

## **1 General**

### **1.1 SUMMARY**

- .1 Section includes:
  - .1 Labour, products, equipment and services necessary to complete the work of this Section.

### **1.2 RELATED SECTIONS**

- .1 Section 26 05 00: Common Work Results - Electrical

### **1.3 DIMENSIONS AND QUANTITIES**

- .1 Dimensions shown on Drawings are approximate. Verify dimensions by reference to shop drawings and field measurement.
- .2 Quantities or lengths indicated in any of the Contract Documents are approximate only and are not to gauge or limit the Work.
- .3 Make necessary changes to routing of cables and the like to accommodate structural, mechanical, electrical and architectural conditions. Coordinate with other trades and make allowance for conditions that will arise from work in progress under separate contract.

### **1.4 OPERATING AND MAINTENANCE MANUALS**

- .1 Submit Operating and Maintenance Manuals.

### **1.5 "AS BUILT" RECORD DRAWINGS**

- .1 Where wiring is underground or underfloor, furnish field dimension with respect to building column lines and inverts with respect to finished floor levels or grades.
- .2 Record deviations from cable numbers shown on the Contract Drawings.
- .3 Prepare records of interconnecting and cross-connecting wiring between items of equipment including equipment supplied by Departmental Representative and under other Specification Sections. Provide the records loaded into a data base. Select the data base by mutual agreement with the Departmental Representative.
- .4 Approved data base products:
  - .1 Microsoft Access
  - .2 Microsoft Excel
- .5 Prepare drawings clearly identifying routes taken by cable where the cable is not supported along its length by either conduit or raceway.
- .6 Include all test reports as part of the "As-built" submittals.
- .7 Provide all test data and numeric as-built information in PDF format.

## **1.6 MANUFACTURER'S ATTENDANCE**

- .1 Provide manufacturer's representatives to verify installation practices for each part of the Work as may be relevant to all components including wiring and terminations.

## **1.7 FIELD INSPECTION**

- .1 Provide field engineer for inspection and certification of equipment during installation, testing and commissioning as required.

## **1.8 QUALITY ASSURANCE**

- .1 These Specifications supplement the Electrical and Electronic Manufacturers Association of Canada, Canadian Standards Association Standards, Electronic Industries Association, Telecommunications Industries Association standards and recommendations. Conditions of the EEMAC, CSA, EIA, TIA and ISO/IEC standards and recommendations apply unless superseded or modified by this Specification.
- .2 Where requirements of the specifications exceed referenced standards, the specifications apply. Where standards differ between authorities, the most rigid applies.
- .3 Requirements of the specifications that are substandard to referenced standards should be brought to the attention of Departmental Representative during bidding period in sufficient time to allow suitable action to be taken and addenda issued as necessary.
- .4 Equipment must be acceptable to electrical inspection authorities.
- .5 Where any part of the Work fails tests, repair the fault in a manner to prevent recurrence and re-test.
- .6 Where any part of the Work fails tests and that Work is to be built without physical discontinuity, remove the offending material and install new without increase in cost to the Contract.

## **2 Products**

### **2.1 MANUFACTURERS**

- .1 Cable Support Hardware
  - .1 Cable supports of open hook construction with curved cable bearing surface. Do not exceed minimum bending radius restriction.

## **3 Execution**

### **3.1 GENERAL**

- .1 All cables and cable pathways to run parallel or perpendicular to building lines.

- .2 Proposed installation drawings to be submitted to the Engineer or Departmental Representative prior to installation.

