27 00 00 COMMUNICATIONS

1.01 Scope of Standard

A. These guidelines identify and define the Texas State requirements and policies for designing and installing telecommunications infrastructure and substructure at all Texas State facilities. Use of, and compliance with these guidelines is mandatory for Texas State personnel, and for architects, engineers, and installation contractors working on Texas State projects.

2.01 Design Guidelines

A. The Texas State Telecommunications Infrastructure Standards are based upon the code requirements and telecommunications industry standards contained in the following guidelines. These guidelines will not duplicate the information contained in those references, except where necessary to provide guidance, clarification or direction. It is imperative that Texas State personnel, architects, engineers, and installation contractors working on Texas State projects become familiar with these guidelines and the industry telecommunications standards referenced.

B. In instances where several technical alternatives may be available to provide a design solution, these guidelines will identify the preferred solution to meet Texas State needs. However, each facility and project is unique. Design for new construction will differ from design for retrofit of existing facilities. These guidelines will differentiate certain design approaches and solutions to be applied to new construction versus existing facilities, and different types of Texas State facilities. However, designers and installers shall always use sound engineering judgment in order to comply with the requirements of the codes and standards identified in this section. Design or installation questions shall be referred to the Texas State IT staff via Office of Campus Construction for resolution.

3.01 Reference Standards

A. Adherence to, and compliance with, the codes and standards referenced, and the Texas State unique requirements and design solutions identified in the manual, is mandatory. Requests to deviate from the industry standards and design solutions prescribed in these guidelines may be submitted, on a case-by-case basis, in accordance with the instructions in the Policy and

Procedures section of these guidelines. No deviation from the requirements of the National Electrical Code will be allowed.

B. Architects, Consultants and Contractors shall always reference the most recent standards available. Most references listed below can be purchased directly from the individual standards organization, or from:

Global Engineering Documents
Inverness Way East
Englewood, CO 80112-5776
Telephone: (800) 854-7179 (303) 397-7956
Fax :(303) 397-2740
http://www.global.ihs.com

4.01 Codes, Standards, References, and Applicability

A. NATIONAL ELECTRICAL CODE, NFPA 70

1. The National Fire Protection Association has acted as the sponsor of the National Electrical Code (NEC) since 1911. The original Code was developed in 1897 as a result of the united efforts of various insurance, electrical, architectural, and allied interests. The purpose of the NEC is the practical safeguarding of persons and property from hazards arising from the use of electricity. The NEC provides the minimum code requirements for electrical safety. In telecommunications distribution design, the NEC must be used in concert with the ANSI/EIA/TIA standards identified below, which are intended to insure the performance of the telecommunications infrastructure.

B. ANSI/TIA/EIA STANDARDS

1. The Telecommunications Industry Association/Electronics Industry Association (TIA/EIA) engineering standards and publications are designed to serve the public interest through eliminating misunderstandings between manufacturers and purchasers. The standards facilitate interchangeability and improvement of products, and assist the purchaser in selecting and obtaining the proper product for his or her particular need.

The TIA/EIA Standards are updated every five years. Due to the rapid changes in the telecommunications and electronics industries, TIA/EIA publishes periodic Telecommunications Systems Bulletins (TSB), which provide additional guidance on certain technical issues that must be addressed prior to the next scheduled revision of

the standards. The information contained in TSBs is usually incorporated into the applicable standard during the next standards revision. Standards and publications are adopted by TIA/EIA in accordance with American National Standards Institute (ANSI) patent policy. The TIA web site is: http://www.tiaonline.org/

C. FIBER OPTIC TEST STANDARDS, TIA/EIA-526 (SERIES)

1. The TIA/EIA-455 series, together with its addenda, provides uniform test procedures for testing the fiber optic components intended for, or forming a part of, optical communications and data transmission systems. This series contains standard test procedures for optical fibers, cables, transducers, and connecting and terminating devices.

D. CABLING STANDARD, ANSI/TIA/EIA-568 (SERIES)

1. The ANSI/TIA/EIA-568-A (series) is the Commercial Building Telecommunications Cabling Standard. This standard defines a generic telecommunications wiring system for commercial buildings that will support a multiproduct, multivendor environment. It also provides direction for the design of telecommunications products for commercial enterprise.

   a. The purpose of the standard is to enable planning and installation of building wiring with little knowledge of the telecommunications products that subsequently will be installed. Installation of wiring systems during building construction or renovation is significantly less expensive and less disruptive than after the building is occupied. TIA/EIA-568-A establishes performance and technical criteria for various wiring system configurations for interfacing and connecting their respective elements.

E. PATHWAYS AND SPACES, ANSI/TIA/EIA-569-A (SERIES).

1. The ANSI/EIA/TIA-569-A (series) is the Commercial Building Standard for Telecommunications Pathways and Spaces. This standard will be followed for all low voltage systems in all TEXAS STATE buildings. This standard encompasses telecommunications considerations both within and between buildings, and recognizes three fundamental concepts:

a. Buildings are dynamic. Over the life of a building, or campus, remodeling is more the rule than the exception. The standard recognizes that changes will take place.

b. Building telecommunications systems and media are dynamic. Over the life of a building, or campus, both telecommunications equipment and cabling change dramatically. The standard recognizes this fact by being as independent as possible from specific vendor equipment and media.

c. Telecommunications is more than just voice and data. Telecommunications also encompasses many building systems including environmental controls, security, audio, television, sensing, alarms and paging. Telecommunications includes all low voltage signal systems that convey information within or between buildings.

2. In order to have a building, or campus, successfully designed, constructed, and provisioned for telecommunications, it is imperative that the telecommunications design be incorporated during the preliminary architectural design phase. To accomplish this, the architect must work closely with the designated IT staff member via office of campus construction.

F. ADMINISTRATION STANDARD, ANSI/TIA/EIA-606 (SERIES)

1. The ANSI/TIA/EIA-606 (series) is the Administration Standard for the Telecommunications Infrastructure of Commercial Buildings. Administration of the telecommunications infrastructure includes documentation of cables, termination hardware, patching and cross-connection facilities, conduits, other cable pathways, telecommunications closets, and other telecommunications spaces. The purpose of this standard is to provide a uniform administration scheme that is independent of applications, which may change several times throughout the life of a building. Unless specified otherwise in these Texas State Design and Construction Guidelines administration standard at all Texas State facilities will be in compliance with TIA/EIA-606.

G. GROUNDING AND BONDING, ANSI/TIA/EIA-607 (SERIES)

1. The ANSI/TIA/EIA-606 (series) is the Commercial Building Grounding and Bonding Requirements for Telecommunications. The National Electrical Code (NEC) provides grounding, bonding, and electrical protection requirements to ensure life safety. Modern telecommunications systems require an effective grounding infrastructure to insure optimum performance of the wide variety of electronic information transport systems that may be used throughout the life of a building. The grounding and bonding requirements of this standard are additional technical requirements for telecommunications that are beyond the scope of the NEC. These standards are intended to work in concert with the cabling topology specified in ANSI/TIA/EIA-568-A, and installed in the pathways and spaces designed in accordance with ANSI/TIA/EIA-569-A.

H. CUSTOMER OWNED OUTSIDE PLANT (OSP), ANSI/TIA/EIA-758

1. The ANSI/TIA/EIA-758 provides industry standards for the design and construction of customer owned OSP infrastructure. Unless specified otherwise in the Texas State standard OSP designed and constructed at all Texas State facilities will be in compliance with ANSI/TIA/EIA-758.

I. TRANSMISSION PERFORMANCE SPECIFICATIONS, TIA/EIA BULLETIN TSB67

1. TSB67 is the Transmission Performance Specification for Field Testing of Unshielded Twisted-Pair (UTP) Cabling Systems. This bulletin specifies the electrical characteristics and performance requirements of field test instruments, test methods, and the minimum transmission requirements for UTP cabling. All testing of horizontal distribution cabling at Texas State facilities will be performed with a TSB67 Level II test instrument.

J. ADDITIONAL HORIZONTAL CABLING PRACTICES FOR OPEN OFFICES, TIA/EIA BULLETIN TSB75

1. This document specifies optional practices for open office environments, for any horizontal telecommunications cabling recognized in TIA/EIA-568. It specifies optional cabling schemes and topologies for horizontal cabling routed through modular office furniture or movable partitions, which are frequently reconfigured. These optional practices may be applied at TEXAS STATE classrooms, offices and multipurpose rooms.

K. LOCAL AREA NETWORK ETHERNET STANDARD, IEEE 802.3 (SERIES)

1. Texas State utilizes the Ethernet LAN protocol at all facilities. All Texas State telecommunications infrastructure must be designed to support the Institute of Electrical and Electronic Engineers (IEEE) Ethernet 802.3 standards, which define protocols and signaling technologies. All newly installed cabling must support 1000Base-X Gigabit Ethernet protocol based on the IEEE 802.3z standard.

