Standards

ANSI/TIA/EIA 568-B

Commercial Building Telecommunications Cabling Standard

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qd.tek
A member of Quang Dung Group

Head Office
Suite 202, The Colonnade Building, 27 Nguyen Trung Truc St.,
District 1, Hochiminh City, Vietnam
Tel: 84.8 823-1693 Fax: 84.8 823-1665

Hanoi Office
A11, 3/Fl., Horizon Hotel, 40 Cat Linh St.,
Dong Da District, Hanoi, Vietnam
Tel: 84.4 736-7055 Fax: 84.4 733-2470
Website: www.qd-tek.com.vn Email: info@qd-tek.com

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ANSI/TIA/EIA-568-B.1

Commercial Building Telecommunications Cabling Standard

General Requirements

HORIZONTAL CABLING

The definition of horizontal cabling is that portion of the cabling system that extends from the work area outlet, through the cabling in the wall/ceiling/floor and then to the patch panel in the telecommunications room. The system also includes the patch cords at the work area outlet, and patch cords in the telecommunications room. When provisioning for the horizontal cabling system the designer should also consider voice, fire/safety, video, HVAC and EMS.

A good design should be aimed at minimizing relocations and maintenance of the horizontal system as it is much more costly to do it later.

Topology

Horizontal cabling will be installed in a star topology, with each work area outlet being connected via the horizontal cable to the horizontal cross connect in the telecommunications room. Each floor should have its own telecommunications closet, sized as per ANSI/TIA/EIA 569.

Any devices required such as baluns and impedance matching devices should not be installed in the horizontal system, but rather, kept external to the telecommunications outlet. This will facilitate network changes.

Only one transition point or consolidation point between the horizontal cross connect and the telecommunications outlet shall be allowed, and bridged taps and splices are not allowed in the copper horizontal.

Cable Length

The maximum distance between the telecommunications outlet and the horizontal cross connect shall be no more than 90 meters. The maximum length of all patch cords and jumpers in the telecommunications closet shall be no more than 5 meters, and the total length of all patch cords both in the telecommunications closet and at the work area shall be no more than 5 meters.

Recognized Cables

a. 4-pair 100 ohm unshielded twisted pair (UTP) or screened twisted pair (ScTP).
b. two or more multimode optical cables, either 62.5/125 or 50/125

150 ohm shielded twisted pair (STP-A) is a recognized cable type but is not recommended for new cabling installations.
All jumpers, patch cords, equipment cords shall meet all applicable standards as specified in ANSI/TIA/EIA 568-B.2 and B.3.

When hybrid and bundled cables are used, each cable type will meet the requirements for that cable type, and the bundled or hybrid cable will meet the specifications for bundled cables. Both of the above requirements are located in ANSI/TIA/EIA 568-B.2 and B.3.

Telecommunications Outlets

Each individual work area shall be serviced with a minimum of two telecommunications outlets. One will be associated with voice and the other data. One outlet will be a 4 pair 100 ohm UTP cable rated category 3 or higher. Category 5e is recommended. The other outlet will be either a 4 pair 100 ohm UTP category 5e, or 2 multimode fibers, either 50/125 or 62.5/125 micron fibers. All connectors must meet all ANSI/TIA/EIA 568-B.2 and B.3 requirements.

Grounding

The system must be bonded and grounded as per ANSI/TIA/EIA 606.

Backbone Cabling

General

Backbone cabling provides interconnections between telecommunications rooms, equipment rooms, and entrance facilities. It consists of the cabling, copper and/or fiber, the terminations, patch cords, jumper cords, intermediate and main cross connects.

Backbone cabling is expected to serve the needs of the user for 3-10 years based on current and future needs.

Topology

The backbone cabling will be laid out in a hierarchical star so that each horizontal cross connect is connected to the main cross connect or to an intermediate cross connect and then to a main cross connect. There can be no more than two hierarchical levels of cross connects in the backbone. No more than one cross connect shall be passed through between the horizontal cross connect and the main cross connect. This means that between any two horizontal cross connects, the signal must pass through 3 or fewer cross connect facilities.

Recognized Cables

The following cables are recognized in the backbone and may be used on their own, or in combination.

a. 100 ohm twisted pair cable
b. either 50/125 micron or 62.5/125 micron multimode fiber.
c. Singlemode fiber.

All patch cords, jumpers, connecting hardware must meet ANSI/TIA/EIA-568-B.2 and B.3.

Backbone Cabling Distances

The distances in the table below are inclusive of cable, patch cords, jumpers and equipment cable.

Maximum Backbone Distance			
Media Type	**Main to Horizontal Cross Connect**	**Main to Intermediate Cross Connect**	**Intermediate to Horizontal Cross Connect**
Copper (Voice)	800 m (2,624 ft)	500 m (1640 ft)	300 m (984 ft)
Multimode Fiber	2000 m (6560 ft)	1700 m (5575 ft)	300 m (984 ft)

Singlemode Fiber	3000 m (9840 ft)	2700 m (8855 ft)	300 m (984 ft)

Jumper and Patch Panel Lengths

Main cross connect jumper and patch cords should not exceed 20 meters. Intermediate cross connect jumper and patch cords should not exceed 20 meters. Equipment jumpers should not exceed 30 meters.

Grounding and Bonding

Grounding and bonding practices as per ANSI/TIA/EIA 607 should be followed.

Work Area

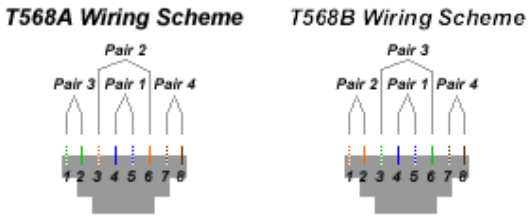
General

The work area components are those that extend from the work area outlet to the telecommunications device(s).

100-Ohm Balanced Twisted-Pair Telecommunications Outlet/Connector

Each 4 pair cable shall be terminated on an 8 position modular jack, and all UTP and ScTP telecommunications outlets shall meet the requirements of IEC 60603-7, as well as ANSI/TIA/EIA 568-B.2 and the terminal marking and mounting requirements of ANSI/TIA/EIA-570-A.

There are two recognized pin out assignments, T568A and T568B.



Optical Fiber Telecommunications Outlet

Horizontal fiber shall be terminated in a duplex outlet meeting ANSI/TIA/EIA 568-B.3. The 568SC was specified in ANSI/TIA/EIA 568A-A and is still recommended. As well other connectors such as some small form factor connectors may be used.

Work Area Cords

The maximum length of a work area patch cord is 5 meters. Generally, the patch cord will have similar connectors on each end. If additional devices are required, such as adapters, they will not be part of the horizontal cabling system, but rather be connected via the patch cord.

Open Office Cabling

The open office cabling recognizes that some offices are faced with regular reconfigurations and require a more flexible cabling system to facilitate these changes.

Multi-user Telecommunications Outlet-MUTOA

The MUTOA is used where there are frequent changes in office layout. The MUTOA allows the horizontal cable to remain undisturbed while allowing office

rearrangements. The work area cables originating from the MUTOA are connected directly to the station equipment without the use of any additional connections.

The MUTOA:

1. Should be located in an area so that each furniture cluster is served by at least 1 MUTOA.
2. Should serve a maximum of 12 work areas.
3. Will have a maximum work area cable length.
4. Shall be attached to a permanent part of the building
5. Shall not be located in the ceiling or furniture, unless that part of the furniture is permanently affixed to the building.

Administration

The MUTOA is are administered as in ANSI/TIA/EIA-606. The work area cables connecting a MUTOA to a device are to be assigned a unique identifier and the cable shall be labelled at both ends. The outlet end shall identify the work area it serves and the work area end shall identify which MUTOA it is connected to, and what port on the MUTOA.

When a MUTOA is used the horizontal cable maximum length will be affected, based on the length of the work area cord. The maximum length of the work area cord is 22 meters. For purposes of calculating the horizontal cable and the work area cord, the formula is:

C = (102 - H)/(1 = D)

Where:

C = maximum combined length of the work area cable, equipment cable and patch cord

H = the length of the horizontal cable (H + C < 100)

D = the derating factor for the patch cord type. (.2 for 24AWG UTP and ScTP, and .5 for 26 AWG ScTP)

There is a second formula for calculations which is not shown here.

Maximum Work Area Cable Length		
Length of Horizontal Cable	**Maximum Length of Work Area Cable**	**Maximum Combined Length of All Patch and Equipment Cords**
Meters (Ft)	**Meters (Ft)**	**Meters (Ft)**
90 (295)	5 (16)	10 (33)
85 (279)	9 (30)	14 (46)
80 (262)	13 (44)	18 (59)
75 (246)	17 (57)	22 (72)
70 (230)	22 (72)	27 (89)

For fiber optic cables, a reduction of the total 100 meters is not required.

Consolidation Point

A consolidation point is an interconnection point within the horizontal cabling using compliant connecting hardware. It requires an additional connection point (telecommunications outlet). Cross connects cannot be used at a CP and no more than 1 CP is permitted in a horizontal run, nor can a CP and transition point be used in the same horizontal run. The CP should be located a minimum of 15 meters from the telecommunications room to reduce the effects of NEXT and return loss.

The CP should be located in a fully accessible and permanent location.

Administration of the CP should follow ANSI/TIA/EIA 606.

Telecommunications Rooms

General

Consult ANSI/TIA/EIA 569 for design and provisioning requirements for telecommunication rooms.

The telecommunications room may contain horizontal cable, backbone cable and their connecting hardware, intermediate cross connect or main cross connect for portions of the backbone system. The TR also provides environmental control for the telecommunications equipment and splice closures as they relate to the building.

Cross Connection and Interconnection

All connections between horizontal cabling and backbone cables shall be cross connects. All connecting hardware and cables shall meet the requirements of ANSI/TIA/EIA 568-B.2 and B.3.

An interconnection will connect the connecting hardware of the horizontal cable (patch panel) to the telecommunications equipment (eg: hub).

A cross connect will have the connecting hardware of the horizontal system (eg: patch panel) connected to connecting hardware (patch panel), which is in turn connected to the common equipment.

Equipment Rooms

Equipment rooms differ from telecommunications rooms in that the ERs generally contain more complex equipment, but an ER may also be a telecommunications room. Equipment rooms must conform to ANSI/TIA/EIA 569 requirements.

An equipment room may also contain main cross connects, the intermediate cross connect used in the backbone hierarchy.

The ER may also act as a telecommunications room and house the horizontal terminations, telephone provider terminations, premise network terminations and other miscellaneous terminations.