### 3.2 DUCT DISTRIBUTION

- .1 Clean out each section of duct by pulling a steel wire brush and mandrel of the correct size through the duct before pulling cables.
- .2 When cleaning ducts, if obstructions are encountered which cannot be removed, advise the Departmental Representative of the problems encountered.
- .3 Cable entry and exit from ducts to be protected by flexible corrugated non-metallic conduit or plastic bushings attached to the end of the conduit.
- .4 Pull cables in underground duct-bank in continuous length. Splicing of any kind will not be permitted.
- .5 Pull cable in bottom ducts first, leaving top ducts for future.
- .6 Apply manufacturer recommended lubricant to cables to reduce friction between the cable and the duct.
- .7 Cable grip to be attached to the sheath and its strength members so that no direct force is applied to the conductors/fibres. The cable grip shall have a ball bearing swivel to prevent the cable from twisting during pulling.
- .8 Station personnel at each access point (i.e. manhole/handhole) to observe and lubricate the cables during pull.
- .9 Cable passing through manholes to have sufficient slack for expansion and contraction and to be mounted with clips to prevent sagging.
- .10 The fibre optic cables maximum tensile rating shall not be exceeded during installation. Tension of cable to be monitored during installation.
- .11 Minimum bend radius to be as per manufacturer's recommendations or 10 times the cable outside diameter which ever is the greater.
- .12 Where cable must be pulled through a distance of greater than 30 m or through a pathway containing more than one 90° bend, use a dynamometer to record installation tension and a tension limiting device to be used to prevent exceeding the maximum pulling tension specification during installation. The tension limit shall be set at or below the manufacturer's maximum limit. The cable to be taken up at intermediate pulling points with an intermediate cable take-up device as approved by the Departmental Representative, to prevent over tension on the cable.
- .13 Make cable pulls continuous and steady between pull points and not to interrupt the pull unless necessitated by excessive tension on the cable.

- .14 Following the installation of the cables, all duct entrance into buildings to be sealed with duct sealing compound to prevent the ingress of moisture, foreign materials and rodents.
- .15 Exposed cable ends shall be protected from moisture ingress.
- .16 For underground non-metallic conduit run-empty/spare or with fiber optic cables, provide a metal tracing cable through their entire length within the conduit conveying such cable. The tracing cable will be a minimum size # 12 AWG wire to be terminated at each end so that tracer can be attached. All underground buried conduits will also be marked with plastic caution tape, within a layer of backfill just above the conduit as a warning for future excavation.

### 3.3 GROUNDING

- .1 All grounding bonding to comply with CSA C22.1 standard or after applicable codes.
- .2 Install grounding cables between all equipment frames and enclosures and connect to grounding bus.
- .3 Support grounding cables in the non-metallic conduits or cable trays provided.

### 3.4 WARRANTY

- .1 Test complete structural cabling system to meet manufacturer's best warranty.
- .2 Submit all necessary test results, drawings, and any other documents required to receive manufacturer's warranty certificate to manufacturer's representative.

**END OF SECTION**

1 General

1.1 **SUMMARY**

.1 Section includes:

.1 Labour, products, equipment and services necessary to complete the work of this Section.

.2 The work includes: Supply and installation of copper backbone cabling, supply and installation of Category 6 (Category 6) Voice and Data Horizontal Distribution Cabling; Supply and installation of associated passive network equipment.

.3 The voice/data communication systems shall comprise all components specified, implied or otherwise necessary to constitute a fully operational system. The work includes, but is not necessarily limited to, the following:

.4 Provision of copper backbone cables interconnecting the Main Telephone Room and the Typical Communications rooms, etc.

.5 Provision of cable termination panels, patch panels, and patch cords to support the system. Provision of equipment racks.

.6 Provision of Voice/data outlets indicated in various locations. Required hardware includes, but is not limited to, cross-connection system, termination blocks, fastening devices, system patch cords and all required accessories to comply with this Specification.

.7 Provision of direct horizontal runs of unshielded twisted pair (UTP) Category 6 cables in star configuration from Communications Rooms/Closets to the outlets for all data and voice circuits identified on drawings.

.8 Termination of all UTP cables at panels, outlets and Communications closets. Termination and hardware are defined as all labour and materials required to terminate all cables.

.9 Provision of all cable supports and ties required to support the cabling system for this installation.

.10 Testing certification and warranty of all cabling and components which are within the scope of this Contract.

.11 Provision of as-built AutoCAD drawings fully documenting the cabling.

1.2 **RELATED SECTIONS**

.1 Section 26 05 00: Common Work Results - Electrical

1.3 **SHOP (VENDOR) DRAWINGS AND PARTS LISTS**

.1 Submit for review, manufacturer's or vendor's drawings and specifications for all products being furnished. Include rating, performance, specification sheets,

descriptive literature, schematic and wiring diagrams, dimensional layouts and weights of components as well as complete assemblies.