L. THE BICSI TELECOMMUNICATIONS DISTRIBUTION METHODS MANUAL

1. The Building Industry Consulting Service International, Inc. (BICSI) is a Telecommunications Association whose mission is to provide state-of-the-art telecommunications knowledge to the industry, resulting in good service to the end user. BICSI develops and publishes the Telecommunications Distribution Methods Manual (TDMM). The TDMM is not a code or standard. The TDMM is an extensive volume of information on the various aspects of telecommunications systems and telecommunications distribution. The TDMM provides discussions and examples of various engineering methods and design solutions that can be selected and employed in order to meet the requirements of the NEC and ANSI/TIA/EIA standards. Designers and installers are encouraged to use the TDMM as an engineering tool, within the constraints of the unique requirements of the Texas State Telecommunications Infrastructure Standards.

27 01 00 Operation and Maintenance of Communications Systems

1.01 POLICY AND PROCEDURES

A. Management of Texas State's Campus Network is the responsibility of the IT staff. This includes network design, operations, performance monitoring, optimization, troubleshooting, and disaster recovery. The IT staff at Texas State is also responsible for the planning and development of operational and design standards for local area networks (LANs) and voice communication systems at all Texas State facilities, including the telecommunications infrastructure and substructure.

B. Texas State IT staff will be responsible for installation and support of LAN hardware, software, data communications and voice system backplane hardware.

2.01 DESIGN PHILOSOPHY

A. Texas State requires that the telecommunications infrastructure and substructure be designed and installed in accordance with applicable codes and industry standards. Due to the unique physical characteristics of many Texas State facilities, some technical design solutions are better suited than others. These guidelines identify which design solutions are appropriate and approved for the various types of buildings and areas in Texas State facilities.

3.01 PRELIMINARY ARCHITECTURAL DESIGN PHASE

A. Texas State requires that the telecommunications design be incorporated during the preliminary architectural design phase. This will insure that the building(s) will be successfully designed, constructed, and provisioned for telecommunications.

4.01 IT ROLE IN CAMPUS BUILDING PROJECTS

A. Texas State requires the architect and designers to work closely with the Texas State IT designated staff as a team throughout the entire project life cycle, starting at the preliminary architectural design phase.

B. The Director of Telecommunications Services responsibility is to improve communication on capital projects, ensure successful design and implementation of telecommunications infrastructure throughout the lifecycle of each project and to ensure integration of project design into existing campus infrastructure.

C. The Director of Instructional Technology's responsibility is to ensure compliance of latest classroom design concerning telecommunications infrastructure and technology used by classroom instructors.

5.01 NEW CONSTRUCTION

A. All new construction projects shall contain a telecommunications infrastructure designed and installed in accordance with the requirements of these guidelines.

6.01 RENOVATION TO EXISTING STRUCTURES

A. All Texas State facilities undergoing renovation or remodeling shall incorporate a telecommunications infrastructure designed and installed in accordance with the requirements of these guidelines.

7.01 UPGRADING TELECOM INFRASTRUCTURE TO NEW STANDARDS

A. Every effort should be made to upgrade existing telecommunications infrastructure at any Texas State facility, during renovation, to meet the standards and specifications of these guidelines.

8.01 DESIGN PROCEDURES

A. In order to have a building successfully designed, constructed, and provisioned for telecommunications, it is imperative that the telecommunications design be incorporated during the preliminary architectural design phase. To accomplish this, the architect must work closely with the designated Texas State IT staff.

9.01 APPROVAL FOR ALTERNATIVE DESIGN SOLUTIONS

A. This guideline identifies specific design solutions that are intended to meet the technical requirements of Texas State telecommunications and information technology systems. Requests to deviate from industry standards or Texas State design solutions will be considered on a case-by-case basis. Any request to deviate from the requirements of the National Electrical Code will not be accepted.

B. Requests to apply alternative design solutions shall be submitted to the Texas State Director of Telecommunications Services for consideration. Approval will only be granted in writing.

C. The request must include: A complete description of the proposed alternative design solution identifying: The type of facility; the conditions at the facility; the approved design solution contained in these guidelines and the relevant standards identified in section 27 01 00; the proposed alternative design; identify all standards referenced in these guidelines which the alternative design will not be in compliance with, and the effect of non-compliance, both short and long term; and the reason for wishing to use the alternative design.

10.01 PROCUREMENT AND INSTALLATION POLICY

A. In larger construction projects, the telecommunications infrastructure installation will be part of the general construction contract. A competitive acquisition should still be pursued with the contractors listed by Texas State Telecommunications as approved contractors. The procurement and installation of the telecommunications infrastructure in large construction projects will be a combined effort between the Texas State IT and Texas State Facilities staff.

11.01 STRUCTURED CABLING SYSTEM WARRANTY AND CERTIFICATION.

A. Texas State requires a warranty on the installation of the Structured Cabling System of at least one year from building acceptance. In addition, Texas State requires that 100% of the cables and termination equipment installed be tested and certified at the designed and intended performance level.

12.01 INSTALLER QUALIFICATIONS

A. Installation contractors must be manufacturer trained and certified resellers. The installation contractor must be engaged in the normal business of installing telecommunications cabling systems, and licensed to operate in the State of Texas. All installation technicians must be familiar with the codes, standards, and procedures required by these guidelines and must be Ortronics trained and certified for installations.

27 05 26 Grounding and Bonding for Communications Systems

1.01 GROUNDING, BONDING, AND ELECTRICAL PROTECTION

A. A #6 AWG insulated stranded copper cable shall be provided from the ER to the building main electrical service ground electrode. A Telecommunications Main Grounding Busbar (TMGB) shall be installed in the ER. All metallic conduits entering the ER, all equipment racks in the ER, and all exposed non-current carrying metal parts of telecommunications and information technology equipment in the ER must be bonded to the TMGB.

2.01 SPECIFIC ELECTRICAL REQUIREMENTS MAY CHANGE ON A PROJECT BASIS- PLEASE CONSULT TEXAS STATE TELECOMMUNICATIONS SERVIES FOR SPECIFIC SPECIFICATIONS IN ADDITION TO THE SPECIFICATIONS CONTAINED IN THIS SECTION AND IN THE EQUIPMENT ROOM SECTION(S).

27 05 28 Pathways for Communications Systems

1.01 DESIGN CRITERIA FOR INSIDE PLANT CONDUIT

A. Telecommunications conduit must be properly designed and installed. The design and installation practices for telecommunications conduit have some unique requirements beyond those normally seen in standard electrical conduit. The following items are required to be included in the design and installation of interior telecommunications conduit:

1. Conduits must be designed and installed in the most direct route possible from the telecommunications closet to the work area.

2. The maximum length of LAN copper horizontal distribution cable is 90 meters (295 ft) from the work station outlet to the TC patch panel, no exceptions. Where this length would be exceeded the designer will add additional TCs as required.

3. Telecommunications cabling is always installed in a home-run fashion with individual cables running from the work area all the way to the telecommunications closet. Splices in horizontal distribution cable are not allowed.

4. Factory-manufactured sweeps which meet ANSI/TIA/EIA569-A bend radius requirements shall be used for all telecommunications conduit. The bend radius of the sweeps must be a minimum of 10-times the internal conduit diameter. Bending conduit in the field using manual or mechanical methods is not acceptable. Standard electrical elbows shall not be used. This sweep radius is necessary to insure that the conduits can accept future fiber optic cables. All horizontal conduit will be tested by the conduit installation contractor with a mandrel to prove compliance with the sweep radius requirements throughout the conduit run

5. Each telecommunications outlet box shall have an individual conduit routing to the telecommunications closet, or to the pull box or pulling point, connecting to a major cable pathway routing to the telecommunications closet. Box shall be located in serviceable space. Looping, or “daisy-chaining,” of conduits between outlet boxes is not allowed.

6. All conduit ends shall have plastic bushings installed before the cable is pulled into the conduit.

7. Conduits will not be run next to hot water lines, steam pipes, or other utilities that may present a safety hazard or cause a degradation of system performance.

8. Conduits entering the Telecommunications Closet should be designed and located allowing for the most flexibility in the routing and racking of cables.

9. Conduits or conduit sleeves entering through the floor of the Telecommunications Closet shall terminate four (4) inches above the finished floor.

10. All metallic telecommunications conduits entering the Telecommunications Closet, Equipment Room, or Entrance Facility shall be bonded together, and bonded to the Telecommunications Main Grounding Busbar with a #6 AWG ground cable.

11. All in-use and spare conduits entering the Telecommunications Closet, Equipment Room, or Entrance Facility shall be sealed to prevent the intrusion of water, gasses, and rodents throughout the construction project. Within five days of releasing the conduit for the installation of cable, the conduit installation contractor shall prove all conduits to be clean and dry.

