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1. INTRODUCTION

The intent of this document is to establish the general specifications for a premises structured cabling system, which will meet the voice and data communication needs of PALM BEACH STATE COLLEGE (PBSC). Low voltage and fiber optic cabling needs for PBSC’s Multimedia Department are detailed in the “PBSC Multimedia Cabling Guideline.” You may obtain information on obtaining a current version of this document from the Campus Director of Media Services. Any new construction or building renovation should include two separate low voltage cabling Scopes of Work: one detailing the low voltage wiring requirements of the Network and Telecommunication Departments needs and a separate scope detailing the requirements for the A/V Multimedia Department. This Structured Cable Guide details generalities of the requirements of the Network and Telecommunication Departments within PBSC Information Technology.

This document specifies guidelines that the contractor is required to meet when performing work for Palm Beach State College. A project specific scope of work must always accompany this document detailing the specific needs of a particular project. If the project scope is in conflict with any portion of this document in materials or procedures, the project scope will override this document.

The System offered and quoted, shall incorporate all features and facilities listed in this specification. As standards change, the latest edition of standards specified in this document shall prevail if not otherwise noted.

Specific questions may be addressed to Michael Merker at merkerm@palmbeachstate.edu or 561-868-3252.

2. CONTRACTUAL RELATIONSHIP

- Nothing contained herein creates any contractual relationship between PALM BEACH COLLEGE and the contractor, subcontractor, or supplier. However, bidding statements contained in the response of the successful bidder will become part of the contract for equipment and services.
- If, after award of the contract, the contractor becomes aware of possible problems which could result in delay in completion of the system on schedule, the contractor must immediately notify the PALM BEACH STATE COLLEGE (failure to promptly notify will be basis for determining contractor negligence in an otherwise excusable delay).
- Contractor is expected to comply with PALM BEACH STATE COLLEGE’s terms and conditions and should consider these terms and conditions as part of the contract.
- Contractors shall be licensed and comply with the requirements of the Florida Building Code. Permitting and inspections shall be required for all work covered under the FBC, which includes the NEC. Permits may be obtained at the PBSC Building Dept. located in Facilities planning. Telephone # 561-868-3486 – Chief Building Official.
3. FINANCIAL REQUIREMENTS

Additional work of reasonable scale shall be priced consistent with proposal to allow for additions and future expansions. The contractor must submit a “Change Order” for approval by an authorized representative of PALM BEACH STATE COLLEGE.

4. RESPONSIBILITIES

Customer Responsibilities:

PALM BEACH STATE COLLEGE is responsible for the following:

- Allowing the contractor’s employees free access to the premises and facilities at all reasonable hours during the installation.
- Furnishing adequate detailed drawings of the building to allow installation of equipment and cables by the contractor.
- Providing free and clear access to existing conduit or the placement of new conduit if necessary to all work locations, floor, buildings, etc., to support the media installation and providing contractor access to these adjacent areas where and when required.
- Providing access to 120 volt, 20 AMP, 60 Hz commercial power necessary for the installation or comparable 240 volt power.
- Making inspections when notified by the contractor that the equipment or any part thereof is ready for acceptance.
- Participation in a joint communications plan.

Contractor Responsibilities:

- Providing all supervision, labor, tools, equipment, materials, transportation, erection, construction, unloading, inspection and inventory housing. Must also return spare material as specified.
- Furnishing and installing materials for a complete structured cabling system unless specific provisioning or installation of materials is denoted in this RFP.
- Obtaining PALM BEACH STATE COLLEGE’s permission before proceeding with any work necessitating cutting into or through any part of the building structure such as girders, beams, concrete, tile floors or partition ceilings.
- Promptly repairing all damage to the building due to carelessness of contractor employees and exercising reasonable care to avoid any damage to the building. Reporting to PALM BEACH STATE COLLEGE any damage to the building that may exist or may occur during the contractor’s occupancy of the building.
• Taking necessary steps to ensure that required fire fighting apparatus is accessible at all times. Flammable materials shall be kept in suitable places outside the building.

• Installing the wire, cable and hardware in accordance with the specifications outlined herein.

• Identify and label any existing connections before disconnecting any fiber or copper connections. Unless instructed otherwise, the contractor is required to return all connections to their original location.

• Conducting tests and inspections as specified post-installation.

• Promptly notifying PALM BEACH STATE COLLEGE at least one week prior to completion of work on equipment wherein such portions are ready for inspection.

• Promptly correcting all defects for which contractor is responsible as determined by PALM BEACH STATE COLLEGE.

• Coordinating all work with PALM BEACH STATE COLLEGE’s representative that may be designated at a future date before the commencement of the installation.

• Maintaining insurance and appropriate warranty bonds on the proposed distribution system until such time as it is accepted by PALM BEACH STATE COLLEGE.

• Removing all tools, equipment, rubbish and debris from the premises and leaving the premises clean and neat upon completion of the work.

• Abiding by the safety and security rules in force on the work site per local and governmental regulation.

• Following industry standard installation practices and as defined in Section 8.

• Providing all test results and as-built drawings in Visio compatible form at the time of project completion, both in hard copy and soft copy to Michael Merker at PBSC.

5. SYSTEM REQUIREMENTS

The system shall:

Support analog and digital voice applications, data, local area networks (LAN), video and low voltage devices for building controls and management on a common cabling platform. The applications that shall be supported include, but are not limited to:
**Data Processing** - UNISYS, Gandalf, Data Communications - EIA-232-D, EIA-422A, EIA-43-A, RS-485,10, 100, 1,000 and 10,000 Mbps Ethernet, StarLAN, Fiber Distributed Data Interface (FDDI), 155 Mbps Asynchronous Transfer Mode (ATM).

**Voice Applications** - AT&T, Siemens, Nortel, ISDN, Avaya

**Video** - Analog Video, Digital Video, Video Conferencing.


The system shall:

Cover its capacity and functionality with minimum components, be flexible and capable of including new facilities or technologies as they become required or available.

In order to get a complete overview of the installation and develop a total list of materials for any renovation or new construction, the following shall be addressed:

A) Needs assessment to determine the systems and networks to be supported.

B) Existing topologies or new topologies requiring design work.

C) Material and equipment layouts.

D) Support of different types of building architectures and environments.

E) The number of data, voice, video and security locations. This includes any mission critical or special data applications.

F) Complete site surveys, walk-throughs, and in-depth building blueprints as are made available.

As new technologies evolve, the need for a balanced and redundant cabling infrastructure to handle these high data rates will become more crucial. All major structured cabling installations for PALM BEACH STATE COLLEGE must be certified to the requirements of the cable and connecting hardware manufacturers and specifications contained herein.

6. THE STRUCTURED CABLELING SYSTEM

The Structured Cabling System (SCS) shall consist of any or all of the following six subsystems in accordance with ANSI/TIA/EIA and BICSI guidelines and shall consist of cable and connecting hardware to meet Anixter’s Level 6XP
Specification. For direct assistance in interpreting telecommunications standards, the services of a Registered Communications Distribution Designer (RCDD) certified by the Building Industry Consulting Service International (BICSI) is recommended:

The six subsystems of a Structured Cabling System are the Building Entrance/Entrance Facilities (EF), the Equipment Room (ER), the Backbone Cabling, the Telecommunications Room (TR), the Horizontal Cabling, and the Work Area (WA)

6.1 Building Entrance/Entrance Facilities (EF)

The entrance facility consists of the telecommunications service entrance to the building, including the entrance point through the building wall, and continuing to the entrance room or space. The entrance facility may contain the backbone pathways that link other buildings in campus situations. Antenna entrances may also constitute part of the entrance facility.

All carriers and telecommunications providers involved in providing service to the building shall be contacted to establish their requirements and explore alternatives for delivering service. The location of other utilities, such as electrical, water, gas and sewer shall be considered in the site selection of the telecommunication entrance facility.

A service entrance pathway shall be provided. The basic methods for provisioning are underground, buried, and aerial pathways.

In determining the total number of pathways required the planner shall consider the following:

- Type and use of building
- Growth
- Difficulty of adding pathways in the future
- Alternate entrance
- Type and size of cables likely to be installed

The entrance room or space is the component of the entrance facility that provides space for the termination of the entrance backbone cable. In accordance with NEC Article 800 Section 800-50 exception No.3 the entrance or outside building cable shall be terminated and protected on a listed primary protector within 50 ft. of entering the building. Where telecommunications equipment (e.g. PBX) is located in the entrance room or space, the entire room or space shall meet the requirements for an equipment room as specified in Section 8 of TIA/EIA-569-A. If the network interface devices and telecommunication equipment are required in the entrance room, additional space will be needed.
The decision whether a room or open area is provided shall be based on security, quantity, type of termination and equipment, size of building and physical location within the building. For buildings exceeding (20,000 sq. ft.) usable floor space, an enclosed room should be provided.