Entrance Facilities (EF)

General

The entrance facilities serve as the entrance point for the outside plant cable from a variety of sources such as the telephone company, private network cables and other access providers. It also houses network protection devices, and may act as the demarcation point for the regulated access provider.

The EF must conform to ANSI/TIA/EIA-569 requirements.

Functions

Network Demarcation

The EF may be the demarcation (termination point) for the regulated access provider(s) and private network providers(s). Local regulations will determine where the demarcation point will be.

Electrical Protection

Interbuilding cables and antennas may require devices to protect from power surges. The designer/installer should consult the local access provider to determine local practices and requirements.

Grounding and bonding should be completed as per ANSI/TIA/EIA 607.

Connections

The EF contains the connections and transition points between the cables designated for outdoor use and cables designated for indoor use.

Cabling Installation Requirements

Cable Placement

Cable should be placed in such a manner as to minimize stress caused by suspending the cable and cinching the cable too tight. If cable ties are used, they should be cinched loosely to prevent deforming the cable sheath.

Balanced 100-Ohm Twisted Pair Cabling (UTP and ScTP)

Minimum Bend Radius

Cable Type	Bend Radius
4 Pair UTP	4 X cable diameter
4 Pair ScTP	8 X cable diameter
Backbone	10 X cable diameter
Patch Cords	Under Review

Maximum Pulling Tension

For 4 pair UTP it is 110 N (25 lbf). For multipair, consult the manufacturers specifications.

Connecting Hardware Termination

Cables should be terminated with connectors of the same category. Connecting cable and components of the same category is not enough to ensure performance. Other factors such a proximity to power cords, termination practices and cable management are jus some of the factors that may affect performance.

In a system with multiple category components, the system shall be rated as that of the lowest performing component.

Only strip back as much jacket as required to properly terminate the cable on the connector. With Category 5e and higher systems the individual pairs should not be

untwisted more that ½". Category 3 systems the pair twists shall be maintained to within 3" of the terminations.

Patch Cords

Patch cords should be of the same category as the link, and should not be field terminated. Jumper cords should not be made by removing a jacket from a previously jacketed cable.

100-Ohm ScTP Grounding

The drain wire on ScTP cable shall be bonded as per ANSI/TIA/EIA 607.

Optical Fiber Cable

Minimum Bend Radius and Maximum Pulling Tension

	No Load Condition*	Maximum Load*
Intrabuilding 2 or 4 Fiber	25mm	50mm
Intrabuilding Backbone	10 X OD	15 X OD
Interbuilding Backbone	10 X OD	20 X OD

Note: The maximums are noted here in the abscence of any manufacturers specifications.

Connecting Hardware and Polarity

Optical fiber shall be installed with odd numbered fibers having Position A at one end and Position B at the other. Even numbered fibers will have position A and B reversed from the odd numbered fibers. When using the 568SC connector or other duplex connectors, the above polarity must be maintained.

Patch Cords

Patch cords shall consist of 2 fiber cables of the same fiber type as the system with connectors at both ends, and shall be positioned A and B as in the connecting hardware section above, with patch cord A connected to position B on the connecting hardware, and vice versa for the B position on the patch cord.

Cabling Transmission Performance and Test Requirements

100 Ohm Twisted Pair

General

System performance is directly related to not only the performance of the individual components, but also the cable installation practices and the number of connectors in the system.

TSB 67 is now found in annex D of the original documentation.

Channel and Permanent Link Definitions

The Channel is defined as the 90 meters of horizontal cable, the telecommunications connector and patch cord in the work area as well as 2 connectors and a maximum of 2 patch/equipment cords in the telecommunications room. The maximum allowable length of patch cords and equipment cords is 10 meters. Also included in the channel is an optional transition or consolidation point.

The Permanent Link is defined as a maximum of 90 meters of horizontal cable, an optional transition or consolidation point and one connection on each end. The Permanent Link does not include the instrument cords or connectors on the field test equipment.

Test Parameters

The primary tests are:

Wire Map
Length
Insertion Loss
Near End Cross Talk (NEXT)
Power Sum Near End Cross Talk (PSNEXT)
Equal Level Far End Cross Talk (ELFEXT)
Power Sum Equal Level Far End Crosstalk (PSELFEXT)
Return Loss
Propagation Delay
Delay Skew

Wire Map

Checks for proper pin to pin termination, and for each of the 8 conductors the wire map checks for:

Continuity to the far end
Shorts between any two or more conductors
Reversed Pairs
Split Pairs
Transposed Pairs
Any other miswiring

Length

The physical length of the cable is the actual length derived by measurement of the cable(s) between the two end points. The electrical length is the length derived from the propagation delay of the signal and depends on the construction of the cable.

The maximum physical length of the horizontal cable (permanent link) one end of the cable to the other is 90 meters. The maximum length of the channel model is 100 meters.

Insertion Loss

Insertion loss is the loss derived from inserting a device into a transmission line. The insertion loss for both the permanent link and the channel models are the total insertion losses of all the components.

Pair to Pair NEXT Loss

Pair to pair NEXT loss is the measurement of signal coupling from one pair to another. The result is based on the worst pair to pair measurement.

Power Sum NEXT (PSNEXT) Loss

Power sum NEXT takes into account the statistical crosstalk between all pairs while energized. This is a calculated amount derived by adding up the crosstalk results between all pair combinations.

Pair to Pair FEXT and ELFEXT Loss

FEXT is the unwanted coupling of a signal induced by a transmitter at the near end, measured on the disturbed pair at the far end. ELFEXT is the same measurement of FEXT, less the effect of attenuation.

Power Sum FEXT and Power Sum ELFEXT

As in Power Sum NEXT, these are computed values based on the sum of all the possible pair combinations under the respective tests.

Return Loss

Return loss is the value of energy reflected by impedance variations when devices are inserted into the cabling system.

Propagation Delay

Is the time it takes the signal to travel from one end of the cable/system to the other. The maximum channel propagation delay is 555ns (nanoseconds) and for the link it is 498 ns, both measured at 10Mhz.

Delay Skew

Delay skew is the signalling delay difference in time (nanoseconds) between the fastest pair and the slowest pair. The maximum channel delay skew is 50 ns, and in the permanent link it is 44 ns.

Optical Fiber Transmission Performance and Test Measurements

Link Segment

An optical fiber link includes the connectors, splices (if required) and the passive cabling between two optical fiber connecting hardware termination points. There are 3 backbone link segments:

MC to IC
MC to HC
IC to HC

Link Segment Performance and Measurement

The most important field test in fiber optic systems is link attenuation. The horizontal link segments should be tested in one direction at either 850 nm (nanometers) or 1300 nm. The result shall be less than 2.0 dB. In an open office with a consolidation point, the resulting test shall be less than 2.75 dB, or if using a MUTOA, the result shall be less than 2.0 dB.

Backbone Link Measurement

The backbone shall be tested in at least one direction at both 850 and 1300 (multimode). For singlemode, the links should be tested at 1310 nm and 1550 nm. Because of the possibility of splice points etc, the link attenuation equation should be used to compute the loss value.

The equation is:

Link Attenuation = Cable Attenuation + Connector Insertion Loss + Splice Insertion Loss

Note: All calculations, equations, and reference test parameters can be found in the original documentation, available through TIA.

ANSI/TIA/EIA 568-B.2
Commercial Building Telecommunications Cabling Standard
Part 2 – Balanced Twisted Pair Cabling Components

BACKBONE CABLE

Multipair cables are defined as cables having more than 4 pairs of 22 AWG to 24 AWG solid conductors with a thermoplastic insulating cover. The conductors are assembled into binder groups of 25 pairs that adhere to the standard industry color code (ANSI/ICEA S-80-576). The individual pairs will be twisted in a manner that will ensure the performance characteristics meet the transmission requirement of this Standard. The entire assembly shall be covered by a continuous thermoplastic jacket.

Core Assembly

For cables of more than 25 pairs, the cable will be assembled in groups of 25 pairs, and each group will be identified by a colored binder as per ANSI/ICEA S-80 576.

Core Wrap

Where applicable, the core may be covered with one or more layers of dielectric.

Core Shield

When a core shield is present, the DC resistance of the core shield shall not exceed a specific value, calculated by an equation available in the original standards documents under Section 4.4.5.

Transmission

All measurements are in accordance with ASTM D 4566, corrected to, or tested at 20°C.

DC Resistance	≤ 9.38 ohms/100 mtrs
DC Resistance Unbalance	≤ 5%
Mutual Capacitance	≤ 6.6 nF/100 mtrs (Cat 3) ≤ 5.6 nF/100 mtrs (Cat 5e)
Capacitance Unbalance	≤ 330 pF/100 mtrs

Characteristic Impedance and Structural Return Loss

Category 3 horizontal cables shall have a Characteristic Impedance of 100 ohms ± 15%. Structural return loss (SRL)is dependent on input impedance, frequency and cable construction. For category 3 cables the SRL for the worst pair is calculated:

Frequency (MHz)	Category 3 (dB)
$1 \leq f < 10$ $10 \leq f < 16$	12 $12-10\log(f/10)$

Return Loss and Insertion Loss

Return Loss and Insertion Loss for backbone cables shall meet the same requirements as for that of horizontal cable.

NEXT Loss

Next loss in mulitpair cables asses the impact of NEXT on not only adjacent pairs, but also adjacent groups. In a 25 pair cable the groups are made up as follows:

Group	Pairs
1	1-4
2	5-8
3	9-12
4	13-16
5	17-20
6	21-24

The 25th pair in any binder group will meet all the transmission parameters when used in a 4 pair group.

Category 5e Backbone NEXT Loss @ 20°C ± 3° C (100 mtrs)		
Frequency	**Cat 5e (within 4-pair group) dB**	**Cat 5e(25th to all other pairs) dB**
.772	67.0	67.0
1.0	65.3	65.3
4.0	56.3	56.3
8.0	51.8	51.8
10.0	50.3	50.3
16.0	47.2	47.2
20.0	45.8	45.8

25.0	44.3	44.3
31.25	42.9	42.9
62.5	38.4	38.4
100	35.3	35.3

PSNEXT Loss

PSNEXT is the combined NEXT from all disturber pairs operating at the same time. It is a statistical value in accordance with ASTM D4566 calculations. PSNEXT is specified for backbone Category 3 cables.