#### 1.4 REFERENCES

- .1 All workmanship and materials supplied shall be in full conformance with applicable building, electrical, and other codes, as determined by the authority having jurisdiction.
- .2 All cabling system components shall be Underwriters Laboratories (UL) Listed and shall be marked as such. In cases where UL has no published standards for a component, any equivalent national independent testing standard shall apply and the item shall be appropriately marked.
- .3 The product specifications, design considerations, and installation guidelines provided in this document are in part derived from recommendations found in recognized telecommunications industry standards. The following are used as reference:
  - .1 TIA-569-B (2004) – Commercial Building Standard for Telecommunications Pathways and Spaces
  - .2 ANSI-J-STD-607-A 2002 – Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
  - .3 TIA/EIA-568-B.1 2002 – Commercial Building Telecommunications Cabling Standard, Part 1: General Requirements
  - .4 TIA/EIA-568-B.2 2001 – Commercial Building Telecommunications Cabling Standard, Part 2: Balanced Twisted-Pair Cabling Components
  - .5 TIA/EIA-862 (2002) – Building Automation Systems Cabling Standard for Commercial Buildings
  - .6 TIA/EIA-606-A (2002) – Administration Standard for Commercial Telecommunications Infrastructure
  - .7 IEEE Standard 802.3an (2006) – 10GBASE-T (10 Gb/s Ethernet operations over balanced twisted-pair cabling)
  - .8 BICSI Telecommunications Distribution Methods Manual (TDMM) – 11th edition
  - .9 BICSI Information Transport Systems Installation Manual (ITSIM) – 4th edition (2004)

#### 1.5 SYSTEM DESCRIPTION

- .1 Structured system of communication cables, copper Category 6 UTP, installed within the building for distributing voice and data.
- .2 Connect each communication outlet in physical star configuration to communications closet.
- .3 Installed in physical star configuration with separate horizontal and backbone sub-systems.

- .4 To avoid network problems caused by impedance balance, and attenuation differences, all passive equipment being installed in the horizontal network shall be of the same type and from the same manufacturer.

#### 1.6 **QUALIFICATIONS**

- .1 The Contractor shall be a Certified System Vendor experienced and trained by the manufacturing company, in all aspects of the placement, terminating, connecting and testing of products described herein and provide certificate of proof prior to start of work.
- .2 The Contractor shall have a minimum of one (1) RCDD "Registered Communications Distribution Designer" recognized by BICSI "Building Industry Consulting Services International" on staff at local offices (the term "Local offices" as applied to RCDD, Registered Communications Distribution Designers, refers to anywhere in the Province of Alberta) and provide certificate of proof prior to start of work.
- .3 Communications contractor shall supply and install a complete system for voice and data.
- .4 The Contractor shall be experienced in all aspects of this work and shall be required to demonstrate direct experience on recent systems of similar type and size. The Contractor shall demonstrate proven expertise in the implementation of network cabling. Expertise can be illustrated through the inclusion of details of at least three projects involving the design and installation of a Category 5e, Category 6, or Category 6A balanced twisted-pair cabling system within the past two-year period. Names and contact information for each of the three projects shall be included. The Contractor shall own and maintain tools and equipment necessary for successful installation and testing of proposed Category 6 distribution systems and have personnel who are adequately trained in the uses of such tools and equipment.
- .5 The communications installer shall be a Certified Communications Cabling Specialist and obtain all required permits.

#### 1.7 **WARANTY**

- .1 The warranty period with regard to the project is for 25 years from the date of Substantial Performance of the Work or those periods specified in the Contract Documents for certain portions of the Work of Products.
- .2 The Contractor shall be responsible for the proper performance of the work.
- .3 The Contractor shall correct promptly, at the Contractor's expense, defects or deficiencies in the Work which appear prior to and during the warranty periods specified in the Contract Documents.
- .4 The Owner, shall promptly give the Contractor notice in writing of observed defects and deficiencies that occur during the warranty period.

