actions.

2.2.8 INSTALLATION:

a) All necessary interfaces, connectors, connecting cables and accessories required for satisfactory installation and convenient operations shall be supplied. Type of connectors, adopters to be used shall be in conformity with the interfaces defined in this GR.
b) It shall be ensured that all testers, tools and support required for carrying out the stage by stage testing of the equipment before final commissioning of the network shall be supplied along with the equipment.
c) All installation materials, consumables and spare parts to be supplied.
d) All literature and instructions required for installation of the equipment, testing and bringing it to service shall be made available in English language.
g) All cable labels shall be machine typed labeled at each end 100 mm from the termination point.
h) The cabling system shall be planned and the routing shall be selected to ensure system integrity and performance, and it shall not present problems to maintenance access.
i) All cable trays, catenaries and ductworks required to complete the installation shall be supplied.
j) All necessary penetrations and access between floors and sealing of the same after installation shall be carried out by the supplier. Support of all cabling within the false space or under raised flooring by steel cable tray, trucking and /or duct, catenary wires, fixed by approved hanger and methods shall be done.
k) Cables shall be neatly bundled into a neat group (50 cables per bundle).
l) Maintain at all times a minimum of 150mm spacing from parallel runs of electrical cabling and 300 mm from fluorescent lights. All telecommunication cables shall cross electrical cables at right angles.
m) Shall support adequately all the cabling that is vertically installed.
n) Shall provide and use screwed moulded plastic bushes to protect cable, with the use of locknuts inside the trunking or tray work to ensure bush remaining securely in place.
o) Shall ensure that the tray shall be thoroughly cleaned of an any extraneous material, such as cable scraps, dust, dirt and construction debris after the installation is completed.
p) Shall provide proper protective earthling for all the cable trays and catenary wires.
q) Shall ensure that the cables are secured with plastic or Velcro cable ties on cable trays and / or catenaries.
r) Shall not have free protrusion of sharp edges where cabling is done in free spaces.
s) Shall have cables installed using a bending radius not less than eight (8) times the overall diameter of the cable. The hauling tension shall not exceed 11.3 Kg.
t) Any Single pull shall be restricted to not more than two (2) 90 degrees' bends, in conduit and ducts.

Glossary

AWG	America Wire Gauge
ATM	Asynchronous Transfer mode
BSNL	Bharat Sanchar Nigam Limited
CAT	Category
CMR	Certification Maintenance report
CMP	Communications plenum cable
CGM	Chief General Manager
EMC	Electromagnetic Compatibility
EIA	Electronic Industries Alliance
EPABX	Electronic Private Automatic Branch Exchange
FRNC	Flame Retardant Non-Corrosive (cable)
FD	Fade Depth
ISO	International Organization for Standardization
IEC	International Electro technical Commission
ICEA	Insulated Cable Engineers Association
IDC	Insulation Displacement Contact
ITU	International Telecommunication Union
IETF	Internet Engineering Task Force
LAN	Local Area Network
LSZH	Low Smoke Zero Halogen
MAC	Media Access Control
MPR	Manufacturer Production Run
NEXT	Near End Cross Talk
PSACR	Power Sum Attenuation to Crosstalk Ratio
PVC	Polyvinyl Chloride
PCB	Printed Circuit Board
TIA	Technology Industries Association
UTP	Unshielded Twisted Pair
WGNA	Wide Band Gigabit Networking Alliance

Annex1:

Cat 6 Channel (Addendum to TIA/EIA-568B)										
Frequency (MHz)	Insertion loss	NEXT pp	ACR pp	NEXT ps	ACR ps	ELFEXT pp	ELFEXT ps	Return Loss		
1	3.0	65.0	62.0	62.0	59.0	63.3	60.3	19.0		dB
4	4.0	63.0	59.0	60.5	56.5	51.2	48.2	19.0		dB
8	5.7	58.2	52.5	55.6	49.9	45.2	42.2	19.0		dB
10	6.3	56.6	50.2	54.0	47.7	43.3	40.3	19.0		dB
16	8.0	53.2	45.2	50.6	42.5	39.2	36.2	18.0		dB
20	9.0	51.6	42.6	49.0	39.9	37.2	34.2	17.5		dB
25	10.1	50.0	39.9	47.3	37.2	35.3	32.3	17.0		dB
31.25	11.4	48.4	37.0	45.7	34.3	33.4	30.4	16.5		dB
62.5	16.5	43.4	26.9	40.6	24.1	27.3	24.3	14.0		dB
100	21.3	39.9	18.6	37.1	15.8	23.3	20.3	12.0		dB
125	24.1	38.3	14.2	35.4	11.3	21.3	18.3	11.0		dB
200	31.5	34.8	3.2	31.9	0.3	17.2	14.2	9.0		dB
250	36.0	33.1	-2.8	30.2	-5.8	15.3	12.3	8.0		dB