12. All conduits and cables that penetrate fire rated walls or floors must be fire stopped.

13. All ISP conduits and innerduct, used and spare, shall be plugged with watertight plugs at both ends to prevent the intrusion of water, gasses, and rodents throughout the construction project. All ISP conduits shall have pull lines rated at a minimum of 90 kg (200 lb) pulling tension installed. The pull lines must be re-pulled each time an additional cable is installed. Prior to releasing the conduit for the installation of cables, all ISP conduits must be cleaned with a brush pulled through the conduit at least two times in the same direction and swabbed with clean rags until the rag comes out of the conduit clean and dry. All ISP conduits must be tested with a mandrel to prove compliance with the sweep radius requirements throughout the conduit run. Within five days of releasing the conduit for the installation of cable, the conduit installation contractor shall prove all conduits to be clean and dry.

2.01 DESIGN CRITERIA FOR INSIDE PLANT PULLBOXES

A. Pull boxes used with telecommunications conduits in interior locations shall be ratedNEMA-1. Pull boxes used in damp or wet locations such as plumbing chases or out of doors shall be rated NEMA-3R. Pull boxes shall be installed in conduits at an interval no greater than every 100 feet. A pull box shall be installed in conduit runs whenever there are two 90°sweeps, or a total of 180°of sweeps, in a conduit run. Any deviations from these criteria must have prior approval from Texas State IT.

3.01 CABLE PATHWAYS AND SUPPORT STRUCTURES

A. The Inside Plant (ISP) telecommunications substructure are the cable pathways and support structures necessary for routing telecommunications cabling between telecommunications closets, and from the telecommunications closet to the work area. There are numerous different products and methods that can be employed to build the substructure. Some of these methods include: Enclosed conduit system, Open or enclosed cable trays, Routing above a false ceiling using cable supports, and in-slab floor ducts.

B. The conduit system shall be routed inside ceilings, floors, and walls to the greatest extent possible. Surface mounted conduit shall be used only when there is no other route to provide service to the desired location.

C. For the main floor in, “slab on grade constructed buildings”, conduit will route in walls and ceilings not in or under the slab. If this design is not possible, an alternate must be presented and approved following the “Approval for Alternate Design Solutions” process detailed in section 27 01 00. If an under slab route solution is approved, the conduit must be installed with at least 1” of concrete encasement around all sides of the conduit. Exceptions occur in cases of modular furniture installation. In which in slab conduit routing is sometimes necessary; design should work in conjunction with modular furniture.

D. Telecommunications outlets shall be located to minimize the length of patch cord required to connect the computer or telephone to the outlet.

E. All outlets shall have a minimum three-quarter inch conduit. Increase the conduit size as necessary for the quantity of cables to be installed. Cable fill shall not exceed 40%.

F. All wall outlets shall be mounted in a minimum four (4)-inch by four (4)-inch by two and one-half (2 ½)-inch deep double gang outlet box.

G. An electrical outlet shall always be located within three (3) feet of a telecommunications outlet.

H. Telecommunications cable and conduit shall maintain the minimum separation distance from power as listed below.

I. For power systems operating at 480V or greater, including electrical distribution panels, step down devices or transformers, maintain a minimum separation distance of 6 m (20 ft) from all telecommunications cross-connects.

J. For power systems operating at 480V or greater, maintain a minimum separation distance of 3 m (10 ft) from all telecommunications cabling. Pathways should cross perpendicular to electrical power cables or conduits.

K. For large electrical motors or transformers, maintain a minimum separation distance of 1.2 m (4 ft) from all telecommunications cabling

L. For lightning protection system conductors (NEC 800-13), maintain a minimum separation distance of 1.8 m (6 ft) from all telecommunications cabling

M. For power systems operating at less than 480V, including all conduit and cables used for electrical power distribution, maintain a minimum separation distance of 0.6 m (2 ft) from all telecommunications cabling. Pathways should cross perpendicular to electrical power cables or conduits.

N. For fluorescent lighting, maintain a minimum separation distance of 12 cm (5 in) from all telecommunications cabling. Pathways should cross perpendicular to fluorescent lighting.

O. For branch circuits (secondary) power (120/240V, 20A) where electric light or power circuits coexist with telecommunications cabling, maintain a minimum separation distance of 0.50 mm (2 in).

27 05 43 Underground Ducts and Raceways for Communications Systems

1.01 TELECOMMUNICATIONS SUBSTRUCTURE—OUTSIDE PLANT

A. The Outside Plant Substructure is the physical pathway used to distribute backbone cabling between buildings, and to bring the entrance cable from the nearest campus backbone access point across Texas State property to the Entrance Facility. Underground conduit is the standard method of distribution between buildings on campus. Input from Texas State IT and site operations staff must be incorporated in developing the initial and on-going construction schedules. This input is especially important when an early or phased turn-up of buildings is required. Timing on the construction of the main telecommunications room and building, and the backbone cable plant connecting it to key buildings, would be a vital consideration in bringing key buildings online at required dates. In new construction, the outside plant substructure must be sized to accommodate all low voltage services planned for initial installation, plus a minimum of 25% growth capacity.

2.01 UNDERGROUND DISTRIBUTION

A. Underground distribution of low voltage services on Texas State property will consist of appropriately sized conduits and telecommunications manholes or handholes. Telecommunications services (voice and data) and other low voltage services such as fire alarm, security systems, and CATV distribution shall not share the same underground distribution conduits and manholes as electrical power distribution.

B. UNDERGROUND CONDUIT

1. Direct burial of telecommunications cable is not desired, and will only be approved under unique circumstances on a case-by-case basis. Requests to direct bury cable must follow the "Approval for Alternative Design Solutions" process described in section 27 01 00. The major cost in placing underground utilities is the labor for digging the trench. Therefore, underground telecommunications distribution to permanent facilities shall always be placed in conduit to facilitate the easy installation of additional future cables. Key requirements for underground conduit installation include:

   a. OSP conduit quantity and size shall be determined based on the requirements for the initial installation of cable **and a**

realistic prediction of future expansion in the area. Always provide a minimum of 25% spare capacity above the initial installation requirements and known growth.

b. OSP conduit quantities shall be based on a maximum of 40% cable fill per conduit.

c. All OSP telecommunications conduit installations shall have a minimum of two spare conduits.

d. All OSP telecommunications conduits shall be Schedule 40 or Schedule 80 Rigid Nonmetallic conduit, Polyvinyl Chloride (PVC), and must meet the requirements of NEMA TC 6. All conduit sections shall be glued with PVC pipe glue to form a watertight joint. All schedule 40 pipes to be embedded in sand. Spacers are required to maintain proper separation between multiple conduits in a run.

e. All OSP conduits shall be installed with a slight drain slope (0.125 inches-per-foot) away from buildings to prevent the accumulation of water in the conduit or ingress to the buildings.

f. Factory-manufactured sweeps which meet ANSI/TIA/EIA569-A bend radius requirements shall be used for all telecommunications conduit. The bend radius of the sweeps must be a minimum of 10-times the internal conduit diameter. Bending conduit in the field using manual or mechanical methods is not acceptable. Standard electrical elbows shall not be used.

g. All campus distribution conduits must be buried a minimum of 24 inches below grade, with preferred depth of 36 inches.

h. All cable shall be installed in the lowest available conduit in a duct bank, working up as additional cables are installed.

i. All OSP conduits and innerduct, used and spare, shall be plugged with watertight plugs at both ends to prevent the intrusion of water, gasses, and rodents throughout the construction project. All OSP conduits shall have quarter (1/4)-inch polypropylene pull ropes installed. The pull ropes must be re-pulled each time an additional cable is installed. All OSP conduits must be tested with a mandrel

to prove compliance with the bend radius requirements throughout the conduit run. Within five days of releasing the conduit for the installation of cable, the conduit installation contractor shall prove all conduits to be clean and dry.

j. In new construction and new conduit, fiber optic backbone cables shall always be installed in fiber optic innerduct. Normally, three to four innerduct can be placed in a four (4)-inch conduit. Where fiber optic cable is installed into existing conduits, the use of fiber optic innerduct is preferred if space is available. Innerduct is used to separate and segregate cables, and to prevent the tangling of cables in a conduit. Types of textile innerduct may be used if pre-approved by Texas State Telecommunications.

k. Splices in backbone fiber optic cable are not allowed, design OSP conduit accordingly.

3.01 TELECOMMUNICATIONS MANHOLES

A. Telecommunications manholes shall be placed in outside plant conduit runs at an interval no greater than every 500 feet. Conduits routing between two telecommunications manholes, or between a manhole and a building, shall contain no more than two 90°sweeps or a total of 180°of sweeps. If additional conduit sweeps are required, place additional manholes as needed. Telecommunications manholes are typically constructed in pre-fabricated cast concrete, and contain a floor section, wall section, and top section. Manholes are sized based on the ultimate duct structure and equipment that will be located in the manhole. Minimum size of any manhole shall be 6'X8'X7'. Key requirements for telecommunications manhole installation include:

1. Telecommunications manhole sections must be installed with a watertight joint sealer between the sections of the manhole.