All Buildings shall have a minimum of one enclosed room per floor, to be used exclusively as a distribution point for voice, data and video.

Free standing frames must be used for all cable terminations unless otherwise specified. Tables 8.3-1 and 8.3-2 of TIA/EIA-569-A specify the space for all telecommunications equipment and associated cross-connections based on an 8 ft. wall or on free standing racks.

Listed below are some additional provisions:

- A minimum of two walls should be covered with rigidly fixed (3/4 trade size) A-C plywood preferably void free, 8 ft. high, capable of supporting attached equipment. Plywood should be either fire rated or covered with two coats of fire retardant paint.

- Lighting shall be a minimum of 50 foot candles measured 3 ft. above the finished floor.

- False ceiling shall not be provided.

- The access door shall be a minimum of 36 in. wide and 80 in. high and shall be fitted with a lock.

- Floors, walls and ceiling shall be treated to eliminate dust. Finishes shall be light in color to enhance room lighting.

- Electrical: A minimum of two dedicated 20A, 110V AC duplex electrical outlets, each on separate circuits, shall be provided for equipment power. Consideration should be given to identifying those outlets dedicated to telecommunications equipment. In addition, convenience duplex outlets shall be placed at 6 ft. intervals around the parameter walls, at a height of 6 in. above the floor. If emergency power is available, consideration shall be given to automatic power backup.

- If an emergency power source is available in the building, it is desirable that at least one of the duplex outlets be so supplied.

- Access shall be made available to the independent telecommunications grounding system specified by ANSI/TIA/EIA 607.
• TIA/EIA-569-A contains fire-stopping, sprinkler requirements, miscellaneous pathways, telecommunications recommendations of separation from less than 480V power lines. Further information of entrance rooms can be found in TIA/EIA-569-A and the BICSI Telecommunications Distribution Methods Manuals.

6.2 Equipment Room (ER)

The equipment room is a centralized space for telecommunications equipment (e.g., PBX, computing equipment, video switch) that serves occupants of the building. The room shall house only equipment directly related to the telecommunications systems and its environment support systems.

When selecting the equipment room site, avoid locations that are restricted by building components that limit expansion such as elevators, core, outside walls or other fixed building walls. Special attention for distance separation shall be given to electrical power supply transformers, motors and generators, x-ray equipment, radio, or radar transmitters, and induction sealing devices. It is desirable to locate the equipment room close to the main backbone pathway.

When designing the equipment room floor space, allowance should be made for non-uniform occupancy throughout the building. The practice is to provide 0.75 sq. ft. of equipment room space for every 100 sq. ft. of work area space. The equipment room shall be designed to a minimum of 150 sq. ft.

In special-use buildings, equipment room floor space shall be based on the known number of work stations (not on usable floor area) this can be found in TIA/EIA-569-A table 8.2-1.

Installation of environmental control equipment, such as power distribution or conditioner, and UPS up to 100 kVA shall be permitted in the equipment room. Equipment not related to the support of the equipment room (e.g., piping, ductwork, pneumatic tubing, etc.) shall not be installed or pass through the equipment room. The equipment room shall be connected to the backbone pathway. Additional provision can be found in TIA/EIA-569-A and the BICSI Telecommunications Distribution Design Manual.

Access shall be made available to the main telecommunications grounding system specified by ANSI/TIA/EIA-607.

Racks
In all Equipment Rooms and Telecommunication Rooms, the preferred mounting hardware for all equipment will be black Chatsworth 7’ X 19” (Part #55053-703) open relay racks. The racks shall, in all instances, be attached to the floor with an anchor kit and braced with an overhead 12” X 10’ grey ladder rack. The ladder rack shall be properly attached to the rack with plate and j-hook kit, as well as braced to the adjacent wall. It is recommended that racks be placed three feet from the wall behind them and three feet from a side wall.
If more than one rack is to be installed in a Equipment / Telecommunication Room every effort shall be made to install the racks in a line, side to side, with appropriate cable management between them (detailed below). If three or more racks are installed in a room, the contractor shall, in most cases, install fiber enclosures and patch panels in the first, third, fifth (etc.) rack. Every second, forth, sixth (etc.) rack should remain empty for the installation of PBSC’s electronic equipment. One extra, empty 48-port patch panel will be installed in each rack for future expansion.

**Cable Management**

Two Chatsworth model 30094-703 4.4” wide (7’high) double-sided black vertical cable managers will be installed to each 7’ rack that is installed by contractor. In the event that two or more racks are installed side by side, 6” wide double sided vertical cable management(30095-703) unit shall be used between all racks. The 4.4 inch model vertical cable manager may only be installed on rack ends and will not be acceptable between two racks.

Between each and every 48 port patch panel installed by a contractor, a Chatsworth model 30330-719 horizontal cable manager shall be installed. No spacing between 48 port patch panels and horizontal cable management shall exist.

**Fiber Termination**

Fiber shall be terminated into Panduit FRME2 rack-mount enclosures. No more than thirty six fiber should be terminated into any fiber enclosures. Fiber termination enclosures shall be mounted near the top of the rack above any patch panels. It is preferred that the fiber enclosures be mounted approximately 7 feet high. No gaps or spacing is required between Panduit fiber enclosures. If separate fiber enclosures for single mode and multi mode fiber optic cabling are specified, single mode fiber enclosures shall be installed above multi mode enclosures. Single mode fiber shall terminate to SC simplex connectors, Panduit model FAP6WBUSCZ. Multimode fiber shall be terminated to SC duplex connectors, Panduit model FAP3WEIDSC.

All backbone and horizontal cabling shall have an additional 3 meter coil above each stub-up or coiled under any raised floor.

**Power Distribution**

The contractor is required to provide and install one rack mount surge protection and power distribution unit (PDU) to the base of every installed rack. These PDUs shall have a minimum of 8 AC outlets and a 10 foot power cord. The following products are acceptable: Tripp Lite model IBAR 12, APC model NET9RM, ITW LINX model GRM0600-80.

6.3 Backbone Cabling
The function of the backbone cabling is to provide interconnections between telecommunications closets, equipment rooms, and entrance facilities in the telecommunications cabling system structure (Diagram 1). In accordance with TIA/EIA-568-B.1 the backbone cabling consists of the backbone cables, intermediate and main cross-connects, mechanical termination, and patch cords or jumpers used for backbone to backbone cross-connection. Backbone cabling also includes cabling between buildings. During each planning period, growth and changes in service requirements should be accommodated without installation of additional cabling. The length of the planning period should be based upon the stability and growth of the user’s organization. For each telecommunications room, equipment room and entrance facility, the maximum number of connections over the planning period should be estimated. Sufficient backbone cabling for both copper and fiber media should then be installed to accommodate the maximum number of connections either directly or using auxiliary electronic devices.

ANSI/TIA/EIA-569-A specifies separation of the backbone cabling pathways from sources of EMI by referencing the NFPA/NEC. Grounding of all metallic shields shall also be made to the main telecommunication ground.

The backbone cabling shall use the conventional hierarchical star topology as illustrated by Diagram 2 wherein each horizontal cross connect in a telecommunications room is cabled to a main cross-connect or an intermediate cross-connect then to a main cross-connect. The exception to this is when bus or ring configurations are anticipated, cabling directly between telecommunications rooms is allowed. Such cabling is in addition to the connections for the basic star topology. Consult TIA/EIA-569-A for pathway and floor penetration and conduit stub heights for all topologies.

There shall be no more than two hierarchical levels of cross-connects in the backbone cabling. From the horizontal cross-connect, no more than one cross-connect shall be passed through to reach the main cross-connect. Therefore, interconnections between any two horizontal cross-connects shall pass through three or fewer cross-connects. Only a single cross-connect shall be passed through to reach the main cross-connect.

A single backbone cabling cross-connect (the main cross-connect) may meet cross-connect needs. Backbone cabling cross-connects may be located in telecommunications closets, equipment room, or at entrance facilities. Bridged taps shall not be used as part of the backbone cabling.

**All backbone fiber counts will be specified in the scope of work.** Multimode 50/125 micron fiber shall be used whenever multimode fiber is specified. Unless otherwise indicated, hybrid cable is not to be utilized. If combined fiber counts do not exceed 36 strands, one fiber termination enclosure may be used for both single and multi mode fiber optic cables. Single mode fiber shall always terminate to SC simplex connectors. Multimode fiber shall be terminated to SC duplex connectors. **PBSC must approve any deviation from this standard.** Additional fiber counts indicated in any scopes prepared for PBSC’s Multimedia Department’s use is not to be terminated within any existing fiber termination cabinet.
For voice applications, Jell filled 100 pair voice grade cable terminated on Circa model 1880ECA1-100G lightning protection shall be used. Only 110 style protectors shall be used. Voice riser cable shall be terminated on Systimax, Commscope, Ortronics, Siemon, Panduit or equivalent 100 pair 110 blocks using C5 clips with printed labels showing pair counts in increments of five (i.e. 5 10 15 20…) under a clear cover. Riser cable will also be terminated to 48 port patch panels. Voice cable patch panels shall be mounted above any patch panels that terminate in work areas.