- .5 The Contractor shall correct or pay for damages resulting from corrections made under the requirements of paragraph 1.8.3.
- .6 The Contractor shall be responsible for obtaining Product warranties in excess of one year on behalf of the Owner from the manufacturer. These product warranties shall be issued by the manufacturer to the benefit of the Owner.
- .7 The Contractor shall provide a twenty-five (25) year Extended Product Warranty and Lifetime Application Assurance Warranty for the Communications Network. This warranty shall be backed up by the manufacturer and taken over by the manufacturer or his representative if the Contractor fails to follow through with the requirements of the warranty.
- .8 The Communications Network is defined as all required passive equipment and cabling, including hardware, terminations, and jacks, configured to provide data and voice connectivity from each data or voice outlet provided by the Contractor in this Contract.
- .9 The System Assurance shall cover the applications that the installed system is designed to support for a twenty-five (25) year period.
- .10 The copper system shall be constructed to conform to ANSI/TIA-568-B.2-10-2008 – Transmission Performance Specifications for 4-pair 100  $\Omega$  Category 6 Cabling Commercial Building Telecommunications Cabling Standards.
- .11 The Extended Product Warranty and the Systems Assurance together comprise the Structured Cabling System Quality Assurance Program.
- .12 Upon successful completion of the Structured Cabling System installation and subsequent testing by certified technical personnel the Contractor shall provide to the Owner a numbered certificate registering the installation.

## 2 Products

### 2.1 MANUFACTURERS

- .1 Horizontal Distribution Cables (UTP)
  - .1 Copper telecom cables shall be Category 6.
  - .2 Horizontal cables to comply with ANSI/EIA/TIA specifications for Category 6 cables except where indicated otherwise on the Contract Drawings.
  - .3 Exposed cable in air space between underside of ceiling and underside of overhead slab to be FT6 Plenum rating (CMP).
  - .4 Cable routed through the air space between underside of ceiling and underside of overhead slab and fully contained in metallic conduit or electrical metallic tubing to be FT4 rated (CMG).

### 2.2 STANDARD OF ACCEPTANCE

- .1 Belden IBDN Certified Structured Cabling System or equivalent is specified as Standard of Acceptance.



- .2 The Belden standard referenced is referenced to establish a minimum standard of acceptance. Any equivalent system can be installed and is acceptable without pre-approved authorization.

3 Execution

3.1 **GENERAL**

- .1 All cables and cable pathways to run parallel or perpendicular to building lines.
- .2 The following minimum clearances from electrical and heat sources are to be maintained when routing cables. If clearances cannot be maintained, then contact the departmental representative for clearance requirements.
- |     |   |        |
|-----|---|--------|
| .1  | Unit substations                        | 3 m    |
| .2  | Power transformers (greater than 30KVA) | 3 m    |
| .3  | Transformers                            | 1.2 m  |
| .4  | Motors                                  | 1.2 m  |
| .5  | Switch gear (greater than 600V)         | 3 m    |
| .6  | Feeder cables (600V and above)          | 1 m    |
| .7  | Distribution cables (less than 600V)    | 750 mm |
| .8  | Conduit (Enclosing 30A branch circuits) | 300 mm |
| .9  | Conduit (Enclosing 20A branch circuits) | 75 mm  |
| .10 | Conduit (Enclosing 15A branch circuits) | 65 mm  |
| .11 | Fluorescent luminaires                  | 120 mm |
| .12 | Pipes (gas, oil, water, etc.)           | 300 mm |
| .13 | HVAC (equipment, ducts, etc.)           | 150 mm |
- .3 Any deviation from cable routing shown on drawings to be approved by Departmental Representative and documented on as-built drawings.
- .4 Avoid scraping, denting, crushing, twisting, kinking or otherwise damaging cables, before, during or after installation. Damaged cables to be replaced by the Contractor without additional compensation.
- .5 Patch-panels and cable management panels to be mounted with clearance between equipment enclosure doors and patch cables.
- .6 Proposed installation drawings to be submitted to the Engineer or Departmental Representative prior to installation.

3.2 **CABLING - GENERAL**

- .1 Pull all UTP cables in a continuous run. Cable splices will not be permitted.