The equation for calculating PSNEXT Cat 5e backone cable is:

$PSNEXT_{cable} \geq 32.3-15\log(f/100)$ dB

For Cat 3 cable it is:

$PSNEXT_{cable} \geq 23-15\log(f/16)$ dB

Backbone Cable PSNEXT Loss @ 20°C ± 3° C (100 meters)		
Frequency	**Category 3 (dB)**	**Category 5e (dB)**
.772	43	64
1.0	41	62.3
4.0	32	53.3
8.0	28	48.8
10.0	26	47.3
16.0	23	44.2
20.0		42.8
25.0		41.3
31.25		39.9
62.5		35.4
100		32.3

PSELFEXT

Power Sum ELFEXT is the stastistical calculation of the sum of all far end disturbers on the near end pair. PSELFEXT is calculated in accordance with ASTM D4566.

Category 5e Backbone Cable PSELFEXT @ 20° C ± 3° C	
Frequency (MHz)	**Category 5e (dB)**
1.0	60.8
4.0	48.8
8.0	42.7
10.0	40.8
16.0	36.7
20.0	34.8
25.0	32.8
31.25	30.9
62.5	24.9
100	20.8

Propagation Delay and Delay Skew

Propagation delay in backbone cables shall meet the requirements of propagation delay in horizontal cables. Similarly, delay skew in all sequential 4 pair groups, eg: pairs 1-4, shall meet the same requirements as horizontal cable delay skew.

Dielectric Strength

The insulation between each conductor shall be capable of withstanding a minimum DC potential of 5kV for 3 seconds.

HORIZONTAL

Recognized Categories

Categories 1, 2, 4, and 5 are not recognized as part of the standard and therefore transmission parameters are not listed.

The only recognized categories are 3,5e and 6. Category 6 was ratified mid 2002, and the specifications for it can be found in Addendum 1.

Horizontal Cable

The cable shall be 4 twisted pairs of 22-24 AWG solid conductors with a thermoplastic jacket, and shall meet the requirements of ANSI/ICEA S-80-576 where applicable to 4 pair inside wiring. Bundled and hybrid cables are allowed provided that each cable type is recognized by ANSI/TIA/EIA-568-B.1, as well as Annex M of this standard. Hybrid cables must also have better than 3 dB PSNEXT value when compared to the pair to pair NEXT value for any disturbed pair within the cable, and all pairs external to the cable but contained within the bundle.

Construction

Conductor Diameter(Max)	1.22 mm (.048")
Cable Diameter (Max)	6.35 mm (.25")
Breaking Strength	400 N (90 lbf)
Bending Radius	25.4 mm (1")

Color Codes

Conductor Identification (T568A Wiring)	Color Code	Abbreviation
Pair 1	White-Blue Blue	(W-BL) (BL)
Pair 2	White-Orange Orange	(W-O) (O)
Pair 3	White-Green Green	(W-G) (G)
Pair 4	White-Brown Brown	(W-BR) BR

Transmission

The following performance characteristics have been measured in accordance with ASTM D 4566, and measured at, or corrected to 20°C.

DC Resistance	$\leq$ 9.38 ohms/100 mtrs
DC Resistance Unbalance	$\leq$ 5%
Mutual Capacitance	$\leq$ 6.6 nF/100 mtrs (Cat 3) $\leq$ 5.6 nF/100 mtrs (Cat 5e)
Capacitance Unbalance	$\leq$ 330 pF/100 mtrs

Characteristic Impedance and Structural Return Loss

Category 3 horizontal cables shall have a Characteristic Impedance of 100 ohms ± 15%. Structural return loss (SRL) is dependent on input impedance, frequency and cable construction. For category 3 cables the SRL for the worst pair is calculated:

Frequency (MHz)	Category 3 (dB)
$1 \leq f < 10$ $10 \leq f < 16$	12 $12-10\log(f/10)$

Return Loss

Return loss is the measurement of the reflected energy caused by impedance mismatches in the cable and components. This measurement is extremely important for applications that use full duplex (bi-directional) transmission. Return loss is not specified for Category 3 cables.

Category 5e Return Loss @ 20°C ± 3°	
Frequency (Mhz)	**Category 5e (dB)**
$1 \leq f < 10$ $10 \leq f < 20$ $20 \leq f \leq 100$	$20 + 5\log(f)$ 25 $25-7\log(f/20)$

Insertion Loss

In previous standards, insertion loss was referred to as attenuation. Insertion loss is the loss of signal strength when a cable is inserted between the transmitter and the receiver. Insertion loss is measured as per ASTM D 4566 and is shown in dB.

Near End Crosstalk (NEXT) Loss

NEXT is the unwanted coupling of a signal from one pair onto another when a signal is induced by a transmitter at the near end, and measured in dB.

Power Sum Near End Crosstalk (PSNEXT) Loss

PSNEXT is the combined NEXT from all disturber pairs operating at the same time. It is a statistical value in accordance with ASTM D4566 calculations. PSNEXT is not specified for Category 3 cables.

The actual equation for calculating PSNEXT is:

$PSNEXT_{cable} \geq 32.3-15\log(f/100)$ dB

Equal Level Far End Crosstalk and Power Sum Equal Level Far End Crosstalk

ELFEXT is the measurement of the unwanted coupling of a signal injected at the far end into adjacent pairs at the near end, expressed in dB as the difference between the measured FEXT and the insertion loss (attenuation) of the disturbed pair. Power Sum ELFEXT is the stastistical calculation of the sum of all far end disturbers on the near end pair.

Propagation Delay and Delay Skew

Propagation delay is the time it takes a signal to travel from one end to the other, measured in nanoseconds (ns) as per ASTM D 4566. Delay skew is the signal delay differential in time (ns) from the fastest pair to the slowest pair.

Propagation Delay, Velocity of Propagation & Delay Skew @ 20° C ± 3° C			
Frequency	Maximum Propagation Delay (ns/100 m)	Minimum Velocity of Propagation (%)	Maximum Propagation Delay Skew (ns/100m)
1	570	58.5%	45

10	545	61.1%	45
100	538	62.0%	45

Bundled and Hybrid Cables

Bundled and hybrid cables may be used in a horizontal applicaton provided that each cable is recognized under ANSI/TIA/EIA 568-B.1, and meets the transmission and color code standards as laid out by the original standard in Clause 4.

Cables made up of fiber optic and copper conductors are sometimes referred to as composite cables.

Category 3 Transmission Performance Standards

Cabling Transmission Performance Standards

Frequency-MHz	Insertion Loss-dB (Solid Cable)	Insertion Loss-dB (Stranded Cable)	NEXT-dB (worst pair to pair)
.772	2.2	2.7	43
1.0	2.6	3.1	41.3
4.0	5.6	6.7	32.3
8.0	8.5	10.2	27.8
10.0	9.7	11.7	26.3
16.0	13.1	15.7	23.2

Connecting Hardware Transmission Performance Standards

Frequency-MHz	Insertion Loss-dB	NEXT-dB (Worst pair to pair)
1.0	.1	58
4.0	.2	46
8.0	.3	39.9
10.0	.3	38
16.0	.4	33.9

Permanent Link Transmission Performance Standards

Frequency-MHz	Insertion Loss-dB	NEXT-dB (worst pair to pair)
1.0	3.5	40.1
4.0	6.2	30.7
8.0	8.9	25.9
10.0	9.9	24.3
16.0	13	21.0

Channel Transmission Performance Standards

Frequency-MHz	Insertion Loss-dB	Next-dB (worst pair to pair)
1.0	4.2	39.1
4.0	7.3	29.3
8.0	10.2	24.3
10.0	11.5	22.7
16.0	14.9	19.3

Category 5e Transmission Performance Standards

Cabling Transmission Performance Standards

Frequency (Mhz)	Insertion Loss (dB) (Solid)	Insertion Loss (dB) (Stranded)	NEXT (dB)	PS NEXT (dB)	ELFEXT (dB)	PS ELFEXT (dB)	Return Loss (dB)
.772	1.8		67.0	64.0			
1.0	2.0	2.4	65.3	62.3	63.8	60.8	20
4.0	4.1	4.9	56.3	53.3	51.8	48.8	23
8.0	5.8	6.9	51.8	48.8	45.7	42.7	24.5

10	6.5	7.8	50.3	47.3	43.8	40.8	25
16	8.2	9.9	47.2	44.2	39.7	36.7	25
20	9.3	11.1	45.8	42.8	37.8	34.8	25
25	10.4	12.5	44.3	41.3	35.8	32.8	24.2
31.25	11.7	14.1	42.9	39.9	33.9	30.9	23.3
62.5	17.0	20.4	38.4	35.4	27.9	24.9	20.7
100	22.0	26.4	35.3	32.3	23.8	20.8	19.0

Connecting Hardware Transmission Performance Standards

Frequency (MHz)	Insertion Loss (dB)	NEXT (dB)	Return Loss (dB)	FEXT (dB)
1.0	.1	65	30	65
4.0	.1	65	30	63.1
8.0	.1	64.9	30	57.0
10	.1	63.0	30	55.1
16	.2	58.9	30	51.0
20	.2	57.0	30	49.0
25	.2	55.0	30	47.1
31.25	.2	53.1	30	45.2
62.5	.3	47.1	24.1	39.2
100	.4	43.0	20.0	35.1

STRANDED CONDUCTOR CABLE

Stranded cable is used to construct patch, equipment and work area cords.

Transmission

Stranded cable shall meet the transmission requirements for horizontal cable except for return loss.

Return Loss

Return loss for stranded cables is measured as per annex C of the original standard. Annex C details the measurement methods for testing patch cords. There is an equation that can be used for calculation purposes and is also available in the standard.

Insertion Loss

Formerly known as attenuation, insertin loss is the decrease in signal strength between a transmitter and receiver. Insertion loss shall be measured in accordance with ASTM D4566.

With Category 3 and Category 5e stranded conductors, the insertion loss is derated by a factor of 1.2. With Category 3 cables all frequencies from .772 to 16 MHz will be derated, and with Category 5e cables all frequencies from 1 MHz to 100MHz are derated by the 1.2 factor.

CONNECTING HARDWARE

General

Compliance to the transmission performance for connecting hardware will help ensure that the connecting hardware will have minimal impact on the performance of the cable. Although there are several punch down systems available, IDC is the desired method.

Connecting hardware is installed at:

1. main cross connect
2. intermediate cross connect
3. horizontal cross connect
4. horizontal cabling transition points
5. consolidation points
6. telecommunications outlets

Unless otherwise stated, all connections of modular jacks and plugs will be tested in a mated state.

Mounting and Density

The connecting hardware should be flexible enough to mount on racks, walls and other types of support equipment. Connecting hardware should be dense enough to minimize space, and should also provide easy cable management.