All backbone cabling shall include a minimum 3 meter coil above the stub-up.

IF any PBSC conduit is used for new backbone cabling, the contractor shall install the maximum innerduct allowable into the conduit even if only one inner duct will be used. Pull strings shall be installed into any conduits or innerducts used or installed.
Diagram 1

Typical Telecommunication Cabling System

NOTES:
1. This figure is not meant as an all-inclusive representation of the telecommunications cabling system but only as a typical example.
2. All cross-connects located in TRs in this figure are horizontal cross-connects (HCs).

Typical Telecommunications Cabling System
Diagram 2
Backbone Hierarchical Star Topology

**LEGEND**

- **CROSS-CONNECT**
- **ER** EQUIPMENT ROOM
- **HC** HORIZONTAL CROSS-CONNECT
- **IC** INTERMEDIATE CROSS-CONNECT
- **MC** MAIN CROSS-CONNECT
- **TR** TELECOMMUNICATIONS ROOM
- ▲ TELECOMMUNICATIONS OUTLET / CONNECTOR
- **WA** WORK AREA

Backbone Hierarchical Star Topology
Recognized Backbone Cables in accordance with ANSI/TIA/EIA 568-B.2 are noted below.

These specified transmission media types shall be used individually or in combination in the backbone cabling.

- 100 Ohm UTP/ScTP cable
- 62.5/125 µm multi-mode optical fiber
- 8.3/125 µm Single-mode optical fiber

All intra-building, (within the building) backbone cables shall meet the appropriate NEC flame and smoke specifications. These include NEC Article 800 for copper cables and Article 770 for fiber optics. All cables shall meet or exceed the electrical specifications of ANSI/TIA/EIA 568-B.2. In addition all 100 Ohm UTP/ScTP (screened 100 Ohm twisted pair) shall meet the requirements of Anixter Levels Specification LPS(A)-Rev 18.02. All cables should be manufactured by an ISO 9000 series manufacturer.

**Optical Fiber Backbone Cable Specifications:**

- **Maximum Fiber Loss (indoor multimode):**
  - 3.5 dB/km at 850nm
  - 1.5 dB/km at 1300nm

- **Minimum Bandwidth:**
  - 160 MHz/km at 850 nm
  - 500 MHz/km at 1300 nm

- **Transmission Parameters (outdoor single-mode):**
  - Attenuation: .5 dB/km at 1310 nm
  - .5 dB/km at 1550 nm

- **Operating Temperature Range:** -40 degrees F to 158 degrees F

All fiber optic cable installed for PALM BEACH STATE COLLEGE shall conform to the warranty requirements of specified fiber manufacturer.

The type of termination used for all fiber optic cabling shall be SC and shall conform to requirements of specified fiber manufacturer, Corning Cable Systems.

Backbone Distances in accordance with TIA/EIA 568-B.1 are as follows:

- UTP: Voice Applications (<5MHz): 2,624 ft.
  UTP: Data Applications (>5MHz): 295 ft.
- Multimode Fiber Data Applications: 6,560 ft.
• Single-mode Fiber Applications: 9,840 ft.

While it is recognized that the capabilities of single-mode fiber may allow for backbone link distances of up to 37 miles, this distance is generally considered to extend outside the scope of TIA/EIA 568-B.

When the Horizontal Cross-Connect (HC) to Intermediate Cross-Connect (IC) is less than maximum, the IC to Main Cross-Connect (MC) distance for optical fiber can be increased accordingly. But, the total distance from HC to IC shall not exceed the maximum 6,560 ft. for multimode fiber or 9,840 ft. for single mode. Then the HC to IC distance is less than maximum, the IC to MC distance for UTP cabling can be increased accordingly but the total distance from the HC to the MC shall not exceed the maximum of 2,624 ft.

6.4 Telecommunications Room (TR)

Telecommunications Rooms (TR) provide many different functions for the cabling systems and are often treated as a distinct sub-system within the hierarchical cabling system.

The primary function of a telecommunication room is for termination of the horizontal cable distribution. Horizontal cables of all recognized types are terminated in the telecommunications room on compatible connecting hardware. Similarly, recognized types of backbone cable are also terminated in the TR on compatible connecting hardware. The cross-connection of horizontal and backbone cable using jumper or patch cords allows flexible connectivity when extending various services to telecommunications outlet/connectors. Connecting hardware, jumpers, and patch cords used for this purpose are collectively referred to as “horizontal cross-connect”. The TR may also contain the IC or the MC connections for different portions of the backbone cabling system. Sometimes backbone to backbone cross-connections in the TR are used to tie different TR’s together in a ring, bus, or tree configuration.

Equipment cables that consolidate several ports on a single connector shall be terminated on dedicated connecting hardware. Equipment cables that extend a single port appearance may either be permanently connected or interconnected directly to horizontal or backbone termination. Direct interconnections reduce the number of connections required to configure a link but may reduce flexibility. See Diagram 3.

For telecommunication closet dimensions and requirements, refer to TIA/EIA-569-A, Section 7 and TIA/EIA 607.

Racks
In all Equipment Rooms and Telecommunication Rooms, the preferred mounting hardware for all equipment will be black Chatsworth 7” X 19” (Part #55053-703) open relay racks. The racks shall, in all instances, be attached to the floor with an anchor kit and braced with an overhead 12” X 10’ grey ladder rack. The ladder rack shall be properly attached to the rack with plate and j-hook kit, as well as braced to the adjacent wall. It is recommended that racks be placed three feet from the wall behind them and three feet from a side wall.
If more than one rack is to be installed in a Equipment / Telecommunication Room every effort shall be made to install the racks in a line, side to side, with appropriate cable management between them (detailed below). If three or more racks are installed in a room, the contractor shall, in most cases, install fiber enclosures and patch panels in the first, third, fifth (etc.) rack. Every second, forth, sixth (etc.) rack should remain empty for the installation of PBSC’s electronic equipment. One extra, empty 48-port patch panel will be installed in each rack for future expansion.

**Cable Management**

Two Chatsworth model 30094-703 4.4” wide (7’ high) double-sided black vertical cable managers will be installed to each 7’ rack that is installed by contractor. In the event that two or more racks are installed side by side, one Chatsworth 30095-703 (7’ high) 6” wide double sided vertical cable management unit shall be used between all racks. The 4.4 inch model vertical cable manager may only be installed on rack ends and will not be acceptable between two racks.

Between each and every 48 port patch panel installed by a contractor, a Chatsworth model 30330-719 horizontal cable manager shall be installed. No spacing between 48 port patch panels and horizontal cable management shall exist.

**Fiber Termination**

Fiber shall be terminated into Panduit FRME2 rack-mount enclosures. No more than thirty six fiber should be terminated into any fiber enclosures. Fiber termination enclosures shall be mounted near the top of the rack above any patch panels. It is preferred that the fiber enclosures be mounted approximately 7 feet high. No gaps or spacing is required between Panduit fiber enclosures. If separate fiber enclosures for single mode and multi mode fiber optic cabling are specified, single mode fiber enclosures shall be installed above multi mode enclosures. Single mode fiber shall terminate to SC simplex connectors, Panduit model FAP6WBUSCZ. Multimode fiber shall be terminated to SC duplex connectors, Panduit model FAP3WEIDSC.

All backbone and horizontal cabling shall have an additional 3 meter coil above each stub-up or coiled under any raised floor.

**Power Distribution**

The contractor is required to provide and install one rack mount surge protection and power distribution unit (PDU) to the base of every installed rack. These PDUs shall have a minimum of 8 AC outlets and a 10 foot power cord. The following products are acceptable: Tripp Lite model IBAR 12, APC model NET9RM, ITW LINX model GRM0600-80.

**Voice Backbone Cabling**

Voice riser cable shall be terminated on Siemons, Avaya, Panduit or equivalent 100 pair 110 blocks using C5 clips with printed labels showing pair counts in increments of five (i.e. 5 10 15 20…) under a clear cover. Riser cable will also be terminated to 48 port patch panels. Voice cable patch panels shall be mounted above any patch panels that terminate in work areas.
Diagram 3

VOICE CABLE CONNECTIONS
Diagram 4
Cross-connect/Inter-connect

NOTE - The horizontal cabling to Work Area 1 is interconnected to the common equipment.

NOTE - The horizontal cabling to Work Area 2 is cross-connected to the common equipment.