- .2 Install all cables in accordance with manufacturer's specifications ensuring that proper installation techniques are observed and that the cable maximum pull-force and minimum bend radius specifications are adhered to.
- .3 Utilize all indicated and available cable pathways such as slots, sleeves, conduits, cable trays, ducts, raceways and furniture system channels except where otherwise noted to route cable vertically and horizontally through the building. Exercise caution when pulling cables in such pathways to avoid damage to any existing cables and follow manufacturer's maximum pull-force and minimum bend radii.
- .4 Where cables are exposed to risk of being damaged by sharp edges of furniture, cable tray, raceway etc. protect cables by feeding them through a length of flexible plastic conduit.
- .5 Where cables exit the cable tray and are exposed to sharp bends, reduce the bending stress by covering the cable tray with protective flexible plastic conduit.
- .6 Neatly bundle, secure and tie-wrap all cables. Ensure cable ties do not deform the cable jacket.
- .7 Where cables are terminated on a patch panel, bundle and dress cables in groups of 12 or 24, each group consisting of cables from a single 12 or 24 port patch panel.
- .8 Where cables are terminated on a cross-connect field, bundle and dress cables in groups of 12 or 24, each group consisting of cables from a single cross-connect panel.
- .9 Where voice and data cables are separately identified on the Contract Drawings, separate voice and data cable into distinct bundles.
- .10 Do not maintain bundles for distances greater than 1m in cable trays.
- .11 For cables being terminated on a backboard mounted cross-connect field, pass all cables behind backboard in bundles and pass them through holes positioned in the center of the termination mount.
- .12 When bundling Category 6 cable bundles, comply with manufacturer's recommended bundling practices for Category 6 installations. Ensure that no cable bundling puts excess pressure on the cable at any point which may result in compression or deformation of the cable jacket and internal pair/conductor geometry.
- .13 Follow proper installation and termination practices for Category 6 UTP cabling. Do not kink or exceed manufacturer's restrictions on the UTP cable minimum bend radius.
- .14 For UTP cables, maintain a minimum bending radius of 4 times cable diameter or 25 mm whichever is the greater.

- .15 When terminating UTP cables to IDC blocks or outlet connections, observe the manufacturer's recommendations on stripping back insulation and the extent that pairs may be untwisted. Do not untwisted pairs for more than 13 mm.
- .16 When terminating UTP cables follow manufacturer's installation instructions. Unless directed by the manufacturer's instructions otherwise, remove cable jacket only enough to perform termination and untwist pairs no more than 13 mm for Category 6 cable.
- .17 Secure UTP distribution cables at rear of patch panels. Ensure cable approach to the patch panel is normal to the panel and stress is not transmitted to the termination.
- .18 Ground all metallic strength members integral to cables and components to manufacturer's specifications and standard practices
- .19 Do not strap cables to, or lay cables on, any length of conduit, pipe, ventilation duct or other building element not expressly installed for the purpose of cable support.
- .20 When determining a cable routing pathway, give priority to air handling ducts, fire sprinkler pipes and electrical conduits.
- .21 Except for spare cables, terminate all pairs of UTP cable at both ends.
- .22 Terminate all pairs of spare UTP cable in telecommunication closet and store workstation end in ceiling space by coiling neatly and suspending. Do not rest cables on ceilings or air handling ducts.
- .23 Spare cables to be of sufficient length to permit reaching any point in the room to which they apply.

### 3.3 HORIZONTAL DISTRIBUTION

- .1 Where practicable and where the maximum allowable cable length is not exceeded, provide 3 m of slack UTP cable at the workstation end of each distribution cable to permit outlet relocation after installation. Neatly coil slack in ceiling space and store suspended.
- .2 Secure and support cables every 1.2 m when running in free space. Bundle and tie-wrap all suspended cables so that droop between supports is minimized.
- .3 Attach cable supports only to the building structure or to support wires installed expressly for cable suspension. Do not attach cable supports to ceiling support wires.
- .4 Where the telecommunications outlet is mounted on a wall box or floor box or system furniture, provide working slack allowance for UTP cable of 300 mm. Coil neatly and secure.
- .5 Where the telecommunications outlet is mounted on furniture, do not crimp or trap the cable between the outlet receptacle and furniture structure.

- .6 Select least obstructed pathway through modular or system furniture. Where available, use eye-level pathways in preference to base-level pathways.
- .7 Install blank filler plates for all unused modular jack positions on faceplates.
- .8 Install blank cover plates for all unused or abandoned outlet boxes.
- .9 Inform Departmental Representative immediately of any horizontal cable runs exceeding 90 m in length.