2. Telecommunications manholes must be equipped with a pre-cast concrete floor section. Bare earth for the floor of a manhole is not allowed. The floor section must contain a sump to facilitate the use of a submersible pump for de-watering the manhole.

3. A submersible sum pump shall be placed in each manhole; with necessary power requirements.

4. Telecommunications manholes must be equipped with steel pulling eyes pre-cast in the walls opposite to each duct bank to facilitate cable-pulling apparatus.

5. Telecommunications manholes must contain 18 hole or 37 hole cable racks for dressing and securing cables that route through the manhole. Must contain at least two sets per manhole wall.

6. Telecommunications manholes over five (5) feet deep must have permanently installed ladders.

7. All telecommunications manholes shall have a minimum of one grounding rod.

8. All metal hardware in the manhole or handhole (racks and ladders) must be grounded to the bonding tabs pre-cast in the manhole, with the bonding tabs bonded to the ground rod.

9. The cover of all telecommunications manholes must be a minimum of one (1) inch above the finished grade after all landscaping is completed. If manholes are located in paved areas, the pavement must be tapered up to the manhole cover.

4.01 TELECOMMUNICATIONS HANDHOLE

A. A handhole is similar to a miniature manhole that is used solely as a pulling point to expedite the installation of cable in conduit runs over 500 feet or with more than two 90°sweeps. Maximum size of handhole is 4X4X4. The following rules apply to the use of handholes:

1. A handhole shall not be used if the ultimate or total requirements exceed the capacity of two four (4)-inch conduits, in and out.

2. Where more than two four (4)-inch conduits are used in a duct bank, telecommunications manholes must be used in lieu of handholes.

3. A handhole shall not be utilized for splicing cables together.

4. Conduit entering the handhole shall be aligned on opposite walls of the handhole at the same elevation.

27 05 53 Identification for Communications Systems

1.01 TELECOMMUNICATIONS ADMINISTRATION

A. Administration of the telecommunications infrastructure includes documentation of cables, termination hardware, patching and cross-connection facilities, conduits, other cable pathways, telecommunications closets, and other telecommunications spaces. All Texas State facilities shall apply and maintain a system for documenting and administering the telecommunications infrastructure.

B. In order to create a consistent environment, Texas State maintains a campus wide numbering scheme for voice and data outlets and patch panels.

1. All voice and data outlets and patch panels shall be clearly marked using permanent means. Voice and data outlets shall us the following system of numbering:

   a. DATA: Actual room number of jack + patch panel port number

   b. VOICE: V +Actual room number of jack

   c. When more than one TC is needed per floor, the room number of the TC shall be added to the numbering scheme.

   d. When more than one data patch panel is needed per TC, the numbering scheme shall continue consecutively. Example: If two 48 port patch panels are needed, the second patch panel will be labeled starting with port 49.

   e. All voice and data outlet and port numbering must match actual room numbers. Careful consideration should be given when developing and maintaining a numbering scheme that the scheme matches exactly the actual room numbers; **not builders room number**.

   f. All voice and data terminations made in the TCs shall be made in a numerical order by room number of each jack.

g. Outlet numbers shall be marked by permanent means on each cable at the outlet and at the TC.

2.01 RECORDS

A. A record is a collection of information about or related to a specific element of the telecommunications infrastructure. Records must be maintained in a computer spreadsheet, or in a computer database. Paper records are encouraged, but are optional. A cable record is prepared for each backbone cable. The record will show the cable name, and must describe the origin point and destination point of the cable. The cable record will record what services and/or connections are assigned to each cable pair or strand. An equipment record is prepared for services distributed from a certain piece of equipment, such as a router, or a system such as the telephone system PBX.

3.01 DRAWINGS

A. Drawings are used to illustrate different stages of telecommunications infrastructure planning, installation, and administration.

B. Installation or Construction Drawings

1. Installation or construction drawings are the plans that show the installer how the infrastructure is to be installed. The quality of the installation can be directly impacted by the level of detail in the installation drawings and written specifications. Installation drawings for Texas State projects shall, at a minimum, show pathway locations and routing, configuration of telecommunications spaces including backboard and equipment rack configurations, and wiring details including identifier assignments.

C. As-built Drawings

1. The as-built drawings graphically document the installed telecommunications infrastructure through floor plan, elevation, and detail drawings. In many cases, these drawings will differ from the installation drawings because of changes made during construction and specific site conditions. In the as-built drawings, the identifiers for major infrastructure components must be recorded. The pathways, spaces, and wiring portions of the infrastructure each may have separate drawings if warranted by the complexity of the installation, or the scale of the drawings. As-

built drawings are a vital component of the telecommunications administration system, and must be kept current as adds, moves, and changes take place. Texas State requires the installer to provide a complete and accurate set of as-built drawings.

4.01 LABELING AND COLOR CODING

A. To be consistent with ANSI/TIA/EIA standards and industry practices, it is important that both labeling and color coding be applied to all telecommunications infrastructure components. Labeling with the unique identifier will identify a particular component. Proper color coding will quickly identify how that component is used in the overall telecommunications infrastructure of the facility (Please see Appendix I Equipment Specification).

B. Labeling

1. Labels are generally of either the adhesive or insert type. All labels must be legible, resistant to defacement, and maintain adhesion to the application surface.

2. Outside plant labels shall be totally waterproof, even when submerged.

3. All labels shall be machine printed.

4. Labels applied directly to a cable shall have a clear vinyl wrapping applied over the label and around the cable to permanently affix the label.

5. Other types of labels, such as tie-on labels, may be used. However, the label must be appropriate for the environment in which it is used, and must be used in the manner intended by the manufacturer.

6. See Section 27 05 53, **1.01**, B, 1, a-g.

C. Color Coding – Cable Termination Fields

1. Industry standard (ANSI/TIA/EIA 606) color coding shall be applied to all cable termination fields in Telecommunications Closets, Equipment Rooms, and Entrance Facilities. Color coding may also be used to identify specific cables in a pathway, or the function of specific equipment racks or equipment. The same color is always applied to both ends of any given cable. Cross-connections are generally made between termination fields of

different colors. The color may be applied to the plywood backboard behind the termination block, may be the color of a plastic cover on a termination block, or may be the actual color of the insert label on a termination block or patch panel. The following color code shall be used in all Texas State facilities:

a. Orange – Reserved for identification of the telecommunication service demarcation point (demarc). Orange may only be used by the telephone company.

b. Green – Used to identify the termination of network connections on the customer (Texas State) side of the demarc.

c. Purple – Used to identify cables originating from common equipment, such as the telephone PBX, LAN hubs, or multiplexer.

d. White – Used to identify the first-level backbone telecommunications media termination in the building containing the main cross-connect. The main cross-connect is usually in the Equipment Room. In buildings that do not contain the main cross-connect, white may be used to identify the second-level backbone terminations.

e. Gray – Used to identify the second-level backbone telecommunications media termination in the building containing the main cross-connect.

f. Blue – Used to identify the termination of horizontal distribution cables routing from the Telecommunications Closet or Equipment Room to the Work-Area. A blue color coding is only required at the TC or ER end, not at the work-area end of the cable.

g. Brown – Used to identify interbuilding backbone cable terminations.

h. Yellow – Used to identify termination of auxiliary circuits, alarms, maintenance, security, and other miscellaneous circuits.

27 06 00 Schedules for Communications

1.01 CRITICAL DELIVERABLES EXPECTED FROM TELECOMMUNICATIONS CONTRACTOR

A. It is essential for Texas State Telecom to receive all test results and as-built drawings prior to job acceptance. The test results must adhere to the following specifications, formats and delivery conditions :

1. Specifications

a. Complete end-to-end test results for all copper UTP and fiber optic lines installed is required.

b. All fiber optic cable must be visually inspected and optically tested on the reel upon delivery to the installation site. Using an Optical Time Domain Reflectometer (OTDR), an access jumper with like fiber, a pigtail, and a mechanical splice, all fibers shall be tested for continuity and attenuation. Testing for continuity and attenuation on the reel must confirm factory specifications to ensure that the fiber optic cable was not damaged during shipment. The test results must match the results of the factory-attached tag on the reel, or the fiber shall not be used. Reel data sheet must be provided showing test results.

c. End to end test measurements shall be provided for singlemode and multimode fibers (2 wave lengths per test is required). Test results must be submitted for review as part of the installation inspection requirements. Test results shall be in paper form and electronic form, and must contain the names and signatures of the technicians performing the tests.

d. Testing shall be performed on 100% of the fibers in the completed end-to-end system. ANSI/TIA/EIA-568-A, Annex H, provides the technical criteria and formulae to be used in fiber optic testing. Note however, that all Texas State fiber must be tested, rated and guaranteed for Ethernet GigaSPEED 1000B-X performance. Additionally, all fiber optic cable links must pass all installation and performance

tests both recommended and mandated by the cable manufacturer.

e. 100% of all pairs in backbone copper cables shall be tested for continuity and wire-map.

f. The transmission performance of a cabling system depends upon the characteristics of the horizontal cable, connecting hardware, patch cords, equipment cords, work area cords, cross-connect wiring, the total number of connections, and the care with which they are installed and maintained. The development of high-speed applications requires that cabling systems be characterized by transmission parameters such as insertion loss, PSNEXT loss, return loss, and PSELFEXT. System designers use these performance criteria to develop applications that utilize all four pairs in a cabling system for simultaneous bi-directional transmission. This Standard provides minimum cabling component performance criteria as well as procedures for component and cabling performance validation.