Illustration of Cross-Connection and Interconnection
6.5 Horizontal Cabling

Horizontal cabling is the cabling from the TR to the work area (WA) and includes the following:

- Horizontal Cabling
- Telecommunications outlet at WA
- Cable termination & Cross-Connects in the TR

**Recognized media types are:**

- Four pair 100 Ohm UTP/ScTP (24 AWG solid conductor) category 6 or higher.
- Two fiber, 50/125µm multimode optical fiber cable

PALM BEACH STATE COLLEGE requires cable to meet, at a minimum, requirements specified within this document.

All cables shall meet the appropriate NEC fire and smoke regulations; NEC Article 800 for copper and Article 770 for optical fiber. All copper cables shall be enrolled in an independent test laboratory category verification program. An ISO 9000 series manufacturer shall manufacture all cables.

Maximum horizontal cable length from the mechanical termination of the cable in the TR to the telecommunication WA outlet is 295 ft., independent of media type.

Only one transition point is allowed in the horizontal cable.

It is suggested that the maximum equipment cable length from the telecommunication outlet to the work area equipment be limited to 10 ft. In addition, it is suggested that the maximum cable length for jumpers and patch cords in the TR be limited to 20 ft. See Diagram 4 for distances.

All horizontal copper cable shall be blue in color unless otherwise indicated. All horizontal cabling will be terminated TIA/EIA T568-B pin outs. In situations when a contractor is installing additional drops to building that is already wired, the contractor shall utilized the pin out (T568-B or T568-A) that the building already has in service.
Diagram 5
Maximum Horizontal Distances

TIA/EIA-568-B.1

A

Equipment Cords

Patch Cords

7 Meter Total Typical

Horizontal Cabling

90 Meter Max.

B

Work Area Cords

2-3 Meter Typical

A+B=10 Meter Max.
There shall be a minimum of four cable drops per work area

- The first cable shall be 4 pair 100 Ohm Anixter Level 6XP.

- The second shall also be 4 pair 100 Ohm and meet the minimum performance requirements for Anixter Level 6XP. Other approved cables are:
  - 4 pair 100 Ohm, Anixter Level 6XP.
  - 2 fiber 62.5/125 um optical fiber
  - Cables will not be split behind the face-plate. If necessary an external splitter plug will be used.
  - Hybrid cables shall be allowed if they meet the required specifications.

In computer classrooms and labs, a minimum of two cable drops for each planned workstation shall be installed.

*It will be required by all PALM BEACH STATE COLLEGE installers that all horizontal cable supporting data applications must meet at a minimum the Anixter Level 6XP performance requirements.

All 100 Ohm UTP shall be wired to 8 position modular jacks using the T568B pin-out unless otherwise specified, consistent with PALM BEACH STATE COLLEGE’s existing facility standard. See Diagram 5.
6.6 Work Area (WA)

If requested, contractor must provide factory assembled patch cords rated in accordance to section 10 of this document. Other work area components extend from the telecommunication outlet/connector end of the horizontal cabling system to the station equipment, which is outside the scope of ANSI/TIA/EIA-568B. All adapters, baluns, etc. must be external to the telecommunication outlet.

A four port (quad) single-gang jack for voice/data connectivity shall be installed at all workstation locations unless specific deviation from this standard is indicated. All jacks shall be electrical ivory in color.
7. APPROVED UTP CABLE PERFORMANCE

Scope
This specification applies to solid 4-pair unshielded twisted-pair (UTP) communications cables and stranded patch cordage, NEC types CM, CMG, CMR, CMP, MP, MPG, MPR and MPP, and where applicable, CSA FT-4 and FT-6. Zero Halogen constructions are also included.

Normative References

Reference Documents
The latest edition of referenced standards (from the latest available draft in the case of proposed standards) shall be the controlling document. Where the standards appear to conflict with one another, the one with the most stringent requirements shall be applicable.
- ANSI/ICEA S-90-661
- CSA
- UL 444
- ANSI/TIA/EIA-568-B
- ISO/IEC 11801
- CENELEC EN50173: 1995
- NEC, NFPA70 2002
- NEMA WC-63/66

Applicable Testing Standards
Testing shall be in accordance with the following standards:
- ANSI/TIA/EIA-568-B-1, Propagation Delay and Delay Skew Specifications for 100 Ω 4-pair cable, 1997
- ANSI/TIA/EIA-568-B-2, Corrections and Additions to TIA/EIA-568-B, 1998
ANSI/TIA/EIA-568-B-2-1, Transmission Performance Specifications for 4-pair 100 Ω Category 6 Cabling, 2002

This document provides required test values at specific discrete frequencies. The tabulated values are intended for reference only. All Levels products are swept-tested through a prescribed frequency range. The Anixter Levels purchase specification requires 100% compliance throughout the specified range of frequencies tested. By convention, all values of electrical characteristics, while predominantly negative numbers (representing losses), are expressed as absolute values (positive numbers).

**General Requirements**

**Applicable Cables**
Levels of performance apply to 4 pair unshielded twisted pair cables manufactured by Belden. A shielded version, if allowed, shall comply with the performance requirements of the applicable Level.

**Minimum Performance Requirements**
All cables shall meet the minimum performance requirements of the latest applicable standards defined above.

**Minimum Levels Requirements**
The cable for each purchasing Level shall meet the performance requirements of all lower Levels.

**Virgin Materials**
Only Virgin materials shall be used in the construction of Levels cables

**Plenum Rated Cables**
Plenum-rated cables shall use 100% FEP for the insulation except where it is proven that the cable constructed with alternate materials meets or exceeds the electrical performance of FEP.

**Quality Assurance**
The manufacturer of Level cables specified herein, shall be ISO 9000 registered. Initial Qualification and Certification of the manufacturer is required. An ongoing program of random Palm Beach State College compliance testing of all Levels products must be maintained.

**Labeling of UTP Cable and Patch Cordage**
The following information will be repetitively printed every 12-24 inches on the cable jacket: Name, brand, gauge, pair count, NEC type (CSA in Canada), part number, other standards compliance rating, and footage marker.

**Packaging of UTP Cable**
Standard packaging is 1,000 feet, one continuous length on a reel, in a reel-less box or on a reel in a box. All cables shall be shipped on 42” x 48” pallets, and shall not be stacked higher than 48”. All pallets shall contain the same color cable with the same footage marked with the appropriate part number.
Level Six (6) Cable

Reference Documents.
In addition to the requirements listed above and below, - select - Level 6XP cables shall meet the requirements of:
ANSI/TIA/EIA-568-B-2-1 (Category 6)

Performance Requirements

Level 6XP Cable - Highest Test Frequency
350 MHz minimum (all parameters)

Level 6XP Cable - Input Impedance
Input impedance shall be measured per ASTM 4566-94, 43.2 Method 2, Option 2. Level 6XP input impedance shall be swept out to 350 MHz and meet the following:

<table>
<thead>
<tr>
<th>FREQUENCY (MHz)</th>
<th>UPPER INPUT IMPEDANCE LIMIT (Ohms)</th>
<th>LOWER INPUT IMPEDANCE LIMIT (Ohms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>122</td>
<td>82</td>
</tr>
<tr>
<td>10</td>
<td>111</td>
<td>90</td>
</tr>
<tr>
<td>20</td>
<td>111</td>
<td>90</td>
</tr>
<tr>
<td>250</td>
<td>132</td>
<td>76</td>
</tr>
</tbody>
</table>

The above limits describe the boundaries of an envelope within which the swept curve must fit.

Level 6XP Cable - Minimum Pair-to-Pair NEXT and ELFEXT
Pair-to-Pair Near End Crosstalk (NEXT) shall not be less than the minimum numbers shown in the following table. Pair-to-Pair Equal Level Far End Crosstalk (ELFEXT) shall not be less than the minimum numbers shown in the following table.

<table>
<thead>
<tr>
<th>FREQUENCY (MHz)</th>
<th>PAIR-TO-PAIR NEXT LOSS (dB)</th>
<th>PAIR-TO-PAIR ELFEXT LOSS (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>67.3</td>
<td>66.8</td>
</tr>
<tr>
<td>10</td>
<td>52.3</td>
<td>46.8</td>
</tr>
<tr>
<td>20</td>
<td>47.8</td>
<td>40.7</td>
</tr>
<tr>
<td>31.25</td>
<td>44.9</td>
<td>36.9</td>
</tr>
<tr>
<td>100</td>
<td>37.3</td>
<td>26.8</td>
</tr>
<tr>
<td>200</td>
<td>32.8</td>
<td>20.7</td>
</tr>
<tr>
<td>250</td>
<td>31.3</td>
<td>18.8</td>
</tr>
</tbody>
</table>

Level 6XP Cable - Minimum Power Sum NEXT and ELFEXT
Power Sum Near End Crosstalk (PSNEXT) shall not be less than the minimum numbers shown in the following table. Power Sum Equal Level Far End Crosstalk (PSELFEXT) shall not be less than the minimum numbers shown in the following table.
**Level 6XP Cable - Maximum Attenuation, Minimum Pair-to-Pair ACR and Power Sum ACR**

Attenuation shall not be greater than the maximum numbers shown in the following table when measured at an ambient temperature of 20°C (68°F). Pair-to-Pair Attenuation to Crosstalk Ratio (ACR) shall not be less than the minimum numbers shown in the following table. Power Sum Attenuation to Crosstalk Ratio shall not be less than the minimum numbers shown in the following table.