Design

Cross connect hardware shall be desgned to provide a means to:

1. Cross connect cables with cross connect jumpers or patch cords
2. Connect premise equipment to the UTP network
3. Indentify circuits as per ANSI/TIA/EIA 606
4. Use industry standard colors to identify functional fields, eg: First level backbone
5. Administer cable and patch cords in an orderly fashion
6. Access and monitor test cabling and premise equipment
7. Protecting exposed terminals

Transition and consolidation points, and telecommunications outlets shall provide a the appropiate means to terminate the cable and a means to identify the conductors.

Transmission

Connecting hardware shall be tested in accordance with Annex D of the original standard. Annex D describes the testing methods for testing 100 ohm balanced twisted pair cabling.

Recognized Categories

Category 5e 100 ohm connecting hardware specified to 100 MHz.
Category 3 100 ohm connecting hardware specified to 16 MHz.

Insertion Loss

The equation provided in the original standard document will assist in loss calculations.

Near End Crosstalk

NEXT loss shall be measured in accordance with Annex D of the orginal standard for all pair combinations. Once again there are equations contained in the original standard for calculation of NEXT.

Return Loss

Return loss shall be calculated as per Annex D, and for all frequencies from 1-100MHz the results shall exceed the values calculated as per the equation in the original standard.

Far End Crosstalk (FEXT)

FEXT shall be measured in accordance with Annex D.

Propagation Delay and Delay Skew

For propagation delay each mated connection is assumed to contribute no more than 2.5 ns (nanoseconds) from 1 MHz to 100 MHz in both the channel and link models.

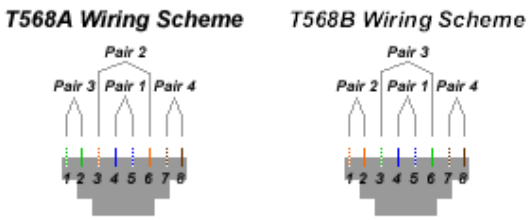
For delay skew each mated connection is assumed to contribute no more than 1.25 ns.

DC Resistance

For category 3, the DC resistance between the input and output connections of the connecting hardware shall not exceed 0.3 ohms, and for category 5e, 0.2 ohms.

Telecommunications Outlet

Each 4 pair horizontal cable shall be terminated on an 8 position modular jack. The outlet shall meet the interface requirements of IEC 60603-7. The standard pin configuration is T568A, and T568B is provided to accommodate other 8 pin configurations.



Performance Marking

Each piece of connecting hardware should be marked to designate its performance level. The marking is up to the discretion of the manufacturer and must be approved by the agency.

CORDS AND CROSS CONNECT JUMPERS

General

Cables used to make patch cords should be stranded. Cables used for patch cords shall meet all the applicable standards for cords, eg: insulation diameter and color codes.

Insulated Conductor & Color Codes

The insulation for a patch cord terminated with a modular plug shall not exceed 1.22 mm. The color coding for the pairs shall have a white conductor and the other conductor shall be of a visibly distinct color.

Conductor Identification (T568A Wiring)	Color Code	Color Code (Abbreviation) Option 2
Pair 1	White-Blue (W-BL) Blue (BL)	Green (G) Red (R)
Pair 2	White-Orange (W-O) Orange (O)	Black (BK) Yellow (Y)
Pair 3	White-Green (W-G) Green (G)	Blue (BL) Orange (O)
Pair 4	White-Brown (W-BR) Brown (BR)	Brown (BR) Slate (S)

Transmission

Cross connect jumpers shall meet the insulation and color code requirements of section 4.3.4 and 4.3.3.1 of the original standard.

Near End Cross Talk

The NEXT loss for patch, work and area codes shall meet or exceed the values as per the equation shown and tested as per Annex F in the original standard.

Return Loss

For category 5e patch, work area and equipment cords with modular plugs, return loss shall be measured according to Annex F, clause 4.

ANSI/TIA/EIA-568 B.3
Optical Fiber Cabling Components Standard

Introduction

The purpose of this standard is to specify the component and transmission requirements for a fiber optic system.

Normative References

As with most of the telecommunication standards, other standards are referenced. While the following standards may not be directly referenced within this document, they are referred to in the original standard, and should be reviewed for clarification if required.

ANSI/TIA/EIA-455-A-1991

ANSI/ICEA S-83-596-1994

ANSI/ICEA S-87-640-2000

ANSI/TIA/EIA-526-7-1998

ANSI/TIA/EIA-526-14-A-1998

ANSI/TIA/EIA-568B.1

ANSI/TIA/EIA-598-A-1995

ANSI/TIA/EIA-604-3-1997

ANSI/TIA/EIA-606-1993

Optical Fiber Cables

Cable Transmission Performance

Cable Type	Cable Type Wavelength (nm)	Maximum Attenuation (db/km)	Minimum Transmission Capacity(Mhz*km)
50/125 micron multimode	850	3.5	500
	1300	1.5	500
62.5/125 micron multimode	850	3.5	160
	1300	1.5	500
singlemode inside	1310	1.0	N/A

plant cable	1550	1.0	N/A
singlemode outside plant cable	1310	0.5	N/A
	1550	0.5	N/A
Note: The manufacturer's documentation on the fiber's performance can be used to demonstrate compliance with the above performance requirements.			

Physical Cable Specifications

The cable may be 50/125 micron or 62.5/125 micron multimode or singlemode, or a combination of the above, but must be identifiable as per ANSI/TIA/EIA 598-A, and marked as per the local electrical code.

Inside Plant Cable Specifications

2 and 4 fiber cables used in horizontal and centralized fiber applications shall support 25mm bend radius under no-load. If 2 and 4 fibers intended to be pulled through horizontal pathways shall support a bend radius of 50mm under pull load of no more than 222 Newtons (50 lbf). All other inside plant cables will support a bend radius of 10 times the cable diameter under no load (eg: on a reel), and 15 times the diameter when under the rated load limit.

Outside Plant Specifications

OSP optical fiber shall have a water block construction and meet the requirements for compound flow and water penetration, and have a minimum pull strength of 2670 Newtons (600 lbf). OSP cable must support a bend radius of 10 times its diameter under no load (on the reel), and 20 times the outside diameter when subject to the cable's rated load limit.

Drop Cables

Shall have a minimum pull strength of 1335 Newtons, (300 lbf).

Connecting Hardware

General

All connectors, regardless of type must meet the specifications set out in Annex A of the original documentation.

Connectors and Adapters

A multimode connector and adapter will be identified with a beige coloring of the housing or boot, and a singlemode connector and adapter will be identified with a blue colouring of the housing or boot.

The 568SC Connector

The 568SC connector is a duplex connector made up of two, single SC type adapters held together in a single unit. Each connector is labelled with either an "A" or "B". When mating two individual or another 568SC duplex connector, care must be taken to make sure that and "A" mates with a "B".

Telecommunications Outlet Box

The telecommunications outlet box shall at a minimum be able to house two terminated fiber optic cables and provide a minimum bend radius of 25mm (1")

Patch Panels

Patch panels should be flexible enough to be mounted on a rack, wall or other standard mounting frame.

Connecting hardware should provide for high density termination and provide easy patch cord management after installation.

The patch panel shall be designed to provide a means to:

1. cross connect cabling with patch cords
2. interconnect premises equipment to the optical fiber cabling
3. identify cabling as specified in ANSI/TIA/EIA-606
4. use standard colors to identify fiber groups as per ANSI/TIA/EIA-606.
5. handle optical fibers and patch cords in a managed fashion
6. access and test fiber optic cable and premises equipment
7. protect the cabling, adapters and connectors.

Connecting Hardware for Centralized Cabling

When using a centralized cable design to join horizontal cables to intrabuilding backbone cables, the configuration shall be designed to:

1. use either re-mateable connectors or splices, and the connectors or splices will meet all other requirements contained in the original document.
2. allows mating in single or duplex fashion, but manages the fiber in pairs.
3. provide a method to identify each position
4. allow for the addition and removal of horizontal connections
5. provide storage for non-connected fibers
6. provide a method to add additional cables from the backbone or horizontal
7. provide a method to convert from an interconnection or splice to a cross connect
8. provide an access point for testing purposes
9. provide adequate protection for the adapters, connectors and cables.

Optical Fiber Splice

Splices should not have an attenuation of .3 dB when measured as per ANSI/TIA/EIA-455-34.

Multimode fiber shall have a minimum return loss of 20 dB, and return loss for singlemode shall be 26 dB, when measured as per ANSI/TIA/EIA-455-1.07. The minimum return loss for singlemode fiber for CATV applications is 55 dB.

Patch Cords

Patch cords shall be a 2 fiber cable and of the same type of fiber optic cable, indoor construction and meet the transmission requirements and construction requirements as per the original standard.

Patch cord connectors shall meet the requirements contained in the section for connectors and adapters.

Patch cords will be duplex in nature and identified in such a manner that one connector is marked "A" and one connector is marked "B". The connector at the opposite end of the patch cord will have the labelling reversed.

Test Equipment

Field test instruments for multimode cable shall meet ANSI/TIA/EIA-525-14-A. Consult also ANSI/TIA/EIA-455-50B and ANSI/TIA/EIA-568-B.1, clause 11 for further clarification.

For singlemode fiber, field test equipment must meet ANSI/TIA/EIA-526-7.

TIA/EIA-568-B.1-1

Part 1: General Requirements

Addendum 1: Patch Cord Bend Radius

Purpose

The purpose of this addendum is to replace sub clause 10.2.1.3 of the original documentation of TIA/EIA-568-B.1, which addresses patch cord bend radius in UTP and ScTP cables.

The new subclause states that the minimum inside bend radius for patch cords under no load conditions shall be 6mm (.25") for 4 pair UTP cables, and 50 mm (2.0") for 4 pair ScTP cables.

TIA/EIA-568-B.1-2

Part 1: General Requirements

Addendum 2: Grounding & Bonding Specifications for Screened Balanced Twisted-Pair Horizontal Cabling

Purpose

The purpose of this addendum is to revise clause 4.6 of the TIA/EIA-568-B.1 documentation which addresses certain grounding and bonding issues.

4.6 Grounding Considerations

A proper grounding system may improve the EMC performance of the cabling system.

Grounding and bonding systems shall meet the requirements of TIA/EIA-J-STD 607-A.

The screen of ScTP cables shall be bonded to the TGB in the Telecommunications Room. Grounding of equipment at the work area such as computers, is done through the ground conductor of the equipment power connection.