2. Format

a. Test Results must be submitted in 2 formats. First, must be original file(s) down loaded from tester. Second, the file must be cohesively placed in excel format with the following fields: ER/TC RM # / RM # of drop / Port # / all relevant test information in as many fields as necessary.

b. Care, with reference to above format criteria, should be taken when recording the information in the tester, proper consistency with port identification is required.

c. As Built drawings must be submitted with .dgn or .dwg file extensions.

3. Delivery

a. Test Results may be electronically submitted to the Office of Telecommunication Services. Contact information will be provided after contract is awarded and before project completion.

27 11 00 Communications Equipment Room Fittings

1.01 MAIN TELECOMMUNICATIONS EQUIPMENT ROOM (ER)

A. The Main Telecommunications Equipment Room (ER) is the central location in a building where the major telecommunications equipment is located. The ER typically contains the telephone switching system, the data switching equipment with LAN switching equipment, the CATV "head end" distribution equipment, closed circuit TV and security systems, and additional low voltage systems. To minimize both conduit and cable lengths, the ER shall be located as close as practical to the center of the building. ER shall be a minimum of 10' by 10'. In new construction, the ER shall be sized and provisioned to contain all major voice, data, and video equipment required to support the building, and all other computer based and networked low voltage systems. During renovation or remodeling of existing facilities, every reasonable effort shall be made to co-locate these systems in a common equipment room. Designs that propose locating data switching equipment in buildings other than the main ER must follow the "Approval for Alternative Design Solutions" process described above in section 27 01 00, and must have the written authorization of the Texas State Director of Telecommunications Services. There are financial implications to Texas State for the LAN equipment when alternative fiber optic designs are implemented. If the data switching equipment is in a location other than the ER, Texas State IT must be consulted to design appropriately sized fiber optic cables to route from the ER to the data switching equipment. All interconnections between the data switching equipment backbone and the campus distribution fiber optic backbone shall be in the ER.

B. ER PLANNING, LAYOUT, AND SIZING

1. The first step in determining the size required for the ER is to identify the systems that will be installed into the ER. In this process, first identify the size of the area that will be served from the ER. Next, identify the quantity, size and variety of systems to be installed to support the area, and the space required for each of the systems. Once the size and quantity of systems are identified, they shall be laid out in a functionally efficient arrangement. Some equipment, such as voice cross connects, LAN switches and patch panels will require regular access, and shall be located where they are easily accessible**. Texas State IT staff must be involved in this process, and must approve the final space requirements**

and design layout for all equipment and racks as well as conduit paths in ER. When laying out the arrangement of the ER, the following requirements and issues shall be addressed:

a. Groups of like equipment types shall be located together; i.e., voice, data for both LAN and video.

b. Wall space and equipment rack space must be designated for particular uses by particular people. Set aside specific backboard space and equipment rack space for the service providers demarc, and any associated equipment. Designate specific adjacent areas for each of the various service providers. Keeping all of the service providers on a common wall and row of equipment racks will limit their access to other areas of the equipment room.

c. Separate wall and equipment rack space is designated for the termination and cross connection of campus distribution cables, both copper and fiber optic. These areas shall be located adjacent to the equipment providing the services, such as the PBX, routers, and switches.

d. Careful design planning must be performed to ensure that all telecommunications cabling has the minimum setback distanced from all potential sources of electromagnetic interference (EMI) or radio frequency interference (RFI), such as electric motors, power transformers, etc. Incorrect planning can result in expensive changes at a later date.

e. Equipment racks and rack mounted equipment must have a minimum of three (3) feet of unrestricted clearance in front and back for technician access. In smaller installations, wall mounted swing-out equipment racks can be used to save space, but must have three (3)-feet clearance to the front of the rack. Note that some LAN equipment may be large, or may require clearance at both the front and back, and wall mounted swing-out racks may not be appropriate.

f. Once an acceptable equipment layout is developed, the size of the equipment room can be calculated. Always provide a minimum of 25% spare space for future growth. With the size determined, the location of the equipment room can be selected.

C. EQUIPMENT ROOM CHARACTERISTICS

1. The characteristics of the ER have a significant impact on all other aspects of telecommunications design. Next to insuring adequate size, selecting a suitable location is the most critical step in planning the ER. The major factors that must be considered when planning and locating the ER are:

    a. Access for delivery and installation of large equipment into the ER.

    b. Access by Texas State and service provider maintenance personnel.

    c. Restrictions on unauthorized access.

    d. Close proximity to electrical service.

    e. The ER must be dedicated to the telecommunications and information technology function. Shared use of boiler rooms, washrooms, janitor closets, electrical closets, or storage rooms is **not allowe**d.

    f. The floor, walls, and ceiling shall be sealed to reduce dust. Finishes shall be light in color to enhance room lighting. Flooring materials having antistatic properties shall be selected.

    g. The room must be free of plumbing and electrical utilities not directly required to support the telecommunications functions.

    h. Close proximity to service entrances for telecommunications and power.

    i. Close proximity and centralized to the campus telecommunications distribution pathways (conduits and/or aerial distribution) to minimize the backbone cable lengths.

D. EQUIPMENT ROOM LOCATIONS

1. **Unacceptable Room Locations**: Any areas subject to water or steam infiltration, particularly basements. A floor drain is required if there is any risk of water entering the ER. Any areas exposed to excessive heat or direct sunlight. Any areas exposed to corrosive atmospheric or environmental conditions. Near or adjacent to any potential sources of electromagnetic interference (EMI) or radio frequency interference (RFI) such as large electric motors, power

transformers, arc welding equipment, or high power radio transmitting antennas. This is a critical consideration, as EMI and RFI can render IT networks totally inoperable. No point within the ER shall be closer than 6 M (20 ft) to power panels or equipment rated at greater than or equal to 480 V that may cause Electrical Interference or equipment which may cause RFI or EMI.

E. ENVIRONMENTAL PROVISIONING

1. The following environmental provisions are required in the Main Telecommunications Equipment Room:

   a. Heating, ventilation, and air conditioning (HVAC) shall be provided on a 24 hours-per-day, 365 days-per-year basis. If the building system cannot assure continuous operation, a stand-alone unit shall be provided for the ER.

   b. The temperature and humidity shall be controlled to provide a continuous operating range of 64°F to 75°F, with 30% to 55% relative humidity.

   c. Lighting shall be a minimum of 50 foot candles, measured three (3) feet above the finished floor in the middle of all aisles between equipment racks and cabinets.

   d. Minimum clear height in the ER shall be eight (8) feet without obstructions.

   e. Dry chemical fire suppression systems are preferred in the ER.

F. ELECTRICAL PROVISIONING

1. The following electrical provisions are required for the Main Telecommunications Equipment Room (ER):

   a. A separate supply circuit serving the room shall be provided and terminated in its own electrical panel located in the ER. This power panel shall be designated as “ER Technical Power.” The ER Technical Power panel shall be used exclusively for supplying power to electronics equipment in the equipment room.

   b. If emergency generator power is available to the facility, the ER Technical Power panel must be linked to the emergency generator power supply.

c. Sizing of electrical power is dependent upon the equipment types and equipment load, and must be calculated on a case by case basis, including sufficient spare capacity for future growth.

d. Each equipment rack and all major freestanding equipment shall be provided with two dedicated 20-amp 110VAC electrical circuits from the ER Technical Power panel, each terminated in a quad (4-plex) outlet. Technical power shall be identified with orange colored electrical outlets. These outlets shall be used exclusively for electronics equipment. Do not use Technical Power outlets for general-purpose or utility devices such as electric drills, vacuum cleaners, or coffeepots.

e. Some IT equipment, such as large LAN switches and routers, are ordered with dual power supplies. The placement of equipment with dual power supplies shall be identified and the appropriate racks must have three, separate, dedicated 20-amp 110VAC electrical circuits from the ER Technical Power panel, each terminated in separate quad (4-plex) outlets, and be appropriately marked to identify the separate circuit breakers.

f. Some major pieces of telecommunications equipment, such as PBX remote equipment, may require 208 or 220 VAC power. These systems must be identified, and power requirements determined, well in advance of the ER architectural and electrical design.

g. The ER shall have 20-amp 110VAC general-purpose convenience electrical outlets placed at 6-foot intervals round the room. The general-purpose circuits must not originate from the ER Technical Power panel. The general purpose circuits shall be used for general purpose, utility devices such as power tools or vacuum cleaners. Do not use general purpose outlets for ER electronics equipment. White, gray, or beige colored outlets to match all other general purpose outlets in the building shall identify the general-purpose outlets.

h. The ER shall be equipped with a power disconnect switch. This switch shall be located near the main door of the ER. The switch shall disconnect power to all electronic equipment in the ER, and is to be used in the event of

electrocution or fire in the ER. There shall also be a similar means to disconnect the power to all dedicated HVAC systems serving the ER and cause all required fire/smoke dampers to close. Refer to the National Electrical Code, NFPA 70, Article 645-10.