<table>
<thead>
<tr>
<th>FREQUENCY (MHz)</th>
<th>ATTENUATION (dB)*</th>
<th>PAIR-TO-PAIR ACR (dB)</th>
<th>POWER SUM ACR (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2.0</td>
<td>65.3</td>
<td>62.3</td>
</tr>
<tr>
<td>10</td>
<td>6.5</td>
<td>45.8</td>
<td>42.8</td>
</tr>
<tr>
<td>20</td>
<td>9.3</td>
<td>38.5</td>
<td>35.5</td>
</tr>
<tr>
<td>31.25</td>
<td>11.7</td>
<td>33.2</td>
<td>30.2</td>
</tr>
<tr>
<td>100</td>
<td>22.0</td>
<td>15.3</td>
<td>12.3</td>
</tr>
<tr>
<td>200</td>
<td>32.4</td>
<td>0.4</td>
<td>-2.6</td>
</tr>
<tr>
<td>250</td>
<td>36.9</td>
<td>-5.5</td>
<td>-8.5</td>
</tr>
</tbody>
</table>

*Attenuation for Level 6XP stranded patch cordage is allowed to be up to 20% greater.

**Level 6XP Cable - Minimum Return Loss (at 100 meters)**

<table>
<thead>
<tr>
<th>FREQUENCY (MHz)</th>
<th>RETURN LOSS (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>20.0</td>
</tr>
<tr>
<td>10</td>
<td>25.0</td>
</tr>
<tr>
<td>20</td>
<td>25.0</td>
</tr>
<tr>
<td>31.25</td>
<td>23.6</td>
</tr>
<tr>
<td>100</td>
<td>20.1</td>
</tr>
<tr>
<td>200</td>
<td>18.0</td>
</tr>
<tr>
<td>250</td>
<td>17.3</td>
</tr>
</tbody>
</table>

**Level 6XP Cable - Longitudinal Conversion Loss (LCL)**

(Reserved for future use when the proper test procedure is developed by ASTM.)

**Level 6XP Cable - Maximum Skew**

25 ns at 100 meters
Level 6XP Cable - Maximum Attenuation
44.9 dB @ 350 MHz

10. APPROVED PATCH CORDS

Scope
This section applies to 100 ohm stranded 4-pair UTP patch cordage in various lengths terminated with eight conductor modular RJ45 or IDC type plugs.

Normative References

Reference Documents
The latest edition of referenced standards (from the latest available draft in the case of proposed standards) shall be the controlling document. Where the standards appear to conflict with one another, the one with the most stringent requirements shall be applicable.
CSA
UL 1863
ANSI/TIA/EIA-568-B
ISO/IEC 11801
ISO/IEC 60603-7

Applicable Testing Standards
Testing shall be conducted in accordance with the following standards:
ANSI/TIA/EIA-568-B-4, Production Modular NEXT Loss Test Method and Requirements for Unshielded Twisted Pair Cabling, 1999
ATS Anixter Test Specification ATS 01.01 for Non-Destructive Testing of Assembled Patch Cords

This document provides required test values at specific discrete frequencies. The tabulated values are intended for reference only. All Levels products are swept-tested through a prescribed frequency range. The Anixter Levels purchase specification requires 100% compliance throughout the specified range of frequencies tested. By convention, all values of electrical characteristics, while predominantly negative numbers (representing losses), are expressed as absolute values (positive numbers).

General Requirements

Applicable Hardware
Levels of performance apply to patch cords used with 100 ohm, 4 pair Unshielded UTP Cabling Systems. A shielded version, if offered, shall comply with the performance requirement of the applicable level.

Quality Assurance
The manufacturer of Level hardware, shall be ISO 9000 registered. Initial Qualification and Certification of the manufacturer is required. An ongoing program of random Palm Beach State College compliance testing of all Levels products must be maintained.
Labeling of Patch Cords

The following information will be repetitively printed every 12-24 inches on the cable jacket: Manufacturer's name, brand, gauge, pair count, NEC type (CSA in Canada), part number, and other standards compliance ratings.

Measurement Precautions

Transmission testing shall be conducted on representative Palm Beach State Colleges of the manufacturer’s shortest, median, and longest length cords received directly from Anixter’s product inventory. The following tables provide reference numbers at specific discrete frequencies for 3 ft., 10 ft., and 25 ft. patch cords. The selected range of patch cord lengths is intended to provide baseline numbers for evaluating patch cord NEXT at varying lengths.

8. Level 6XP Patch Cords

Performance Requirements

Level 6XP Patch Cord - Highest Test Frequency

Swept to 150 MHz minimum.

Level 6XP Patch Cord - Minimum Pair-to-Pair NEXT

Pair-to-Pair Near End Crosstalk (NEXT) shall not be less than the minimum numbers shown in the following table.

<table>
<thead>
<tr>
<th>FREQUENCY (MHz)</th>
<th>PAIR-TO-PAIR NEXT LOSS 3 ft. cord Limit (dB)</th>
<th>PAIR-TO-PAIR NEXT LOSS 10 ft. cord Limit (dB)</th>
<th>PAIR-TO-PAIR NEXT LOSS 25 ft. cord Limit (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>65.0</td>
<td>65.0</td>
<td>65.0</td>
</tr>
<tr>
<td>10</td>
<td>57.7</td>
<td>56.9</td>
<td>55.7</td>
</tr>
<tr>
<td>20</td>
<td>51.8</td>
<td>51.1</td>
<td>50.0</td>
</tr>
<tr>
<td>31.25</td>
<td>47.9</td>
<td>47.3</td>
<td>46.3</td>
</tr>
<tr>
<td>100</td>
<td>38.1</td>
<td>37.7</td>
<td>37.2</td>
</tr>
<tr>
<td>150</td>
<td>34.7</td>
<td>34.4</td>
<td>34.1</td>
</tr>
</tbody>
</table>

Level 6XP Patch Cord - Minimum Return Loss

Return Loss shall not be less than the minimum numbers shown in the following table.

<table>
<thead>
<tr>
<th>FREQUENCY (MHz)</th>
<th>RETURN LOSS (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 to 20</td>
<td>25</td>
</tr>
<tr>
<td>31.25</td>
<td>23</td>
</tr>
<tr>
<td>100</td>
<td>18</td>
</tr>
<tr>
<td>155</td>
<td>16</td>
</tr>
</tbody>
</table>

9. APPROVED CONNECTING HARDWARE PERFORMANCE

Scope

This section applies to 100 ohm UTP connecting hardware.
Normative References

Reference Documents
Connecting hardware shall meet, as a minimum, all the requirements including the electrical and mechanical performance requirements of:
CSA
UL 1863
ANSI/TIA/EIA-568-B
ISO/IEC 11801
CENELEC EN50173: 1995
NEC, NFPA70

Applicable Testing Standards
Testing shall be conducted in accordance with the following standards:
ANSI/TIA/EIA-568-B-2-1, Transmission Performance Specifications for 4-pair 100 Ω Category 6 Cabling, 1999
ISO/IEC 11801

This document provides required test values at specific discrete frequencies. The tabulated values are intended for reference only. All Levels products are swept-tested through a prescribed frequency range. The Anixter Levels purchase specification requires 100% compliance throughout the specified range of frequencies tested. By convention, all values of electrical characteristics, while predominantly negative numbers (representing losses), are expressed as absolute values (positive numbers).

General Requirements

Applicable Hardware
Levels of performance apply to connecting hardware used with 100 ohm, 4 pair Unshielded UTP Levels Type Cables. A shielded version, if offered, shall comply with the performance requirement of the applicable level.

Quality Assurance
The manufacturer of Level hardware specified herein, shall be ISO 9000 registered. Initial Qualification and Certification of the manufacturer is required. An ongoing program of random Palm Beach State College compliance testing of all Levels products must be maintained.

Measurement Precautions
Transmission testing shall be conducted on representative Palm Beach State Colleges received directly from Anixter’s product inventory. The normative annexes C, D, E and F of the ANSI/TIA/EIA-568-B-5 shall be adhered to when quantifying connecting hardware.