Annex 2:

Cat 6 Cable (Addendum to TIA/EIA-568B)										
Frequency (MHz)	Insertion loss	NEXT pp	ACR pp	NEXT ps	ACR ps	ELFEXT pp	ELFEXT ps	Return Loss (solid)	Return Loss str.)	
1	2.0	74.3	72.3	72.3	70.3	67.8	64.8	20.0	20.0	dB
4	3.8	65.3	61.5	63.3	59.5	55.8	52.8	23.0	23.0	dB
8	5.3	60.8	55.4	58.8	53.4	49.7	46.7	24.5	24.5	dB
10	6.0	59.3	53.3	57.3	51.3	47.8	44.8	25.0	25.0	dB
16	7.6	56.2	48.7	54.2	46.7	43.7	40.7	25.0	25.0	dB
20	8.5	54.8	46.3	52.8	44.3	41.8	38.8	25.0	25.0	dB
25	9.5	53.3	43.8	51.3	41.8	39.8	36.8	24.3	24.2	dB
31.25	10.7	51.9	41.2	49.9	39.2	37.9	34.9	23.6	23.3	dB
62.5	15.4	47.4	32.0	45.4	30.0	31.9	28.9	21.5	20.7	dB
100	19.8	44.3	24.5	42.3	22.5	27.8	24.8	20.1	19.0	dB
125	22.4	42.8	20.5	40.8	18.5	25.9	22.9	19.4	18.2	dB
200	29.0	39.8	10.8	37.8	8.8	21.8	18.8	18.0	16.4	dB
250	32.8	38.3	5.5	36.3	3.5	19.8	16.8	17.3	15.6	dB

Annex 3:

Cat 6 Connecting Hardware (Addendum to TIA/EIA-568B)										
Frequency (MHz)	Insertion loss	NEXT pp	ACR pp	NEXT ps	ACR ps	ELFEXT pp	ELFEXT ps	Return Loss		
1	0.02	94.0		90.0		83.1	80.1	30.0		dB
4	0.04	82.0		78.0		71.1	68.1	30.0		dB
8	0.06	75.9		71.9		65.0	62.0	30.0		dB
10	0.06	74.0		70.0		63.1	60.1	30.0		dB
16	0.08	69.9		65.9		59.0	56.0	30.0		dB
20	0.09	68.0		64.0		57.1	54.1	30.0		dB
25	0.10	66.0		62.0		55.1	52.1	30.0		dB
31.25	0.11	64.1		60.1		53.2	50.2	30.0		dB
62.5	0.16	58.1		54.1		47.2	44.2	28.1		dB
100	0.20	54.0		50.0		43.1	40.1	24.0		dB
125	0.22	52.1		48.1		41.2	38.2	22.1		dB
200	0.28	48.0		44.0		37.1	34.1	18.0		dB
250	0.32	46.0		42.0		35.1	32.1	16.0		dB

Freq. (MHz)	TIA/EIA category 5e (dB)					TIA/EIA category 6 (dB)				
	NEXT				RL	NEXT				RL
	1 m	2 m	5 m	10 m		1 m	2 m	5 m	10 m	
1	65.0	65.0	65.0	65.0	19.8	65.0	65.0	65.0	65.0	19.8
4	62.6	62.3	61.5	60.4	21.6	65.0	65.0	65.0	65.0	21.6
8	56.7	56.4	55.6	54.6	22.5	65.0	65.0	65.0	64.8	22.5
10	54.8	54.5	53.7	52.8	22.8	65.0	65.0	64.5	62.9	22.8
16	50.7	50.4	49.7	48.9	23.4	62.6	62.0	60.5	59.0	23.4
20	48.8	48.5	47.9	47.1	23.7	60.7	60.1	58.6	57.2	23.7
25	46.9	46.7	46.0	45.3	24.0	58.8	58.1	56.8	55.4	24.0
31.25	45.0	44.8	44.2	43.5	23.0	56.9	56.2	54.9	53.6	23.0
62.5	39.1	38.9	38.5	38.1	20.0	51.0	50.4	49.2	48.1	20.0
100	35.2	35.1	34.8	34.6	18.0	47.0	46.4	45.3	44.4	18.0
125						45.1	44.5	43.5	42.7	17.0
200						41.1	40.6	39.8	39.3	15.0
250						39.2	38.8	38.1	37.6	14.0

Annex 4:

The UTP-based cabling system shall be capable of supporting the following applications:

a. Gigabit Ethernet (1000BASE-T)
b. Broadband Video & Baseband Video
c. 4/16/100/155/622 Mb/s ATM
d. Fast Ethernet (100Base-TX, 100BASE-T4)
e. Ethernet (10BASE-T)
f. Gigabit Networking (WGNA)
g. Future applications using 250 MHz of bandwidth*

*Note: When using the same transmission technique as Gigabit Ethernet

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