Screen connections to the work area equipment shall be done through the screen of the ScTP work areal cord extending from the telecommunications outlet to the equipment.

The voltage between the screen and the ground wire shall not exceed 1.0 V rms, and 1.0 V dc.

The screen of ScTP hardware shall be bonded to the TGB in the telecommunications room.

The Horizontal cable screen shall be bonded via a screen termination to the connecting hardware screen termination.

The connecting hardware screen termination shall be verified to ensure all applicable requirements are met.

Annex Modifications

This addendum also contains Annex A which pertains to the Grounding and Bonding of Screened Balanced Twisted-Pair Horizontal Cabling. Modifications to this annex are not addressed in this section, but may be obtained through TIAOnline.

TIA/EIA-568-B.1-3

Part 1: General Requirements

Addendum 3: Supportable Distances and Channel Attenuation for Optical Fiber Applications by Fiber Type

Purpose:

The intent of this addendum is to revise information contained in Table E-1 of the original standards documentation, specifically it addresses two new applications, that of 10/100BASE-SX and 10G (Gigabit) Ethernet, and a new fiber type, 850 nm laser optimized 50/125 multimode fiber.

Application	Wave Length (nm)	Maximum Supportable Distance (m)				Maximum Channel Attenuation (dB)			
		Mulitmode			Singlemode	Mulitmode			Singlemode
		62.5/125	50/125	850 Laser Optimized 50/125		62.5/125	50/125	850 Laser Optimized 50/125	
10/100 BASE-SX	850	300	300	300	NST	4.0	4.0	4.0	NST
10G Ethernet									
10GBASE-S	850	26	82	300	NST	2.6	2.3	2.6	NST
10GBASE-L	1310	NST	NST	NST	10000	NST	NST	NST	6.0
10GBASE-E	1550	NST	NST	NST	40000	NST	NST	NST	11.0
10GBASE-LX4	1300	300	300	300	-	2.5	2.0	2.0	-
10GBASE-LX4	1310	-	-	-	10000	-	-	-	6.6

TIA/EIA-568-B.1-4

Part 1: General Requirements

Addendum 4: Recognition of Category 6 and 850 nm Laser-Optimized 50/125µm Multimode Optical Fiber Cabling

Purpose

The purpose of this addendum is to recognize balanced twisted pair Category 6 copper cabling and 850nm laser optimized 50/125µm multimode optical fiber. The revisions occur in sub clauses 4.4, 4.5, 5.3 and 11.2.2 of TIA/EIA-568-B.1.

4.4 Recognized Cables

This clause officially recognizes Catgory 3, 5e, 6 UTP cabling as well as ScTP (Sreened Twisted Pair) which meet the requirements of ANSI/TIA/EIA-568-B.2-1.

As well, it also recognizes 62.5/125µm or 50/125µm multimode fiber which meets the requirements contained in ANSI/TIA/EIA-568-B.3-1.

All recognized cables, associated connecting hardware, jumpers, patch cords, equipment cords and work area cords shall also meet the requirements found in ANSI/TIA/EIA-568-B.2-1, ANSI/TIA/EIA-568-B.3 and ANSI/TIA/EIA-568-B.3-1.

As well as meeting the requirements in ANSI/TIA/EIA-568-B.2 and ANSI/TIA/EIA-568-B.3, bundled and hybrid cables shall also meet the requirements of ANSI/TIA/EIA-568-B.2-1 and ANSI/TIA/EIA-568-B.3-1.

4.5 Choosing Types of Cables

A minimum of two telecommunications outlets/connectors shall be provided for each work area. The two telecommunications outlets shall be configured as:

a) One telecommunications outlet/connector shall be supported by a 4-pair 100 ohm Category 3 or higher, with Category 5e or Category 6 recommended as specified in ANSI/TIA/EIA-568-B.2 and ANSI/TIA/EIA-568-B.2-1.

b) The other outlet/connector shall be supported by one of the following:

- 4 pair, 100 ohm cable either Category 5e or Category 6 as specified in ANSI/TIA/EIA-568-B.2 and ANSI/TIA/EIA-568-B.2-1.
- Two fiber multimode fiber, either 62.5/125µm or 50/125µm as specified in ANSI/TIA/EIA-568-B.3 and ANSI/TIA/EIA-568-B.3-1.

5.3 Recognized Cables-Backbone Cabling

Recognized backbone cables are:

- 100 ohm Category 3, 5e or 6 UTP cables meeting ANSI/TIA/EIA-568-B.2 and ANSI/TIA/EIA-568-B.2-1.

- multimode optical fiber cable, either 62.5/125µm or 50/125µm as specified in ANSI/TIA/EIA-568-B.3 and ANSI/TIA/EIA-568-B.3-1.
- singlemode fiber meeting ANSI/TIA/EIA-568-B.3.

All recognized cables, associated connecting hardware, jumpers, patch cords, equipment cords and work area cords shall also meet the requirements found in ANSI/TIA/EIA-568-B.2-1, ANSI/TIA/EIA-568-B.3 and ANSI/TIA/EIA-568-B.3-1.

5.5.1 Intra and Interbuilding Distances

The length of the horizontal cabling for Category 6 cable supporting data applications up to 250 MHz shall be limited to 90 m (295 ft). This distance assumes a 5 mtr patch cord at each end. The original documentation contains the chart describing the distances.

6.2.1 100 ohm Balanced Twisted Pair Telecommunications Outlet/Connector

The telecommunications outlet/connector for 100 ohm UTP and ScTP shall meet the requirements of ANSI/TIA/EIA-568-B.2 for Category 3 and 5e, and ANSI/TIA/EIA-568-B.2-1 for Category 6.

6.3 Work Area Cords

Work area cords are limited to 5 meters as per subclause 4.3 of the original documentation. Work area cords shall meet or exceed the requirements of ANSI/TIA/EIA-568-B.2 for Category 3 and 5e, and ANSI/TIA/EIA-568-B.2-1 for Category 6 and ANSI/TIA/EIA-568-B.3 or ANSI/TIA/EIA-568-B.3-1.

11.2.2 Applicability

Category 6 channels and links shall meet or exceed the performance requirements of ANSI/TIA/EIA-568-B.2-1.

Standards

ANSI/TIA/EIA 568-B.2-1 Commercial Building Telecommunications Cabling Standard

Part 2: Balanced Twisted-Pair Cabling Components

Addendum 1: Transmission Performance Specifications for 4-Pair 100 Ohm Category 6 Cabling

General

The original document is an addendum to already published document(s), and because of that fact, references are made to the original specification. As an overall statement, this document specifies the requirements and specifications for Category 6 cable, cords and connecting hardware. By definition, Category 6 systems meet transmission requirements up to 250 Mhz.

Recognized Components

Cable

Category 6 cable is by definition a twisted pair, 100 Ohm cable which has transmission parameters specified up to 250 Mhz. Category 6 cable is also a recognized cable in addition to those specified in 4.2.2 of ANSI/TIA/EIA-568-B.2.

Horizontal and Backbone Cable

Category 6 cable may be used for both horizontal and backbone cable. Recognized horizontal and backbone cable shall be either 4 pair 100 Ohm UTP, or ScTP, consisting of 22 AWG or 24 AWG solid conductors individually insulated by a thermoplastic material and then formed into 4 twisted pairs with an overall thermoplastic jacket. The cable shall meet the requirements of ANSI/ICEA S-80-576 applicable to four-pair inside wiring cable for plenum or general cabling within a building, ANSI/ICEA S-90-661-1994. Horizontal cable shall also meet the requirements of clauses 4.3.3.1 to 4.3.3.6 of ANSI/TIA/EIA-568-B.2. Backbone cable shall meet the requirements of clauses 4.4.3.1 to 4.4.3.6 of ANSI/TIA/EIA-568-B.2.

NOTE - Additional requirements for 100 Ohm ScTP cables are located in annex K of the original ANSI/TIA/EIA-568-B.2 standard.

Bundled and Hybrid Cable

Bundled and hybrid cables may be used for horizontal and backbone cabling provided that each cable type is meets the requirements of clause 6.1.1 of this Standard and clause 4.4 of ANSI/TIA/EIA-568-B.1. The cable must also meet the transmission and color-code specifications for that cable type as given in ANSI/TIA/EIA-568-B.2, ANSI/TIA/EIA-568-B.3, and clause 7 in the

original documentation of this standard. The cable must also meet total power sum NEXT loss requirements. The original standard outlines the equation required for calculation of NEXT.

Connecting Hardware and Cords

Connecting hardware and cords meeting transmission characteristics from 1 Mhz to 250 Mhz are recognized under this standard. In addition patch cords and cordage must also meet the requirements of clauses 6.1 through 6.3 of ANSI/TIA/EIA-568-B.2 and clause 7.2.1.3 and 7.4.4 of the original standards documentation.

TRANSMISSION REQUIREMENTS

General

For each transmission parameter where applicable, the cable, connecting hardware and cords are tested for the parameter under the following categories:

Individual test parameter for cable
Individual test parameter for connecting hardware
Permanent Link
Channel
Work Area Cords, Patch Cords and Equipment Cords

In order to calculate the results, an equation is published in the original standards documentation detailing the parameters and conditions for each calculation, eg: temperature. In order to accurately determine the transmission results for each parameter, the equation calculation should be used. However, for standardization and comparison purposes, the results at various frequencies are documented in chart form at the end of the section.

The original standards documents also refer to the various test and measurement methods. Again, for the purposes of this document, it is assumed that the manufacturers have conformed to the proper test and measurement methods.

Insertion Loss

Insertion loss was previously referred to as attenuation, which is the change in signal strength as the signal propagates down the media. Insertion loss is a measure of the signal loss resulting from the insertion of cabling or a component between a transmitter and receiver. Insertion loss is the ratio of signal power at the receiver end to the input power determined from measured voltages, expressed in dB.

Insertion loss can be calculated by using the equation found in the original standards documentation and shall meet the values for all frequencies from 1 MHz to 250 Mhz as it pertains to:

Cable Insertion Loss for solid and stranded cable
Connecting Hardware Insertion Loss
Channel Insertion Loss
Permanent Link Insertion Loss

NOTES

1. A 20 % increase in insertion loss is allowed over category 6 horizontal cable insertion loss for work area and patch cords.
2. The insertion loss of the channel or permanent link does not take into consideration the 0.1 dB measurement floor of the connecting hardware insertion loss requirement.
3. The channel insertion loss requirement is derived using the insertion loss contribution of 4 connections.
4. For the purposes of field measurements, calculated channel limits that result in insertion loss values less than 3 dB revert to a requirement of 3 dB maximum (see ANSI/TIA/EIA-568-B.2-3).
5. The permanent link insertion loss requirement is derived using the insertion loss contribution of 3 connections.
6. The maximum value for insertion loss cannot exceed .10 dB.