Level 6XP Connecting Hardware
Level 6XP Hardware - Performance Requirements

Level 6XP Hardware - Highest Test Frequency
Swept to 155 MHz minimum.
Level 6XP Hardware - Minimum Pair-to-Pair NEXT and Pair-to-Pair FEXT
Connector Pair-to-Pair Near End Crosstalk (NEXT) shall not be less than the minimum numbers shown in the following table. Pair-to-Pair Far End Crosstalk (FEXT) shall not be less than the minimum numbers shown in the following table.

<table>
<thead>
<tr>
<th>FREQUENCY (MHz)</th>
<th>PAIR-TO-PAIR NEXT LOSS (dB)</th>
<th>PAIR-TO-PAIR FEXT LOSS (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>65.0</td>
<td>65.0</td>
</tr>
<tr>
<td>10</td>
<td>64.0</td>
<td>57.0</td>
</tr>
<tr>
<td>20</td>
<td>58.0</td>
<td>51.0</td>
</tr>
<tr>
<td>31.25</td>
<td>54.1</td>
<td>47.1</td>
</tr>
<tr>
<td>100</td>
<td>44.0</td>
<td>37.0</td>
</tr>
<tr>
<td>150</td>
<td>40.5</td>
<td>33.5</td>
</tr>
</tbody>
</table>

Level 6XP Hardware – Minimum Power Sum NEXT and Power Sum FEXT
Connector Power Sum Near End Crosstalk (PSNEXT) shall not be less than the minimum numbers shown in the following table. Connector Power Sum Far End Crosstalk (PSFEXT) shall not be less than the minimum numbers shown in the following table.

<table>
<thead>
<tr>
<th>FREQUENCY (MHz)</th>
<th>POWER SUM NEXT LOSS (dB)</th>
<th>POWER SUM FEXT LOSS (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>65.0</td>
<td>6</td>
</tr>
<tr>
<td>10</td>
<td>61.0</td>
<td>54.0</td>
</tr>
<tr>
<td>20</td>
<td>55.0</td>
<td>48.0</td>
</tr>
<tr>
<td>31.25</td>
<td>51.1</td>
<td>44.1</td>
</tr>
<tr>
<td>100</td>
<td>41.0</td>
<td>34.0</td>
</tr>
<tr>
<td>150</td>
<td>37.5</td>
<td>30.5</td>
</tr>
</tbody>
</table>

Level 6XP Hardware – Maximum Attenuation
Connector Attenuation shall not be more than the maximum numbers shown in the following table.

<table>
<thead>
<tr>
<th>FREQUENCY (MHz)</th>
<th>ATTENUATION (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.04</td>
</tr>
<tr>
<td>10</td>
<td>0.13</td>
</tr>
<tr>
<td>20</td>
<td>0.18</td>
</tr>
<tr>
<td>31.25</td>
<td>0.22</td>
</tr>
<tr>
<td>100</td>
<td>0.40</td>
</tr>
<tr>
<td>150</td>
<td>0.49</td>
</tr>
</tbody>
</table>

Level 6XP Hardware - Minimum Return Loss
Connector Return Loss shall not be less than the minimum numbers shown in the following table.

<table>
<thead>
<tr>
<th>FREQUENCY (MHz)</th>
<th>RETURN LOSS (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 to 18</td>
<td>35.0</td>
</tr>
</tbody>
</table>
10. CHANNEL PERFORMANCE

Scope
This section further defines the complete end-to-end channel requirements for the Levels Channel 6 solution. Channel compliance is only applicable following successful compliance to individual component Levels in this specification. This section specifies the minimum requirements that cables, connecting hardware and assembled patch cords must meet when combined into a full cabling system, in order to reach compliance with the Anixter Levels Channel Program.

Normative Reference

Reference Documents
The latest edition of referenced standards (from the latest available draft in the case of proposed standards) shall be the controlling document. Where the standards appear to conflict with one another, the one with the most stringent requirements shall be applicable.
ANSI/ICEA S-90-661
CSA
UL 444
ANSI/TIA/EIA-568-B
ISO/IEC 11801
CENELEC EN50173: 1995
NEC, NFPA70
NEMA WC-63/66

In addition to the requirements shown above, Level 7XP cables shall previously meet the requirements of:
ANSI/TIA/EIA-568-B-5 Category 5e
ANSI/TIA/EIA-568-B Category 5
ISO/IEC 11801 Category 5 & 6
All connecting hardware and patch cords shall previously meet, as a minimum, all the requirements including the electrical and mechanical performance requirements of:
CSA
UL 1863
ANSI/TIA/EIA-568-B
ISO/IEC 11801
ISO/IEC 60603-7
CENELEC EN50173: 1995
NEC, NFPA70

Applicable Testing Standards
Testing of individual components and channel shall be conducted in accordance with the following standards:
ANSI/TIA/EIA-568-B-1, Propagation Delay and Delay Skew Specifications for 100 Ω 4-pair cable, 1997
ANSI/TIA/EIA-568-B-2, Corrections and Additions to TIA/EIA-568-B, 1998
This document provides required test values at specific discrete frequencies. The tabulated values are intended for reference only. All Levels products are swept-tested through a prescribed frequency range. The Anixter Levels purchase specification requires 100% compliance throughout the specified range of frequencies tested. By convention, all values of electrical characteristics, while predominantly negative numbers (representing losses), are expressed as absolute values (positive numbers).

**Requirements**

**Applicable Channels**

Levels of performance apply to 4-pair unshielded twisted pair cables, assembled patch cords and connecting hardware used with 100 ohm, 4-pair Unshielded UTP Levels Type Cables. A shielded version, if allowed, shall comply with the performance requirements of the applicable Level. The Anixter channel will consists of an equipment patch cord, information outlet, horizontal cabling (90m) with a transition point near the information outlet (I/O), two telecom closet connection points and patch cords for a total of 4 connection points, as shown below.

**Quality Assurance**

The manufacturers of Level cables and hardware specified herein, shall be ISO 9000 registered. Initial Qualification and Certification of the manufacturer is required. Anixter also maintains an ongoing program of random Palm Beach State College compliance testing of all Levels products.

**Level 6XP Channel**

**Performance Requirements**

**Level 6XP Channel - Highest Test Frequency**

150 MHz minimum (all parameters)
Level 6XP Channel - Minimum Pair-to-Pair NEXT and ELFEXT
Pair-to-Pair Near End Crosstalk (NEXT) shall not be less than the minimum numbers shown in the following table. Pair-to-Pair Equal Level Far End Crosstalk (ELFEXT) shall not be less than the minimum numbers shown in the following table.

<table>
<thead>
<tr>
<th>FREQUENCY (MHz)</th>
<th>PAIR-TO-PAIR NEXT LOSS (dB)</th>
<th>PAIR-TO-PAIR ELFEXT LOSS (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>60.0</td>
<td>58.0</td>
</tr>
<tr>
<td>10</td>
<td>48.7</td>
<td>39.8</td>
</tr>
<tr>
<td>20</td>
<td>43.6</td>
<td>33.8</td>
</tr>
<tr>
<td>31.25</td>
<td>40.3</td>
<td>29.9</td>
</tr>
<tr>
<td>100</td>
<td>31.6</td>
<td>19.8</td>
</tr>
<tr>
<td>150</td>
<td>28.5</td>
<td>16.3</td>
</tr>
</tbody>
</table>

Level 6XP Channel - Minimum Power Sum NEXT and ELFEXT
Power Sum Near End Crosstalk (PSNEXT) shall not be less than the minimum numbers shown in the following table. Power Sum Equal Level Far End Crosstalk (PSELFEXT) shall not be less than the minimum numbers shown in the following table.

<table>
<thead>
<tr>
<th>FREQUENCY (MHz)</th>
<th>POWER SUM NEXT LOSS (dB)</th>
<th>POWER SUM ELFEXT LOSS (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>57.0</td>
<td>56.8</td>
</tr>
<tr>
<td>10</td>
<td>45.7</td>
<td>36.8</td>
</tr>
<tr>
<td>20</td>
<td>40.6</td>
<td>30.8</td>
</tr>
<tr>
<td>31.25</td>
<td>37.3</td>
<td>26.9</td>
</tr>
<tr>
<td>100</td>
<td>28.6</td>
<td>16.8</td>
</tr>
<tr>
<td>150</td>
<td>25.5</td>
<td>13.3</td>
</tr>
</tbody>
</table>

Level 6XP Channel - Maximum Attenuation, Minimum Pair-to-Pair ACR and Power Sum ACR
Attenuation shall not be greater than the maximum numbers shown in the following table when measured at an ambient temperature of 20°C (68°F). Pair-to-Pair Attenuation to Crosstalk Ratio (ACR) shall not be less than the minimum numbers shown in the following table. Power Sum Attenuation to Crosstalk Ratio shall not be less than the minimum numbers shown in the following table.