G. TELECOMMUNICATIONS BACKBOARDS

1. All walls of the ER shall be covered with three-quarter inch A-C grade fire retardant plywood, painted with two coats of light colored, non-conductive fire retardant paint. The plywood shall extend from the floor to eight (8) feet above the finished floor, and shall be mounted with the "A" side exposed. Cutouts shall be provided around existing power and telecommunications outlets. In new construction, power and telecommunications outlets, and light switches in the ER shall be surface mounted on the plywood backboard.

H. EQUIPMENT RACKS AND CABINETS

1. Planning of the ER layout must make allowances for proprietary equipment and racks, and allow expansion room for future equipment. Texas State has standardized on a general purpose open frame 19-inch wide EIA standard equipment rack with channels measuring 16.25". (Please see appendix I Equipment Specifications for rack and components.). Floor standing equipment racks must always be securely bolted to the floor. Use cable ladders to interconnect multiple equipment racks, to brace equipment racks to the wall, and as a means of routing cables to and from the rack. Some IT equipment, such as large LAN switches, will require an equipment rack with both front and rear mounting rails. Provide 36" clear work space front, rear, and at one end of each equipment rack / cabinet line up for floor mounted racks / cabinets leaving sufficient front and rear rack / cabinet footprints for any equipment planned for installation. All cabinets must have a minimum of 20" from the front rail to the wall. All racks must have a minimum of 20" from the front rail to the rear isle workspace. All racks must be equipped with an appropriate number and type or horizontal and vertical wire management modules, both front and rear, with strain relief brackets to insure proper bend radius and strain relief is maintained for all UTP, fiber optic and power cables. In cases of multiply rack installations all fiber optic terminations must be housed in left rack and all UTP terminations housed in right rack. Collaborations between architects, consultants, contractors and Texas State

Telecommunications is necessary in planning and placement of all ER/ TC equipment and components.

I. GROUNDING, BONDING, AND ELECTRICAL PROTECTION

1. A #6 AWG insulated stranded copper cable shall be provided from the ER to the building main electrical service ground electrode. A Telecommunications Main Grounding Busbar (TMGB) shall be installed in the ER. All metallic conduits entering the ER, all equipment racks in the ER, and all exposed non-current carrying metal parts of telecommunications and information technology equipment in the ER must be bonded to the TMGB.

J. SEPARATION FROM POWER

1. OSP conduits and cabling shall be bonded to TMGB in a different location than all inside cabling and conduits.

2.01 TELECOMMUNICATIONS CLOSETS (TC)

A. The Telecommunications Closet(s) are located in each building, or each floor of a building, where backbone cables transition to horizontal distribution cables. These cables will be both fiber optic and copper, and will support voice, data, video, and other low voltage systems. The TC may also contain certain items of network electronics equipment such as routers or switching equipment. A large building, with large floors, may have multiple TCs on a floor. To minimize both conduit and cable lengths, the TC shall be located as close as practical to the center of the building where it is housed on each floor of the area to be served. TCs should be "stacked" one above the other for multiple floors. Close attention must be given to the maximum length (90m) on LAN copper horizontal distribution cable.

B. TELECOMMUNICATIONS CLOSET PLANNING, LAYOUT, AND SIZING

1. ANSI/TIA/EIA-569-A provides sizing formula for a TC in normal office buildings. The sizing is based on the "usable floor space," which is the space on a floor that can actually be used for office activities. TC shall be a minimum of 60 square feet. Spaces such as mechanical rooms, janitorial closets, and rest rooms cannot be used for office activities, and are not counted as usable floor space. The sizing formula assumes an average of 100 square feet of floor space for each person, or "work –area." Many Texas State buildings are not traditional commercial or office buildings, and

the sizing guidelines of ANSI/TIA/EIA-569-A must be adjusted to accommodate these buildings.

2. There shall be a minimum of one TC per building (may be ER). Additional TCs shall be added when the area to be served exceeds 10,000 square feet, or the cable length from the TC patch panel to the farthest work area outlet exceeds 90meters (295 feet). Cable length is not calculated on a straight-line distance. The distance must include the rises, drops, and bends that the cable will follow from the TC to the work area.

C. TELECOMMUNICATIONS CLOSET LOCATION

1. The TC in each building is the transition point between backbone cabling and horizontal distribution cabling.

2. The TC must be able to contain telecommunications equipment, cable terminations, and associated cable interconnection apparatus.

3. The TC shall be dedicated to the telecommunications function.

4. The TC shall not be shared with electrical installations other than those necessary for telecommunications.

5. The TC shall be located as close as practical to the center of the area to be served, preferably in the core area of the building, to minimize the cable length. The maximum length of copper horizontal distribution cable is 90 meters (295 ft) from the work station outlet to the TC patch panel, no exceptions. Where this length would be exceeded the designer will add additional TCs as required.

6. Multiple TCs on a floor shall be interconnected by a minimum of three spare conduits. Additional conduits shall be installed as necessary based on the quantity of services supported.

7. All fiber optic backbone cables shall home-run from each individual TC to the main telecommunications Equipment Room, which should be the location of the data switching equipment. Requests for exceptions to this policy must follow the process described in section 27 01 00.

8. TCs shall not be located in or adjacent to areas containing sources of electromagnetic interference (EMI) or radio frequency interference (RFI) such as large electric motors, power transformers, arc welding equipment, radio transmitting antennas,

etc. This is a critical consideration, as EMI and RFI can render IT LAN networks totally inoperable.

9. No point within the TC shall be closer than 6 M (20 ft) to power panels or equipment rated at greater than or equal to 480 V, that may cause electrical interference or equipment which may cause RFI or EMI.

D. TELECOMMUNICATIONS CLOSET SIZING AND LOCATION IN EXISTING FACILITIES.

1. Existing facilities present a unique challenge for sizing and locating the TC. Many buildings were designed and constructed only to support telephones. When planning the size and location of TCs in existing buildings, every reasonable effort shall be made to meet the requirements for telecommunications closets identified above. In certain instances, the only viable alternative will be the use of one or several telecommunications cabinets in lieu of closets.

E. TELECOMMUNICATIONS CABINETS FOR SMALL BUILDINGS WITH LIMITED SERVICES

1. Certain small buildings may not justify a separate room as the telecommunications closet. In existing buildings, sufficient space may not be available for a telecommunications closet. In these instances, a wall or floor mounted telecommunications cabinet may be used as the transition point from backbone cables to horizontal distribution. However, the size of the cabinet and the conduits serving the building must always allow room for future growth, and must always allow room for computer network equipment such as switches or routers. Telecommunications cabinets must provide:

a. Physical security to protect the contents and prevent unauthorized access. The cabinets shall be constructed of heavy gauge steel, and be lockable. Any removable panels must have tamper proof screws.

b. All power and telecommunications cables for equipment housed within the cabinet are to be contained within the cabinet. No exposed cables are allowed.

c. All power and telecommunications cables routed to or from the cabinet must be contained in conduit, surface mounted raceway, or routed within the adjacent wall.

d. The cabinet must contain a plywood backboard for mounting telecommunications hardware.

e. The cabinet must provide a means of mounting electronics equipment, including a LAN switch. Acceptable means are rails for rack mounting, or adequate space on the plywood backboard for electronics equipment wall mounting brackets.

f. The cabinet must have a minimum of one 20-amp 120 VAC quad (4-plex) electrical outlet installed inside the cabinet, on a dedicated circuit breaker from the electrical panel. The outlets shall be colored orange, and identified as Technical Power. An available general purpose power panel may be used to support the telecommunications cabinet power outlet. The power panel shall not be used to supply power to sources of electromagnetic interference such as large electric motors, arc welding, or industrial equipment. The power panel must be located in close proximity to the cabinet.

g. There shall be at least one 20-amp 110VAC general purpose convenience outlet located within 6 feet of the cabinet. White, gray, or beige colored outlets to match all other general-purpose outlets in the building shall identify the general-purpose outlet. The general purpose outlet shall not be used to power electronics equipment.

h. Any cabinet containing electronics equipment must have cooling fans installed in the cabinet.

i. The cabinet must have a telecommunications grounding busbar installed in accordance with the requirements listed in these guidelines.

j. The cabinet shall not be located in or adjacent to areas containing sources of electromagnetic interference (EMI) or radio frequency interference (RFI) such as large electric motors, power transformers, arc welding equipment, radio transmitting antennas, etc. This is a critical consideration, as EMI and RFI can render IT WAN and LAN networks totally inoperable.

k. Standard EIA 19-inch open frame equipment racks as approved for use in the Main Telecommunications

Equipment Room may be used in the TC (Please see appendix I Equipment Specifications for rack and components.). Floor standing racks must be securely bolted to the floor, and must be braced to the wall with cable ladder racking. Multiple racks in the same TC shall be interconnected with cable ladder racks.

l. Some IT equipment, such as large LAN switches, require an equipment rack with both front and rear mounting rails. Where space or equipment is limited, an open frame wall mounted equipment rack or enclosed equipment cabinet may be used. Wall mounted racks and cabinets must have two "swing-gates": one for the front access panel and a second for rear access. Provide 36" clear work space front, rear, and at one end of each equipment rack / cabinet line up for floor mounted racks / cabinets leaving sufficient front and rear rack / cabinet footprints for any equipment planned for installation. All cabinets must have a minimum of 20" from the front rail to the wall; racks must have a minimum of 20" from the front rail to the rear isle workspace. All racks must be equipped with an appropriate number and type or horizontal and vertical wire management modules both front and rear with strain relief brackets to insure proper bend radius and that strain relief is maintained for all cables.