View Category 6 Minimum Standard Requirements for Insertion Loss:

Cable | Hardware | Permanent Link | Channel

Cable

Frequency (Mhz)	Insertion Loss (Solid)	Insertion Loss (Stranded)	NEXT (Worst pair to pair	Power Sum NEXT	ELFEXT (Worst pair to pair)	Power Sum ELFEXT
.772	1.8	-	76.0	74.0	70.0	67.0
1.0	2.0	2.4	74.3	72.3	67.8	64.8
4.0	3.8	4.5	65.3	63.3	55.8	52.8
8.0	5.3	6.4	60.8	58.8	49.7	46.7
10.0	6.0	7.1	59.3	57.3	47.8	44.8
16.0	7.6	9.1	56.2	54.2	43.7	40.7
20.0	8.5	10.2	54.8	52.8	41.8	38.8
25.0	9.5	11.4	53.3	51.3	39.8	36.8
31.25	10.7	12.8	57.9	49.9	37.9	34.9
62.5	15.4	18.5	47.4	45.4	31.9	28.9
100.0	19.8	23.8	44.3	42.3	27.8	24.8
200.0	29.0	34.8	39.8	37.8	21.8	18.8

250.0	32.8	39.4	38.3	36.3	19.8	16.8

Frequency (Mhz)	Return Loss (Solid)	Return Loss (Stranded)	LCL
.772	-	-	-
1.0	20.0	20.0	40.0
4.0	23.0	23.0	40.0
8.0	24.5	24.5	40.0
10.0	25.0	25.0	40.0
16.0	25.0	25.0	38.0
20.0	25.0	25.0	37.0
25.0	24.3	24.2	36.0
31.25	23.6	23.3	35.1
62.5	21.5	20.7	32.0
100.0	20.1	19.0	30.0
200.0	18.0	16.4	27.0

250.0	17.3	15.6	26.0

Hardware

Frequency (Mhz)	Insertion Loss	NEXT (Worst pair to pair)	FEXT	Return Loss	LCL	Work Area Cords
.772	.1	-	-	-	-	-
1.0	.1	75.0	75.0	30.0	40.0	19.8
4.0	.1	75.0	71.1	30.0	40.0	21.6
8.0	.1	75.0	65.0	30.0	40.0	22.5
10.0	.1	74.0	63.1	30.0	40.0	22.8
16.0	.1	69.9	59.0	30.0	40.0	23.4
20.0	.1	68.0	57.1	30.0	40.0	23.7
25.0	.1	66.0	55.1	30.0	40.0	24.0
31.25	.11	64.1	53.2	30.0	38.1	23.0
62.5	.16	58.1	47.2	28.1	32.1	20.0
100.0	.20	54.0	46.1	24.0	28.0	18.0
200.0	.28	48.0	37.1	18.0	22.0	15.0
250.0	.32	46.0	35.1	16.0	20.0	14.0

Permanent Link

Frequency (Mhz)	Insertion Loss	NEXT (Worst pair to pair)	Power Sum NEXT	ELFEXT (Worst pair to pair)	Power Sum ELFEXT	Return Loss

.772	-	-	-	-	-	-
1.0	1.9	65.0	62.0	64.2	61.2	19.1
4.0	3.5	64.1	61.8	52.1	49.1	21.0
8.0	5.0	59.4	57.0	46.1	43.1	21.0
10.0	5.5	57.8	55.5	44.2	41.2	21.0
16.0	7.0	54.6	52.2	40.1	37.1	20.0
20.0	7.9	53.1	50.7	38.2	35.2	19.5
25.0	8.9	51.5	49.1	36.2	33.2	19.0
31.25	10.0	50.0	47.5	34.3	31.3	18.5
62.5	14.4	45.1	42.7	28.3	25.3	16.0
100.0	18.6	41.8	39.3	24.2	21.2	14.0
200.0	27.4	36.9	34.3	18.2	15.2	11.0
250.0	31.1	35.3	32.7	16.2	13.2	10.0

Channel

Frequency (Mhz)	Insertion Loss	NEXT (Worst Pair to Pair)	Power Sum NEXT	ELFEXT (Worst Pair to Pair)	PSELFEXT	Return Loss
.772	-	-	-	-	-	-
1.0	2.1	65.0	62.0	63.3	60.3	19.0
4.0	4.0	63.0	60.5	51.2	48.2	19.0
8.0	5.7	58.2	55.6	45.2	42.2	19.0
10.0	6.3	56.6	54.0	43.3	40.3	19.0
16.0	8.0	53.2	50.6	39.2	36.2	18.0

20.0	9.0	51.6	49.0	37.2	34.2	17.5
25.0	10.1	50.0	47.3	35.3	32.3	17.0
31.25	11.4	48.4	45.7	33.4	30.4	16.5
62.5	16.5	43.4	40.6	27.3	24.3	14.0
100.0	21.3	39.9	37.1	23.3	20.3	12.0
200.0	31.5	34.8	31.9	17.2	14.2	9.0
250.0	35.9	33.1	30.2	15.3	12.3	8.0

Near End Cross Talk (NEXT) and Power Sum Near End Cross Talk (PSNEXT) Loss

NEXT loss is a measure in dB of the unwanted signal coupling from a transmitter at the near-end into neighboring pairs, measured at the near-end. An example of cross talk is hearing a second conversation over a phone line while you are talking on the same line. In data communications, having an unwanted signal on a cable can cause network transmission problems. NEXT loss is expressed relative to the transmit signal level.

Pair to Pair NEXT can be calculated by using the equation found in the original standards documentation and shall meet the values for all frequencies from .772 MHz to 250 Mhz. The worst pair to pair result is shown to ensure all pair to pair combinations meet the transmission requirements.

Near End Cross Talk is shown for:

Cable NEXT
Connecting Hardware NEXT
Permanent Link NEXT
Channel NEXT

Power Sum Near End Cross Talk is the calculated value of NEXT on one pair of conductors at the near end from all other energized conductor pairs at the near end. The original standards documentation provides the calculation proceedures for calculating PSNEXT.

Power Sum NEXT is calculated for:

Cable
Permanent Link
Channel

Connecting hardware NEXT loss shall be measured for all pair combinations in

accordance with annex E. Modular plug cord NEXT loss shall be measured for all pair combinations in accordance with annex J.

Cabling Pair-to-Pair Channel and Permanent Link NEXT loss

For all frequencies from 1 MHz to 250 MHz, category 6 channel and permanent link pair-to-pair NEXT loss shall meet the values determined using the equations available in the original standards documentation. The maximum value for NEXT loss values shall not be greater than 65 dB for pair to pair measurements, and 62dB for channel.

Cable Power Sum NEXT Loss

For all frequencies from 0.772 MHz to 250 MHz, category 6 cable power sum NEXT loss, for a length of 100 m (328 ft) or longer, shall meet the values determined using the calculations found in the original standards documents.

Work Area, Equipment, and Patch Cord Pair-to-Pair NEXT Loss

Work area, equipment, and patch cords shall pass the requirements of this clause and Annex J of the original standards documentation. The original documentation provides the calculation methods for deriving the pair to pair results.

NEXT calculations take into account total NEXT for the connectors and cable used.

View Category 6 Minimum Standard Requirements for Modular Patch Cords

Category 6 Modular Patch Cord NEXT Loss (dB)

Frequency (MHz)	2 Mtr Cord	5 Mtr Cord	10 Mtr Cord
1	65.0	65.0	65.0
4	65.0	65.0	65.0
8	65.0	65.0	64.8
10	65.0	64.5	62.9
16	62.0	60.5	59.0
20	60.1	58.6	57.2
25	58.1	56.8	55.4
31.25	56.2	54.9	53.6
62.5	50.4	49.2	48.1

100	46.4	45.3	44.4
200	40.6	39.8	39.3
250	38.8	38.1	37.6

NOTES

1 Permanent link NEXT and PSNEXT loss test limits are tougher to meet than channel NEXT and PSNEXT loss test limits. This ensures that permanent links can be converted into a channel model by using cords that meet Category 6 minimum standards.

2. A consolidation point in the permanent link may show results below the measurement accuracy for the permanent link.

3. At least a 5 m (16.4 ft) distance between the consolidation point and the telecommunications outlet connector should be maintained to help improve NEXT and PSNEXT.

4. Channel testing can be performed using cabling components that remain in place.

5. The maximum Pair to Pair NEXT value for connecting hardware shall be 75 dB.

6. The maximum value for PSNEXT is 62.0 dB.

View Category 6 Minimum Standard Requirements for NEXT & PSNEXT:

Cable | Hardware | Permanent Link | Channel

FEXT and ELFEXT Loss

FEXT loss is a measurement in dB of the unwanted signal coupling from a transmitter at the far-end into neighboring pairs measured at the near-end. FEXT loss is the ratio of the power coupled from a disturbing pair into the disturbed pair relative to the input power at the opposite end of the transmission lines determined from measured voltages. FEXT loss shall be measured for all pair combinations in accordance with annex E of the original standards documentation.

FEXT is measured for:

Connecting Hardware

ELFEXT shall be calculated for all pair combinations of cables and cabling in accordance with annex C of ANSI/TIA/EIA-568-B.2 and the ASTM D 4566 FEXT loss measurement procedure. Connecting hardware . In addition, since each pair can be disturbed by more than one pair, power sum equal level far-

end crosstalk (PSELFEXT) is also specified for cabling and cables.

ELFEXT is measured for:

Cable
Permanent Link
Channel

PSELFEXT is measured for:

Cable
Permanent Link
Channel

Pair-to-Pair ELFEXT

Cable pair-to-pair ELFEXT

For all frequencies from 1 MHz to 250 MHz, category 6 cable ELFEXT, for a length of 100 m (328 ft), shall meet the values determined using calculations in the original standards documentation.

Connecting Hardware Pair-to-Pair FEXT Loss

For all frequencies from 1 MHz to 250 MHz, category 6 connecting hardware FEXT loss shall meet the values determined using calculations found in the original standard documentation. The maximum FEXT value shall not exceed 75 dB.

Permanent Link and Channel Pair-to-Pair ELFEXT

For all frequencies from 1 MHz to 250 MHz, category 6 channel and permanent link ELFEXT shall meet the values determined using calculations found in the original standards documentation.