<table>
<thead>
<tr>
<th>FREQUENCY (MHz)</th>
<th>ATTENUATION (dB)</th>
<th>PAIR-TO-PAIR ACR (dB)</th>
<th>POWER SUM ACR (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2.2</td>
<td>57.8</td>
<td>54.8</td>
</tr>
<tr>
<td>10</td>
<td>7.1</td>
<td>41.6</td>
<td>38.6</td>
</tr>
<tr>
<td>20</td>
<td>10.2</td>
<td>33.4</td>
<td>30.4</td>
</tr>
<tr>
<td>31.25</td>
<td>12.9</td>
<td>27.5</td>
<td>24.5</td>
</tr>
<tr>
<td>100</td>
<td>24.0</td>
<td>7.6</td>
<td>4.6</td>
</tr>
<tr>
<td>150</td>
<td>30.1</td>
<td>-1.5</td>
<td>-4.5</td>
</tr>
</tbody>
</table>
Level 6XP Channel - Minimum Return Loss
Return Loss shall not be less than the minimum numbers shown in the following table.

<table>
<thead>
<tr>
<th>FREQUENCY (MHz)</th>
<th>RETURN LOSS (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 to 20</td>
<td>17.0</td>
</tr>
<tr>
<td>31.25</td>
<td>15.1</td>
</tr>
<tr>
<td>100</td>
<td>10.0</td>
</tr>
<tr>
<td>150</td>
<td>8.2</td>
</tr>
</tbody>
</table>

11. Installation Requirements
In order for unshielded twisted-pair cabling infrastructure to deliver high-speed performance, it is manufactured to very tight specifications. Consequently, to maintain the unshielded twisted-pair cabling system performance proper installation practices must be followed. Listed below are some requirements that shall be followed:

- Never crush the cable (by over cinching with cable ties or by using a staple gun). **Use of Velcro cable ties in the closets is required.**

- Do not kink, knot or snag the cable while pulling, this will cause damage under the jacket and may alter cable performance.

- Do not to exceed the recommended pulling tension.

- Do not exceed the minimum bend of 4 x Outside Diameter (OD) for 4 pair UTP, 10 x OD for multi pair (more than 4 pair) UTP, 1.18 in. for two fiber cable, and 10 x OD for multi fiber cable.

- Per TIA/EIA-568-B and BICSI, never un-twist the pairs of cable beyond the absolute minimum required for termination.

- The cable jacket on UTP shall only be stripped back the minimum required to terminate to connecting hardware.

- Cable management panels shall be used when terminating cable.

- Use the same performance criteria for both cable and connecting hardware through the entire horizontal run.

- Maximum cable lengths shall not be exceeded.

- Properly rated patch cables will be provided and tested. Silver satin linecord is not acceptable.
• A 40% fill ratio for all conduit runs is recommended (see Diagram 8).

• All fiber optic cables shall be set in inner-duct with the appropriate flame and smoke rating.

• All horizontal runs, moves, adds and changes must be documented. Use of a software package is recommended. Link and Channel test results must be provided.

• Connecting hardware for optical fiber installed at the following locations: main cross-connect, intermediate cross-connect, horizontal cross-connect, horizontal transition point, telecommunications outlet, shall not surpass minimum bend radius and shall be capable of storing 1m (3.28 ft.) of additional fiber.

• SC type connectors for fiber are recommended by TIA/EIA 568-B.3 (beige for multi-mode and blue for single mode). Users that have installed ST type fiber connectors may remain with them for both existing and future additions.

• The use of different colored icons for jacks (e.g., one for data, and one for voice) and different colored jacketed cables (which aide in cable identification and administration) are required.

• A single shared sheath at the outlet is not acceptable.

• Only one pin-out throughout the total installation (T568A or T568B) is allowed.

• Sizing of the house backbone cable (voice) will allow for a minimum of 2 pairs per station, allowing for 30% to 40% growth and rounding off to the next largest pair count cable (e.g., 250 pairs needed which includes growth, move to a 300 pair cable). Never specify smaller than 6 fibers in the backbone. Again, this is driven by the topology being implemented and should always allow for future growth.

• Reinstalling cable that has been pulled out of modular furniture is not allowed.

• Contractor shall install pull strings into every conduit that cable is pulled in.

• Contractor shall install maximum allowable innerducts into conduits where fiber will be installed, even if only one will be utilized currently.

12. LABELING AND ADMINISTRATION

• Each cable shall be labeled.
Each identifier shall be unique.

Components shall be marked where they are administrated (label at all punch down points, panels, blocks, outlets, etc.).

Moves, adds or changes: all labels, records, and reports shall be updated.

All pathways labeled (conduit, trays etc.).

All dedicated telecommunications grounding bus bars shall be labeled.

Cross-connect fields shall be labeled according to Diagram 6. For complete administration and labeling see ANSI/TIA/EIA 606.

**Patch Panel Labeling:**
Patch Panels shall be labeled utilizing 7-digit numbers. The first four will reflect the room number and the last three will indicate the jack number. Examples:
1. Room 203.1 jack 001 shall be labeled as 2031001 or 203.1-001
2. Room 108 jack 007 shall be labeled as 1080007 or 108.0-007.

In any wiring closet, the following labeling guidelines apply:
1. Patch panel labeling shall be ordered from left to right and from top to bottom.
2. The first patch panel port shall be designated for the first drop in the lowest numbered room.
3. The port numbers start at 001 for each room.
4. All drops for a room shall be located together on the patch panel.
5. Patch panels that terminate voice grade cable to 110 blocks in IDF locations will be labeled with pair number in ascending order. The 50 pr voice cable coming off the patch panel will be labeled on the 110 block, 1 – 24 first row(skip/violet/slate) and 25 – 48 second row.(violet/slate left blank).

**Room jack Location Labeling:**
In rooms and classrooms, the following labeling guidelines apply:
1. Starting at the doorway, all jack numbers shall run consecutively and clockwise around the room, starting with jack #001 in each room.
2. For all classrooms in a row configuration, jacks shall be ordered from left to right and from front to back, starting with jack #001. **Note:** In most cases, the computer station closest to the doorway shall designate the front of the room and shall be labeled as jack #001.
3. Labels at the workstation require the official, final PBSC room number on the wallplate and three-digit jack number for each jack. Examples: jack=001, Label=001, Room=121, Wallplate=121.

**Fiber Enclosure Labeling:**
All fiber termination enclosures shall be labeled with the name of the building at the far end of the connection. Each fiber termination cabinet shall contain a label key indicating the color of the jack and strand of each fiber and its location within the enclosure (example BL/OR or SL/WH). A label will also be placed on the fiber cabinet door.
indicating the building and location of the opposite end of the fiber optic cable. All fiber jackets shall also be labeled with the name of the building at far end of the connection.

### Diagram 8
**TIA/EIA 606 Color Coding**

<table>
<thead>
<tr>
<th>Termination Type</th>
<th>Color</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demarcation Point</td>
<td>Orange</td>
<td>Central office termination</td>
</tr>
<tr>
<td>Network connections</td>
<td>Green</td>
<td>Network connections or auxiliary circuit termination</td>
</tr>
<tr>
<td>Common equipment PBX, Host, LANs, Muxes</td>
<td>Purple</td>
<td>Used for all major switching and data equipment termination</td>
</tr>
<tr>
<td>First level backbone</td>
<td>White</td>
<td>MC-IC cable termination</td>
</tr>
<tr>
<td>Second level backbone</td>
<td>Gray</td>
<td>IC-TC cable termination</td>
</tr>
<tr>
<td>Station</td>
<td>Blue</td>
<td>Horizontal cable termination</td>
</tr>
<tr>
<td>Inter-building backbone</td>
<td>Brown</td>
<td>Campus cable termination</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>Yellow</td>
<td>Auxiliary, maintenance alarms, security, etc.</td>
</tr>
<tr>
<td>Key telephone systems</td>
<td>Red</td>
<td></td>
</tr>
</tbody>
</table>

### Grounding

Grounding shall meet the requirements of the NEC and additionally grounding bonding shall conform with ANSI/TIA/EIA-607. For example see Diagram 7.
Diagram 9
Example TIA/EIA 607 Grounding

Bonding to the service equipment (power) ground

The bonding conductor for telecommunications shall bond the TMGB to the service equipment (power) ground. The figure below schematically depicts connectivity to the service equipment (power) ground.