F. ENVIRONMENTAL PROVISIONING FOR TELECOMMUNICATIONS CLOSETS

1. Walls and ceiling shall be treated and sealed to eliminate dust. Finishes shall be light in color to enhance room lighting. The floors in all low voltage equipment rooms will be; light colored, fire retardant, slip resistant, and provide protection from electrostatic discharge (ESD). In TCs that contain active electronics equipment (routers, switches, etc.), an HVAC system shall be provided on a 24 hours-per-day, 365 days-per-year basis. If the building system cannot assure continuous operation, a stand-alone unit shall be provided for the TC. The temperature and humidity shall be controlled to provide a continuous operating range of 64°F to 75°F, with 30% to 55% relative humidity. Lighting shall be a minimum of 50-foot candles measures 3 feet above the finished floor in the middle of all aisles between equipment racks and cabinets. Minimum clear height in the TC shall be 8 feet without obstructions. Fire suppression sprinklers shall be equipped with wire cages under the sprinkler heads to prevent accidental

discharge. Drainage troughs shall be placed under the sprinkler pipes to prevent leakage onto the equipment within the room.

G. ELECTRICAL PROVISIONING FOR TELECOMMUNICATIONS CLOSETS

1. Each TC shall be equipped with a minimum of two 20-amp, 110VAC quad (4-plex) electrical outlets, each on its own dedicated circuit breaker. The outlets shall be colored orange, and identified as Technical Power. These outlets shall be used exclusively for electronics equipment. Do not use Technical Power outlets for general-purpose or utility devices such as electric drills, vacuum cleaners, or coffeepots.

2. The Technical Power circuits should originate from a dedicated power panel serving the TC. However, in small buildings where this may not be cost effective, an available general purpose power panel may be used. The power panel shall not be used to supply power to sources of electromagnetic interference such as large electric motors, arc welding, or industrial equipment. The power panel must be located in the TC, or in close proximity to the TC.

3. Some IT equipment, such as large LAN switches and routers, are ordered with dual power supplies. The placement of equipment with dual power supplies shall be identified and the appropriate racks must have three, separate, dedicated 20-amp 110VAC electrical circuits from the ER Technical Power panel, each terminated in separate quad (4-plex) outlets, and be appropriately marked to identify the separate circuit breakers.

4. The TC shall have 20-amp 110VAC convenience outlets placed at 6-foot intervals around the room. White, gray, or beige colored outlets to match all other general purpose outlets in the building shall identify general purpose outlets. These outlets shall not be used to power electronics equipment.

H. TELECOMMUNICATIONS BACKBOARDS

1. All walls of the TC shall be covered with three-quarter inch A-C grade fire retardant plywood, painted with two coats light colored, non conductive fire retardant paint prior to mounting anything on the backboard. The plywood shall extend from the floor to eight (8) feet above the finished floor, and shall be mounted with the "A" side exposed. Cutouts shall be provided around any existing power and telecommunications outlets. In new construction, power

and telecommunications outlets, and light switches in the TC should be surface mounted on the plywood backboard.

I. EQUIPMENT RACKS AND CABINETS

1. Standard EIA 19-inch open frame equipment racks as approved for use in the Main Telecommunications Equipment Room shall be used in the TC. Floor standing racks must be securely bolted to the floor, and must be braced to the wall with cable ladder racking. Multiple racks in the same TC shall be interconnected with cable ladder racks. Some IT equipment, such as large LAN switches, require an equipment rack with both front and rear mounting rails. Where space or equipment is limited, an open frame wall mounted equipment rack or enclosed equipment cabinet may be used. Wall mounted racks and cabinets must have two "swing-gates": one for the front access panel and a second for rear access. Provide 36" clear work space front, rear, and at one end of each equipment rack / cabinet line up for floor mounted racks / cabinets leaving sufficient front and rear rack / cabinet footprints for any equipment planned for installation. All cabinets must have a minimum of 20" from the front rail to the wall; racks must have a minimum of 20" from front rail to the rear isle workspace. All racks must be equipped with an appropriate number and type or horizontal and vertical wire management modules both front and rear with strain relief brackets to insure proper bend radius and that strain relief is maintained for all cables.

J. GROUNDING, BONDING, AND ELECTRICAL PROTECTION

1. A #6 AWG insulated stranded copper cable shall be provided from the ER to the building main electrical service ground electrode. A Telecommunications Main Grounding Busbar (TMGB) shall be installed in the ER. All metallic conduits entering the ER, all equipment racks in the ER, and all exposed non-current carrying metal parts of telecommunications and information technology equipment in the ER must be bonded to the TMGB.

3.01 TELECOMMUNICATIONS INFRASTRUCTURE

A. The telecommunications infrastructure is the cable and connecting hardware necessary to support the signaling between telecommunications devices. The infrastructure must be designed to support the known present, and reasonably certain future requirements of the telecommunications systems. ANSI/TIA/EIA-568-A provides the standards to be applied when designing and installing the telecommunications infrastructure. Texas State utilizes the Ethernet LAN protocol at all facilities. Backbone Cabling

cables are the major service cables that interconnect various buildings on a campus, connect equipment rooms to telecommunications closets within a building, or connect one telecommunications closet to another within the same building. Backbone cables are typically large capacity (high pair count) copper cables, or fiber optic cables. (Please see Appendix I Equipment Specifications for cable and connecting hardware.)

B. Modular Information Outlet Mounting Faceplates, Frames, and Boxes (Please see Appendix I Equipment Specification for appropriate faceplates, frames and boxes).

C. Eight-Position Jack Pin/Pair Assignments

1. The preferred pin/pair assignment is the **T568A** configuration. In new construction at a new facility, the **T568A** pin/pair assignment shall be used.

4.01 CABLE SERVICE LOOPS

A. Horizontal distribution cables shall be installed with a service loop at one or both ends. The service loop shall have at least 10 feet of slack cable. Care must be exercised so that the service loop does not add excessive length to a cable run beyond the 295-foot distance limitation for horizontal distribution cable, or exceed the bending radius of the cable. The service loop shall be located in the most efficient location for future service depending on the type of cable raceway used. The necessary slack provided by a service loop can be achieved in several aesthetically pleasing methods, including but not limited to:

1. Routing cables the long way around a backboard or equipment rack.

2. Placing a service loop in the pull box of a closed conduit system.

3. Placing the service loop above the false ceiling before dropping down to the outlet location.

5.01 TERMINATION HARDWARE TO SUPPORT OTHER LOW VOLTAGE SYSTEM

A. When other low voltage systems utilize the common structured cabling system, approved termination hardware shall be used for those systems. All fiber optic products shall fully comply with Texas State standards. Copper cables shall fully comply in applications that can utilize GigaSPEED cables.

27 13 00 Communications Backbone Cabling

1.01 BACKBONE CABLING TO SUPPORT VOICE SYSTEMS

A. Voice (telephone) backbone cable shall originate at the location of the campus telephone system or remotes. The backbone cables will route to the various buildings on the campus, and/or the various floors of the building to distribute telephone service to the telecommunications closets. Voice backbone cables shall meet the following requirements:

1. Inter-building outside plant backbone cables shall be Category 3 UTP cables with an overall metallic shield. (Please see Appendix I Equipment Specification)

2. Voice backbone cables installed in underground conduits shall be jelly filled PIC cable to a termination point within the ER. The backbone cable shall then be tip spliced to an air core "tail" connecting the cable to the protected blocks. (Please see Appendix I Equipment Specification)

3. All splice cases used in the multi pair voice backbone will be waterproof. (Please see Appendix I Equipment Specification)

4. The shield of all inter-building backbone cables must be bonded to the ground lug on the primary protector panel. The protector panel must be bonded to the Telecommunications Main Grounding Busbar. The shield of all intra-building backbone cables must be bonded to the Telecommunications Main Grounding Busbar.