Power Sum ELFEXT (PSELFEXT)

Power sum equal level far-end crosstalk loss takes into account the combined crosstalk (calculated) value on a receive pair from all far-end disturbers operating at the same time. The power sum equal level far-end crosstalk (PSELFEXT) loss calculation is found in the original standards documentation.

Cable Power Sum ELFEXT

For all frequencies from 1 MHz to 250 MHz, category 6 cable power sum ELFEXT, for a length of 100 m (328 ft), shall meet the values determined by the equation found in the original standards documentation

Permanent Link and Channel Power Sum ELFEXT

For all frequencies from 1 MHz to 250 MHz, category 6 permanent link and channel power sum ELFEXT shall meet the values determined using the equation found in the original standards documentation.

View Category 6 Minimum Standard Requirements for FEXT, ELFEXT & PSELFEXT:

Cable | Hardware | Permanent Link | Channel

Return Loss

Return loss is a measure of the reflected energy caused by impedance mismatches in the cabling system. An impedance mismatch occurs when one component of the system is transitioned to another; eg: the cable is mated to a connector. This is very important for applications that use simultaneous bi-directional transmission. Information must be able to flow down the cable in both directions with a minimal amount of impedance to ensure smooth network operation.

Return loss is the ratio of the reflected signal power to the input power determined from measured voltages, expressed in dB. Cable and cabling return loss shall be measured in accordance with annex C of ANSI/TIA/EIA-568-B.2. Connecting hardware return loss shall be measured in accordance with annex D of ANSI/TIA/EIA-568-B.2 for all pairs. Modular plug cords shall be measured in accordance with annex J for all pairs.

Return Loss is measured for:

Stranded Cable
Solid Cable
Connecting Hardware
Permanent Link
Channel
Patch Cords and Equipment Cords

Horizontal Cable Return Loss

For all frequencies from 1 MHz to 250 MHz, category 6 horizontal cable return loss, for a length of 100 m (328 ft), shall meet the values determined using the equation in the original standards documentation.

Stranded Conductor Cable Return Loss

For all frequencies from 1 MHz to 250 MHz, category 6 stranded patch cable return loss, for a length of 100 m (328 ft), shall meet the values determined using the equation found in the original standards documentation.

Connecting Hardware Return Loss

For all frequencies from 1 MHz to 250 MHz, category 6 connecting hardware return loss shall meet the values determined using the equation found in the original standards documentation.

Work Area, Equipment, and Patch Cord Return Loss

For all frequencies from 1 MHz to 250 MHz, category 6 work area, equipment, and patch cord return loss shall meet the values determined using the equation found in the original standards documentation.

Permanent Link and Channel Return Loss

For all frequencies from 1 MHz to 250 MHz, category 6 permanent link and channel return loss shall meet the values determined using the equation found in the original standards documentation.

View Category 6 Minimum Standard Requirements for Return Loss:

Cable | Hardware | Permanent Link | Channel

Propagation Delay and Delay Skew

Propagation delay is the time it takes for a signal to travel from one end of a conducting pair in cabling, cables, or connecting hardware to the opposite end of that pair. Propagation delay skew is a measurement of the signaling delay difference from the fastest pair to the slowest. Propagation delay and propagation delay skew are expressed in nanoseconds (ns).

Cable Propagation Delay

For all frequencies from 1 MHz to 250 MHz, category 6 cable propagation delay shall meet the values determined using the equation in the original standards documentation.

Permanent Link and Channel Propagation Delay

The maximum propagation delay for a category 6 channel configuration shall be less than 555 ns measured at 10 MHz.

The maximum propagation delay for a category 6 permanent link configuration shall be less than 498ns measured at 10 MHz.

The propagation delay from each installed mated connection is assumed to not exceed 2.5 ns for all frequencies from 1 MHz to 250 MHz.

Cable Propagation Delay Skew

For all frequencies from 1 MHz to 250 MHz, category 6 cable propagation delay skew shall not exceed 45 ns/100 m. Testing shall be conducted using a minimum 100 m of cable.

Permanent Link and Channel Propagation Delay Skew

For purposes of determining the permanent link and channel propagation delay skew, the propagation delay skew of each installed mated connection is assumed to be no greater 1.25 ns.

The maximum propagation delay skew for a category 6 permanent link configuration shall be less than 44 ns measured at 10 MHz, and less than 50ns for a channel configuration.

Propagation Delay and Delay Skew for Category 6 Cable

Frequency (MHz)	Maximum Delay (ns/100 mtr)	Minimum Velocity of Propagation (%)	Maximum Delay Skew (ns/100 Mtr)

1	570	58.5	45
10	545	61.1	45
100	538	62.0	45
250	536	62.1	45

Balance

Balance ensures that unwanted signal coupling modes are minimized and is related to the emission and immunity characteristics of the cabling. Balance parameters such as Longitudinal Conversion Loss (LCL) and Transverse Conversion Loss (TCL) are expressed in dB as the ratio of the signal measured at the device under test (DUT) output port relative to the signal entering the DUT input port. LCL should be measured for all cable and connecting hardware pairs in accordance with annex D found in the original standards documentation.

NOTE - Measurements of LCL and TCL are reciprocal due to symmetry.

Cable and Connecting Hardware LCL

For all frequencies from 1 MHz to 250 MHz, category 6 cable and connecting hardware LCL should meet the values determined using the equation found in the original standards documentation. Any calculations that result in LCL values greater than 40 dB should be shown to be 40 dB minimum.

Longitudinal Conversion Transfer Loss (LCTL)

LCTL for both cable and connecting hardware is currently under review.

View Category 6 Minimum Standard Requirements for LCL:

Category 6 Connecting Hardware Transmission Parameters

Frequency (Mhz)	Insertion Loss	NEXT (Worst pair to pair)	FEXT	Return Loss	LCL	Work Area Cords
.772	.1	-	-	-	-	-
1.0	.1	75.0	75.0	30.0	40.0	19.8
4.0	.1	75.0	71.1	30.0	40.0	21.6
8.0	.1	75.0	65.0	30.0	40.0	22.5
10.0	.1	74.0	63.1	30.0	40.0	22.8
16.0	.1	69.9	59.0	30.0	40.0	23.4
20.0	.1	68.0	57.1	30.0	40.0	23.7
25.0	.1	66.0	55.1	30.0	40.0	24.0
31.25	.11	64.1	53.2	30.0	38.1	23.0
62.5	.16	58.1	47.2	28.1	32.1	20.0
100.0	.20	54.0	46.1	24.0	28.0	18.0
200.0	.28	48.0	37.1	18.0	22.0	15.0
250.0	.32	46.0	35.1	16.0	20.0	14.0

Standards

TIA/EIA-568-B.2.2

Commercial Building Telecommunications Cabling Standard

Part 2: Balanced Twisted Pair Cabling Components

Addendum 2

Revisions to TIA/EIA-568-B.2

Purpose:

The purpose of this Addendum is to identify and revise certain clauses within the original document, TIA/EIA 568-B.2. The most notable changes are to Tables 13 and 16, which both concern PSNext and NEXT for Category 3 and 5e backbone cables. The major changes are to the Category 3 parameters.

4.3.4.8

Within this section equation 5 is replaced. The new equation can be found in the orginal documents available from TIAONLINE.

4.4

Revised text has been added which states that 4 pr twisted pair cables shall comply with clause 4.3, and that multipair backbone cables shall comply with clauses 4.4.1 through 4.4.6.

4.4.4.9

Revised PSNext Losses for Category 3 and 5e Backbone Cable

Frequency (Mhz)	Category 3 (dB Loss)	Category 5e (dB Loss)
.772	43.0	64.0
1.0	41.3	62.3
4.0	32.3	53.3
8.0	27.8	48.8
10.0	26.3	47.3
16.0	23.2	44.2
20.0	-	42.8

25.0	-	41.3
31.25	-	39.9
62.5	-	35.4
100.0	-	32.3

5.4.3

Revised Table 20 Connecting Hardware NEXT Loss-Worst Pair

Frequency (Mhz)	Category 3 (dB Loss)	Category 5e (dB Loss)
1.0	58.1	65.0
4.0	46.0	65.0
8.0	40.0	64.9
10.0	38.1	63.0
16.0	34.0	58.9
20.0	-	57.0
25.0	-	55.0
31.25	-	53.1
62.5	-	47.1
100.0	-	43.1

Commercial Building Telecommunications Cabling Standard

Part 2: Balanced Twisted Pair Cabling Components

Addendum 3

TIA/EIA-568-B.2-3 Additional Considerations for Insertion Loss and Return Loss Pass/Fail Determination

Purpose:

The purpose of this Addendum is to change some wording in clause 1.2.5 of TIA/EIA-568-B.2

1.2.5

The main wording change states that measured insertion loss values of less than 3dB shall not be marked with an asterik, and shall not be used for pass/fail determination.

Commercial Building Telecommunications Cabling Standard

Part 2: Balanced Twisted Pair Cabling Components

Addendum 4

TIA/EIA-568-B.2-4 Solderless Connection Reliability Requirements for Copper Connecting Hardware

Purpose:

The purpose of this Addendum is specify solderless connection requirements for connecting hardware.

4 Definitions

The document defines the following:

- Insulation Displacement Connection
- Insulation Displacement Connection, Accessible
- Insulation Displacement Connection, Non-Accessible
- Insulation Displacement Contact
- Insulation Displacement Termination
- Insulation Piercing Connection

5 Reliability Requirements

Solderless connections shall meet the following requirements:

Connection Type	Reliability Standard
Crimped	IEC 60352-2
Accessible IDC	IEC 60352-3
Non Accessible IDC	IEC 60352-4
Press-in connection	IEC 60352-5
IPC	IEC 60352-6

Commercial Building Telecommunications Cabling Standard

Part 2: Balanced Twisted Pair Cabling Requirements

Addendum 5:

TIA/EIA-568-B.2-5 Corrections to TIA/EIA-568-B.2

Purpose

The purpose of this addendum is to revise certain clauses within the original TIA/EIA-568B.2 document.

D.5.2 Applicability

For the purposes of this standard...D.6.10 is now replaced with **D.5.10**

D.5.8 De embedding reference jack NEXT loss measurement

Measure the NEXT loss of the de embedded...D.6.5 is changed to **D.5.6.**

D.6 Modular test plug construction

It is necessary to obtain...D.6.10 is changed to **D.5.10**

Standards

Commercial Building Telecommunications Cabling Standard

TIA/EIA-568-B.3-1

Part 3 - Additional Transmission Performance Specifications for 50/125 µm Optical Fiber Cables

Addendum 1

Purpose:

The purpose of this addendum is to identify transmission requirements for 50/125µm fiber optic cable to support 10 Gb/s transmission up to 300 m, using 850 nm lasers.