Schematic of connectivity to the service equipment (power) ground

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**Diagram Legend**

- Solid lines indicate items within the scope of this standard
- Dashed lines indicate items outside the scope of this standard

**Abbreviations**

- TBB: Telecommunication Bonding Backbone
- TMGB: Telecommunication Main Grounding Busbar

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13. TESTING AND CERTIFICATION

Testing of all installed “Basic Links” shall be performed using a Level III hand held tester and performed to the latest revision of the TIA/EIA-568-B documents. All reports shall be recorded and presented to the end user before acceptance. This also includes all fiber runs that have been installed. Fiber will be tested for both wavelengths of multi mode and single mode fiber by power meter and light source.

Testing

Testing of cabling shall be performed prior to system cut-over, 100 percent of the backbone, UTP horizontal and riser pairs shall be tested for opens, shorts, polarity reversals, transposition and presence of AC voltage. UTP voice, data and building control device horizontal wiring pairs shall be tested to the latest revision of the TIA/EIA-568-B documents from the information outlet to the TC and from the TC to the information outlet. In addition, all assigned circuits shall be tested from the information outlet/building control device to the MDF. Voice backbone, horizontal, feeder, and riser cable will be tested with a Mod-Tap(or equivalent) for opens, shorts and reversals. Documentation of test results is required in either paper or electronic form.

Workmanship

Components of the premise distribution system shall be installed in a neat, orderly manner consistent with the best telephone and data installation practices. Wiring color codes shall be strictly observed and termination shall be uniform throughout. Identification marking and systems shall be uniform, permanent and readable and in accordance with TIA/EIA-606 standards. TIA/EIA-568-B.1 wiring codes as shown on the drawings shall standardize all twisted pair wiring.

Inspection

On-going inspections shall be performed during construction by the PALM BEACH STATE COLLEGE Project Manager and Installation Project Managers. All work shall be performed in a high quality craftsman manner and the overall appearance shall be clean, neat and orderly. The following points will be examined:

- Is the design documentation complete and available in both hard and soft copy? Are all cables properly labeled from end-to-end?
- Have all terminated cables been properly tested in accordance with the specifications for the required performance Level as well as tested for opens, shorts, polarity reversals, transposition and presence of AC and/or DC voltage?
- Is the cable type suitable for its pathway? Are the cables bundled in parallel?
• Have the pathway manufacturer’s guidelines been followed? Are all cable penetrations installed properly and fire stopped according the code?

• Have the contractors avoided excessive cable bending?

• Have potential EMI and RFI sources been considered?

• Is Cable Fill correct?

• Are hanging supports within 1.5 meters (5 ft)?

• Does hanging cable exhibit some sag?

• Are telecommunications closet terminations compatible with applications equipment?

• Have Patch Panel instructions been followed?
  a) jacket removal point
  b) termination positions
  c) all pair terminations tight with minimal pair distortions
  d) twists maintained up to the Index Strip

• Have Modular Panel instructions been followed?
  a) cable dressing first
  b) jackets remain up to the Connecting Block
  c) all pair terminations tight and undistorted
  d) twists maintained up to the Connecting Block

• Are the correct outlet connectors used and turned right side up?

• Are identification markings uniform, permanent and readable?

Warranty

A minimum of a 15 year Product Warranty and System Assurance Warranty for this Structured Cabling System is required. Upon successful completion of the installation and subsequent testing by the installer and PALM BEACH STATE COLLEGE, PALM BEACH STATE COLLEGE shall be provided with a Warranty certificate registering the installation by the approved Anixter Level 6XP vendors.

Diagram 10
Sizing of Horizontal Pathways
Cable Diameter

The following table lists typical ranges of cable diameter for recognized Horizontal cabling media. These values are provided for planning purposes only. It is strongly recommended that the distribution designer check the actual diameter of the cable being used before determining pathway size requirements.

Typical ranges of cable diameter:

<table>
<thead>
<tr>
<th>Horizontal Cable Type…</th>
<th>Typical range of Overall Diameter…</th>
</tr>
</thead>
<tbody>
<tr>
<td>Four-pair 100-ohm UTP</td>
<td>0.36 cm to 0.61 cm (0.14 in. to 0.25 in.)</td>
</tr>
<tr>
<td>50/125um Optical Fiber Cable</td>
<td>0.28 cm to 0.46 cm (0.11 in. to 0.18 in.)</td>
</tr>
</tbody>
</table>

Number of cables

The following table provides guide-lines used by ANSI/TIA/EIA-569-A on cable capacity for conduits ranging from trade size ½ to trade size 4.

Conduit Capacity

<table>
<thead>
<tr>
<th>Trade Size</th>
<th>Cable Outside Diameter Cm (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.33 (0.13) 0.46 (0.18) 0.56 (0.22) 0.61 (0.24) 0.74 (0.29) 0.79 (0.31) 0.94 (0.37) 1.35 (0.53) 1.58 (0.62) 1.78 (0.70)</td>
</tr>
<tr>
<td>½</td>
<td>1 1 0 0 0 0 0 0 0 0</td>
</tr>
<tr>
<td>¾</td>
<td>6 5 4 3 2 2 1 0 0 0</td>
</tr>
<tr>
<td>1</td>
<td>8 8 7 6 3 3 2 1 0 0</td>
</tr>
<tr>
<td>11/4</td>
<td>16 14 12 10 6 4 3 1 1 1</td>
</tr>
<tr>
<td>11/2</td>
<td>20 18 16 15 7 6 4 2 1 1</td>
</tr>
<tr>
<td>2</td>
<td>30 26 22 20 14 12 7 4 3 2</td>
</tr>
<tr>
<td>21/2</td>
<td>45 40 36 30 17 14 12 6 3 3</td>
</tr>
<tr>
<td>3</td>
<td>70 60 50 40 20 20 17 7 6 6</td>
</tr>
<tr>
<td>31/2</td>
<td>- - - - - - 22 12 7 6</td>
</tr>
<tr>
<td>4</td>
<td>- - - - - - 30 14 12 7</td>
</tr>
</tbody>
</table>
Example Multi-User Telecommunications Outlet/Connector

Horizontal Distances of Copper Links (Long Work Area Cables)

When used in the context of multi-user telecommunications outlets/connectors and open office furniture, copper work area equipment cables of length up to 15 meters are permitted provided that building cable runs are not longer than allowed in Table 1:

<table>
<thead>
<tr>
<th>Length of horizontal cable, meters</th>
<th>Maximum length of work area cable, meters</th>
</tr>
</thead>
<tbody>
<tr>
<td>90</td>
<td>5</td>
</tr>
<tr>
<td>85</td>
<td>9</td>
</tr>
<tr>
<td>80</td>
<td>13</td>
</tr>
<tr>
<td>75</td>
<td>17</td>
</tr>
<tr>
<td>70</td>
<td>22</td>
</tr>
</tbody>
</table>

Table 1. Maximum length of work area cables.

15. CLOSING REMARKS

There are many occasions where you will not be dealing with a TIA/EIA-569 compliant building. It must be understood however, not all requirements must be met for compliant channel performance. Examples of non-performance requirements are – existing door width, ceiling material, illumination, number of AC receptacles, etc. Every endeavor shall be made to follow TIA/EIA-569 to the letter but the primary goal is to provide a balanced redundant cabling infrastructure.

It should be understood that a structured cabling system will usually only account for approximately 5% of the cost for installing a complete LAN. Since a structured cabling system should only be installed once, cutting cost in this area is not a good long term strategy. The network electronics and software could change three or more times during the life of the cabling infrastructure. In addition to the minimum requirements of ANSI/TIA/EIA-568-B.2, we specify only Anixter Levels Channel 6 compliant components and channels be used in the horizontal. This will allow for a truly redundant and balanced system. This strategy will accommodate future upgrades in the horizontal to more bandwidth intensive network technologies.
APPENDIX A (BILL OF MATERIALS)

Palm Beach State College requires the use of certain products in some cases. The part numbers or models of required parts are itemized below.

Level 6XP solutions include:
Systimax Solutions
Commscope Uniprise
ADC
Ortronics/Berktek
Panduit
Belden CDT
Siemon

Racks - Chatsworth
8 foot: Part #55053-715 - Black
7 foot: Part #55053-703 - Black

Cable Management - Chatsworth - MCS
8 foot x 4.4 inches: 30094-715 - Black
7 foot x 4.4 inches: 30094-703 - Black
8 foot x 6 inches: 30095-715 - Black
7 foot x 6 inches: 30095-703 - Black
Horizontal: 30330-719 - Black

Fiber Termination Cabinets (LIU)
Panduit: FRME2 (36 strands maximum)
FAP3WEIDSC – mm 3-duplex
FAP6WBUSC2 – sm 6-simplex
FAPB - blank

Fiber: Corning

Power Distribution Units
Tripp Lite IBAR 12
APC NET9RM
ITW LINX GRM0600-80.

Lightning Protection
Circa 1880ECA1-100G – 110 in / 110 out w/cover & splice chamber
Circa 4B1S – 5 pin solid state