### 3.4 **INSTALLATION OF CABLES**

- .1 General
  - .1 Install communication cables in accordance with Manufacturer's recommendations and guidelines.
  - .2 Place all communication cables in conduits or cable tray as required, except within closets use conduits as available.
  - .3 Cable Labels:
    - .1 Electrovert Type "Z" cable markers sized to fit cables snugly.
    - .2 Self laminating, heat-shrink, one-piece, custom printed cable labels. Cable labels can be self laminating embossed type in lieu of heat shrink.
- .2 EMT type conduit "wall-stub" c/w flush installed device box shall be located in walls/partitions. Stubs shall be turned out into ceiling space. When installed stubs shall be run into accessible ceiling or an access hatch shall be provided in non-accessible ceilings.
- .3 Single and multi-gang type raised 4" square "tile" rings are also acceptable for use in new dry-wall type construction. Secure directly to face of metal studs. Multi-gang "tile" rings are to be adequately secured within partitions, on "both" left and right hand sides of same.
- .4 Where the "grouping" of various systems outlets or multi type outlets in dry-wall type construction is desirable, the use of "box mounting brackets" are to be installed between, and secured to, both metal studs. To install suitably sized 4" square and/or 4 11/16" boxes c/w raised tile rings as may be required.
- .5 Installation of Unshielded Twisted Pair (UTP) Cable
  - .1 Connect each outlet directly to a communications closets by a continuous UTP cable. There shall be no connector in the cable run between the communication outlet and the cable termination in the closet. Transition points between the communications closet and the communications outlet are disallowed.
  - .2 Horizontal cables shall be bundled in groups of no more than 50 cables. Cable bundle quantities in excess of 50 cables may cause deformation of the bottom cables within the bundles, which will degrade the performance of those cables

- .3 The maximum horizontal cable distance for data and voice circuits to be 90 m (295 ft.). This is the cable length from the mechanical termination of the UTP cable in the communications closet to the communications outlet. In establishing maximum distance, an allowance to be made for 3 additional meters (9.8 ft.) from the communications outlet to computer and 2 meters for patch cords at the closet.
- .4 The following applies to cables installed in return air plenums without the use of tray.
  - .1 Where air plenum is accessible, adjustable cable straps may be used. Routing shall follow building grid lines.
  - .2 Where air plenum is not accessible, conduit raceway shall be provided to span inaccessible ceiling space.
  - .3 Cables crossing power cables or fluorescent light fixtures (outside conduit) must do so at right angles.
  - .4 Install coaxial cables and outlets in accordance with manufacturer's recommendations.
- .5 When installing UTP cable, follow the separation distances from EMI sources detailed in the table:

Source of Electro-Magnetic Interference (EMI)	Minimum Separation Distance from a source Carrying:	
	< 2 kVA	2 – 5 kVA
Unshielded power lines, electrical equipment near open/non-metal pathways.	12.7 cm 5 in.	30.5 cm 12 in.
Unshielded power lines, electrical equipment near grounded metal pathways.	6.4 cm 2.5 in.	15.2 cm. 6 in.
Power lines enclosed in grounded conduit.	5.0 cm 2.0 in.	7.6 cm. 3 in.
Transformers and electric motors.	1.02 m 40 in.	
Fluorescent lights.	30.5 cm 12 in.	

- .6 When terminating cables, the length of cable twist (twist/cm) shall be identical to that of the remainder of the cable. This twist shall be maintained up to 10 mm from the termination point of the cable at the patch panel and the receptacle.
- .7 UTP Cable Terminations
  - .1 Terminate UTP cables at the work area outlet with an RJ 45 female connector.
  - .2 The cable colour code/jack pin assignments shall match (TIA jack-pin pair assignment) T568A.

- .3 Terminate data cables directly to RJ-45 patch panels on equipment racks at the communications closet end and, connected to data hubs via patch chords.
- .4 Maximum untwisted length of conductors shall not exceed 12mm (0.5 inch).
- .8 Identify each cable with a permanent indelible identification band which indicates the room and outlet number to which the cable is connected. Both ends of each cable must have identical identifier bands.
- .9 Identify each communication outlet with a permanent indelible label using standard numbering scheme.
- .10 Identify each patch panel position with the room and outlet number to which the cable is connected.