Application

Cable specified in this addendum is to be used in commercial buildings or between buildings in a campus situation. The cable shall also meet the requirements of ANSI/TIA/EIA-568-B.3 and any further addendums.

Transmission Performance for 850 nm Laser Optimized 50/125µm Fiber

Wavelength	Maximum Attenuation	Overfilled Modal Bandwidth-Length Product MHz•km	Effective Modal Bandwidth-Length Product MHz•km
850 nm	3.5 dB/KM	1500	2000
1300 nm	1.5 dB/KM	500	Not Required

Patch Cord Cable

Patch cords used for the above application (10 Gb/s) shall be manufactured from an indoor cable meeting the above requirements.

TRANSMISSION PARAMETER CHARTS

Category 3 Transmission Performance Standards

Cabling Transmission Performance Standards

Frequency-MHz	Insertion Loss-dB (Solid Cable)	Insertion Loss-dB (Stranded Cable)	NEXT-dB (worst pair to pair)
.772	2.2	2.7	43
1.0	2.6	3.1	41.3
4.0	5.6	6.7	32.3
8.0	8.5	10.2	27.8
10.0	9.7	11.7	26.3
16.0	13.1	15.7	23.2

Connecting Hardware Transmission Performance Standards

Frequency-MHz	Insertion Loss-dB	NEXT-dB (Worst pair to pair)
1.0	.1	58
4.0	.2	46
8.0	.3	39.9
10.0	.3	38
16.0	.4	33.9

Permanent Link Transmission Performance Standards

Frequency-MHz	Insertion Loss-dB	NEXT-dB (worst pair to pair)
1.0	3.5	40.1
4.0	6.2	30.7
8.0	8.9	25.9
10.0	9.9	24.3
16.0	13	21.0

Channel Transmission Performance Standards

Frequency-MHz	Insertion Loss-dB	Next-dB (worst pair to pair)
1.0	4.2	39.1
4.0	7.3	29.3
8.0	10.2	24.3
10.0	11.5	22.7
16.0	14.9	19.3

Category 5e Transmission Performance Standards

Cabling Transmission Performance Standards

Frequency (Mhz)	Insertion Loss (dB) (Solid)	Insertion Loss (dB) (Stranded)	NEXT (dB)	PS NEXT (dB)	ELFEXT (dB)	PS ELFEXT (dB)	Return Loss (dB)
.772	1.8		67.0	64.0			
1.0	2.0	2.4	65.3	62.3	63.8	60.8	20
4.0	4.1	4.9	56.3	53.3	51.8	48.8	23
8.0	5.8	6.9	51.8	48.8	45.7	42.7	24.5
10	6.5	7.8	50.3	47.3	43.8	40.8	25
16	8.2	9.9	47.2	44.2	39.7	36.7	25
20	9.3	11.1	45.8	42.8	37.8	34.8	25
25	10.4	12.5	44.3	41.3	35.8	32.8	24.2
31.25	11.7	14.1	42.9	39.9	33.9	30.9	23.3
62.5	17.0	20.4	38.4	35.4	27.9	24.9	20.7
100	22.0	26.4	35.3	32.3	23.8	20.8	19.0

Connecting Hardware Transmission Performance Standards

Frequency (MHz)	Insertion Loss (dB)	NEXT (dB)	Return Loss (dB)	FEXT (dB)
1.0	.1	65	30	65
4.0	.1	65	30	63.1
8.0	.1	64.9	30	57.0
10	.1	63.0	30	55.1
16	.2	58.9	30	51.0
20	.2	57.0	30	49.0
25	.2	55.0	30	47.1
31.25	.2	53.1	30	45.2
62.5	.3	47.1	24.1	39.2
100	.4	43.0	20.0	35.1

Category 5e NEXT Loss Limits

Frequency (MHz)	2 Meter Limit	5 Meter Limit	10 Meter Limit
1.0	65	65.0	65.0
4.0	62.3	61.5	60.4
8.0	56.4	55.6	54.7
10.0	54.5	53.7	52.8
16.0	50.4	49.8	48.9
20.0	48.6	47.9	47.1
25.0	46.7	46.0	45.3
31.25	44.8	44.2	43.6
62.5	39.0	38.5	38.1
100.0	35.1	34.8	34.6

Category 5e Cord Return Loss (Worst Pair)

Frequency	Return Loss (dB)
1.0	19.8
4.0	21.6
8.0	22.5
10.0	22.8
16.0	23.4
20.0	23.7
31.25	23.0
62.5	20.0
100	18.7

Category 6 Cable Transmission Parameters

Frequency (Mhz)	Insertion Loss (Solid)	Insertion Loss (Stranded)	NEXT (Worst pair to pair	Power Sum NEXT	ELFEXT (Worst pair to pair)	Power Sum ELFEXT
.772	1.8	-	76.0	74.0	70.0	67.0
1.0	2.0	2.4	74.3	72.3	67.8	64.8
4.0	3.8	4.5	65.3	63.3	55.8	52.8
8.0	5.3	6.4	60.8	58.8	49.7	46.7
10.0	6.0	7.1	59.3	57.3	47.8	44.8
16.0	7.6	9.1	56.2	54.2	43.7	40.7
20.0	8.5	10.2	54.8	52.8	41.8	38.8
25.0	9.5	11.4	53.3	51.3	39.8	36.8
31.25	10.7	12.8	57.9	49.9	37.9	34.9
62.5	15.4	18.5	47.4	45.4	31.9	28.9
100.0	19.8	23.8	44.3	42.3	27.8	24.8
200.0	29.0	34.8	39.8	37.8	21.8	18.8
250.0	32.8	39.4	38.3	36.3	19.8	16.8

Frequency (Mhz)	Return Loss (Solid)	Return Loss (Stranded)	LCL
.772	-	-	-
1.0	20.0	20.0	40.0
4.0	23.0	23.0	40.0
8.0	24.5	24.5	40.0
10.0	25.0	25.0	40.0
16.0	25.0	25.0	38.0
20.0	25.0	25.0	37.0
25.0	24.3	24.2	36.0
31.25	23.6	23.3	35.1
62.5	21.5	20.7	32.0
100.0	20.1	19.0	30.0
200.0	18.0	16.4	27.0
250.0	17.3	15.6	26.0

Category 6 Connecting Hardware Transmission Parameters

Frequency (Mhz)	Insertion Loss	NEXT (Worst pair to pair)	FEXT	Return Loss	LCL	Work Area Cords
.772	.1	-	-	-	-	-
1.0	.1	75.0	75.0	30.0	40.0	19.8
4.0	.1	75.0	71.1	30.0	40.0	21.6
8.0	.1	75.0	65.0	30.0	40.0	22.5
10.0	.1	74.0	63.1	30.0	40.0	22.8
16.0	.1	69.9	59.0	30.0	40.0	23.4
20.0	.1	68.0	57.1	30.0	40.0	23.7
25.0	.1	66.0	55.1	30.0	40.0	24.0
31.25	.11	64.1	53.2	30.0	38.1	23.0
62.5	.16	58.1	47.2	28.1	32.1	20.0
100.0	.20	54.0	46.1	24.0	28.0	18.0
200.0	.28	48.0	37.1	18.0	22.0	15.0
250.0	.32	46.0	35.1	16.0	20.0	14.0

Propagation Delay and Delay Skew for Category 6 Cable

Frequency (MHz)	Maximum Delay (ns/100 mtr)	Minimum Velocity of Propagation (%)	Maximum Delay Skew (ns/100 Mtr)
1	570	58.5	45
10	545	61.1	45
100	538	62.0	45
250	536	62.1	45

Category 6 Modular Patch Cord NEXT Loss (dB)

Frequency (MHz)	2 Mtr Cord	5 Mtr Cord	10 Mtr Cord
1	65.0	65.0	65.0
4	65.0	65.0	65.0
8	65.0	65.0	64.8
10	65.0	64.5	62.9
16	62.0	60.5	59.0
20	60.1	58.6	57.2
25	58.1	56.8	55.4
31.25	56.2	54.9	53.6
62.5	50.4	49.2	48.1
100	46.4	45.3	44.4
200	40.6	39.8	39.3
250	38.8	38.1	37.6

Category 6 Permanent Link Transmission Parameters

Frequency (Mhz)	Insertion Loss	NEXT (Worst pair to pair)	Power Sum NEXT	ELFEXT (Worst pair to pair)	Power Sum ELFEXT	Return Loss
.772	-	-	-	-	-	-
1.0	1.9	65.0	62.0	64.2	61.2	19.1
4.0	3.5	64.1	61.8	52.1	49.1	21.0
8.0	5.0	59.4	57.0	46.1	43.1	21.0
10.0	5.5	57.8	55.5	44.2	41.2	21.0
16.0	7.0	54.6	52.2	40.1	37.1	20.0
20.0	7.9	53.1	50.7	38.2	35.2	19.5
25.0	8.9	51.5	49.1	36.2	33.2	19.0
31.25	10.0	50.0	47.5	34.3	31.3	18.5
62.5	14.4	45.1	42.7	28.3	25.3	16.0
100.0	18.6	41.8	39.3	24.2	21.2	14.0
200.0	27.4	36.9	34.3	18.2	15.2	11.0
250.0	31.1	35.3	32.7	16.2	13.2	10.0

Category 6 Channel Transmission Parameters

Frequency (Mhz)	Insertion Loss	NEXT (Worst Pair to Pair)	Power Sum NEXT	ELFEXT (Worst Pair to Pair)	PSELFEXT	Return Loss
.772	-	-	-	-	-	-
1.0	2.1	65.0	62.0	63.3	60.3	19.0
4.0	4.0	63.0	60.5	51.2	48.2	19.0
8.0	5.7	58.2	55.6	45.2	42.2	19.0
10.0	6.3	56.6	54.0	43.3	40.3	19.0
16.0	8.0	53.2	50.6	39.2	36.2	18.0
20.0	9.0	51.6	49.0	37.2	34.2	17.5
25.0	10.1	50.0	47.3	35.3	32.3	17.0
31.25	11.4	48.4	45.7	33.4	30.4	16.5
62.5	16.5	43.4	40.6	27.3	24.3	14.0
100.0	21.3	39.9	37.1	23.3	20.3	12.0
200.0	31.5	34.8	31.9	17.2	14.2	9.0
250.0	35.9	33.1	30.2	15.3	12.3	8.0