### 3.5 ACCEPTABLE TESTING AND CERTIFICATION

- .1 Category 6 performance tests shall be in accordance with ANSI/TIA-568-B.2-10-2008 and must be performed with the wall plates in place.
- .2 Category 6 system testing.
- .3 At a minimum, the balanced twisted-pair cabling system will exceed the key performance parameters for Category 6 found in ANSI/TIA-568-B.2-10-2008 – Transmission Performance Specifications for 4-pair 100  $\Omega$  Category 6 Cabling over the specified frequency ranges.
  - .1 Note: The Margin is the additional headroom (in dB or %) compared to the minimum specified value for Category 6 at each frequency point over the specified frequency range. The Worst Case Margin is determined at the frequency where the measured data point is closest to the limit line. The Category 6 limit line equations are used to determine the Worst Case Margin over the frequency range from 500 MHz to 625 MHz.
    - .1 NEXT = Near-end crosstalk
    - .2 PSACRF = Power-sum attenuation-to-crosstalk ratio far-end
    - .3 PSAACRF = Power-sum alien attenuation-to-crosstalk ratio far-end
    - .4 PSANEXT = Power-sum alien near-end crosstalk
    - .5 PSNEXT = Power-sum near-end crosstalk
  - .2 NOTE: The values listed above are characterized as “Margin” or “Guaranteed Headroom” beyond the performance specified in standards, and serve as additional assurance of the cabling system’s performance after installation and over its operational lifespan.
  - .3 (\*) Value proposed or statement represent guaranteed margin against ANSI/TIA-568-B.2-10-2008 – Transmission Performance Specifications for 4-pair 100  $\Omega$  Category 6 Cabling extrapolated to 625MHz.
- .4 Certification

- .1 Certify that all cabling and hardware meets the performance criteria in this specification and is free from any electrical or mechanical defects as a result of the installation and termination practices for a period of twenty-five (25) years from the time of acceptance by the Departmental Representative.
- .2 Provide two (2) copies of all installation documentation and reports. The minimum documentation set shall include:
  - .3 As-built drawings in paper format, fully documenting the cabling infrastructure. Copies of the approved drawings in AutoCAD "DWG" format shall be provided by the Departmental Representative to form a basis for as-built drawings.
  - .4 Records of all test procedures and test results in a report format and detailed test results including graphical data in an electronic format.
- .5 Upon completion of the Work, the Departmental Representative shall carry out an onsite final inspection.
- .6 As a minimum, the following points will be examined:
  - .1 Is the design documentation complete? Are all cables properly labelled, from end-to-end?
  - .2 Have all terminated cables been properly tested in accordance with the specifications for the specific category as well as tested for opens, shorts, polarity reversals, transposition and presence of AC and /or DC voltage?
  - .3 Is the cable type suitable for its pathway? Are the cables bundled in parallel?
  - .4 Have the pathways manufacturer's guidelines been followed? Are all cable penetrations installed properly and fire stopped according to code?
  - .5 Have the Contractors avoided excessive cable bending?
  - .6 Have potential EMI and RFI sources been considered?
  - .7 Are conduit cable fills correct?
  - .8 Are hanging supports within 1.5 meters (5 feet)?
  - .9 Does hanging cable exhibit some sag?
  - .10 Are telecommunications closet terminations compatible with applications equipment?
  - .11 Have patch panel instructions been followed?
    - .1 Jacket removal point.
    - .2 Termination positions.
    - .3 All pair terminations tight with minimal pair distortions.
    - .4 Twists maintained up to Index Strip.
  - .12 Have modular panel instructions been followed?

- .1 Cable dressing first.
- .2 Jackets remain up to the Connecting Block.
- .3 All pair terminations tight and undistorted.
- .4 Twists maintained up to the Connecting Block.
- .13 Are the correct outlet connectors used?
- .14 Is the jacket maintained right up to the jack?
- .15 Are all pairs tightly twisted and straight across in the Panel?
- .16 Are identification markings uniform, permanent and readable?

**End of Section**