5. Voice backbone cable pair count shall be sized to support one (1) pair per voice station, plus 50% growth. When calculating size, voice stations shall also include fax machines and dial-up modems. (Please see Appendix I Equipment Specification)

6. Voice backbone cables shall have a minimum 10-foot service loop when terminated in the TC and ER, and at any splice points in telecommunications manholes.

2.01 BACKBONE CABLING TO SUPPORT DATA SYSTEMS

A. All intra-building TCs will be fed from the ER utilizing fiber optic and UTP backbones. Required cables are as follows:

1. 6 strand singlemode fiber
2. 12 strand multimode fiber
3. 4 each Category 6 UTP

B. Texas State IT's goal is to prepare facilities for migration of networks to Gigabit and higher backbone speeds. Singlemode fiber optic cable will be required to support most Gigabit and higher applications in the longer distances encountered in Texas State networks. Note that cable distances listed in this section refer to the terminated cable length from the patch panel in each TC to the patch panel in the main ER. Specific Texas State requirements for fiber optic backbones are:

1. All newly installed fiber optic cable and components for LAN use must be rated and installed to comply with the IEEE 802.3z 1000Base-X Ethernet Gigabit Standard.

2. All fiber optic backbone cables shall home-run through conduit from each individual TC to the Main Telecommunications Equipment Room (ER), which should be the location of the data switching equipment.

3. The standard inter-building fiber optic backbone shall be to install singlemode fiber optic cable to all buildings. All fiber optic cable with loose tube construction installed underground shall be gel filled or be constructed of appropriate waterproofing compounds. (Please see Appendix I Equipment Specification)

4. The standard cable size for inter-building fiber optic backbones is 24-strands of singlemode fiber optic cable. Strand count should be increased for specific buildings as required. All fiber optic backbones shall have a minimum of 20% spare capacity for all systems planned for use on the backbone. Where an Alternative Design has been approved to install fiber optic cable to small buildings such as utility buildings, no less than 6-strands singlemode fiber shall be installed.

5. All newly installed fiber optic cable shall be placed inside fiber optic innerduct. Where space is limited in existing conduit systems and only where an Alternative Design has been approved per 27 01 00, innerduct may be omitted. Innerduct shall be used to segregate

and identify fiber optic cables in all telecommunications manholes and at all locations where fiber optic cable is exposed.

6. Fiber optic cables shall always have a minimum 20-foot service loop at the terminating ends and all approved splice points.

7. All strands of a fiber optic cable must be terminated with connectors and tested per previously sited standards.

8. Texas State IT must design the interfaces on the LAN switch equipment based on the actual lengths of the backbone cable runs between the telecommunications closets. Texas State IT must be given the estimated cable length between the fiber patch panels of each TC and the main ER fiber patch panel in the design phase, and the actual cable length as soon as possible in the construction and installation phase.

9. There shall be no splices in fiber optic cable unless specifically allowed in the Texas State project design and specifications. Designers wishing to include fiber optic cable splices must request written approval following the "Approval for Alternative Design Solutions" process described in section 27 00 00. All splices approved by Texas State IT must be fusion splices, and there shall never be more than one splice per cable run between the ER and TC.

3.01 BACKBONE CABLING TO SUPPORT OTHER LOW VOLTAGE SYSTEMS

A. During planning for backbone cable installations, consideration shall be given to migrating other low voltage systems such as CATV, CCTV, fire alarm systems, EMS, emergency call boxes and facility control and monitoring systems to the common structured cabling system.

B. CATV specifics will be provided by current service provider. Necessary contacts will be arranged via Texas State Office of Telecommunications Services.

27 15 00 Communications Horizontal Cabling

2.01 HORIZONTAL DISTRIBUTION CABLING

A. In all cases the Texas State requires cable installed in the horizontal distribution cabling (HDC) environment to support low voltage systems including voice and data, and shall be interior rated cable. Exterior rated OSP waterproof cable will not be allowed in any HDC environment. Horizontal distribution cable is the cable that routes from the telecommunications closet to the work-area. The standard configuration for the Texas State IT to route a minimum of one four (4)-pair cable for voice and one four (4)-pair cable for data to each office or work area. In all new installations, UTP cable (Please see Appendix I Equipment Specification) shall be used for both voice and data. Where additions are made to existing buildings, UTP cable shall be used for voice and data. Additional data cables must be placed to accommodate LAN-attached printers. Splitting cable pairs from one cable to two or more outlets to avoid adding an additional four (4)-pair cable is not allowed—no exceptions. The addition of spare Information Outlet jacks at any given work area, or the addition of spare Information Outlet locations on several walls of a room, is encouraged within the limitations of the project budget.

B. CABLE TO SUPPORT VOICE SYSTEMS IN NEW INSTALLATIONS

1. Horizontal distribution cable to support voice services in new installations or major renovations and remodeling shall be plenum 4-pair UTP cable. (Please see Appendix I Equipment Specification)

C. CABLE TO SUPPORT DATA SYSTEMS

1. All intra-building TCs will be fed from the ER utilizing fiber optic and UTP backbones. Required cables are as follows:

   a. 6 strand singlemode fiber
   b. 12 strand multimode fiber
   c. 4 each Category 6 UTP

2. All horizontal distribution copper cable and components for LAN use at new or refurbished Texas State buildings, and Texas State-owned facilities, must be rated and installed to support the IEEE 802.3ab 1000Base-T Gigabit. (Please see Appendix I Equipment Specification) Additionally, the Texas State IT staff may specify

installation of copper cable and components to support Gigabit Ethernet at Texas State buildings that currently do not have cable capable of supporting these data speeds.

3. Wherever data cables are used, they must be terminated to specified modular outlets and patch panels. (Please see Appendix I Equipment Specification

D. CABLING TO SUPPORT OTHER LOW VOLTAGE SYSTEMS

1. During planning for horizontal cable installations, consideration shall be given to migrating other low voltage systems such as CATV, CCTV, fire alarm systems, EMS, emergency call boxes and building management systems to the common structured cabling system.

3.01 CABLING INTERCONNECTION AND TERMINATION HARDWARE

A. Cable interconnection and termination hardware used at Texas State facilities shall meet the following specifications:

1. COPPER BACKBONE INTERCONNECTION HARDWARE

a. All inter-building voice backbone cables shall be equipped with a primary protector panel. The protector panel must be equipped with Protector Units that provides sneak-current protection. (Please see Appendix I Equipment Specification)

2. FIBER OPTIC BACKBONE INTERCONNECTION HARDWARE

a. All fiber optic cables shall be terminated in the Texas State standard Fiber Optic Interconnection Unit patch panel. (Please see Appendix I Equipment Specification)

b. In all locations where equipment racks are installed, the rack mountable Fiber Optic Interconnection Units shall be used. (Please see Appendix I Equipment Specification)

c. All fiber optic patch cords shall be routed through cable management hardware to prevent the patch cords from becoming tangled or snagged.

d. The standard fiber optic connector for Texas State is the type 568SC. When fiber additions are made to existing facilities where type 568SC connectors are in use, 568SC connectors and new SC patch panels shall be used for the new fiber. (Please see Appendix I Equipment Specification)

e. Where electronics equipment is used that has a different type of fiber optic connector, use fiber optic patch cords with the appropriate connectors on each end, for example a SC to LC patch cord.

f. Care must be taken to maintain the minimum bend radius (10 times the cable diameter) of the fiber optic patch cord.

3. HORIZONTAL DISTRIBUTION VOICE COPPER CABLE TERMINATION HARDWARE

a. In existing facilities with Category 3 cabling; Category 5 shall be used for additional installations. Category 5 horizontal distribution voice cables shall be terminated at the Telecommunications Closet on 110 Wiring Blocks. Category 5 horizontal distribution voice cables shall be terminated at the work area end into modular six (6)-position jack.

4. CATEGORY 5 DATA CABLE TERMINATION HARDWARE FOR EXISTING FACILITIES

a. Where additions are made to existing Category 5 data cable installations, the following components shall be used:

Category 6 horizontal distribution data cables shall be terminated at the Telecommunications Closet on a Category 6 Modular Jack Panel.

27 16 00 Communications Connecting Cords, Devices, and Adapters

1.01 COPPER PATCH CORDS FOR CATEGORY 6 LINES

A. Telecommunications Contractor will be required to provide (2) Category 6 patch cords per Category 6 line installed.

1. The specific number of provided patch cords will be determined by the number of completed drops in the project; this includes any change order. (Please see Appendix I Equipment Specification)

a. 1 per installed drop- 5’ Category 6 patch cord (Blue)
b. 1 per installed drop- 15’ Category 6 patch cord (White)

B. Because UTP cable is protected from cross talk and immunity from EMI through the cables pair twist and lay configuration, care must be taken to maintain the minimum bend radius (4 times the cable diameter) of the copper patch cords. All furnished patch cords must be certified by the manufacturer to match the cable type used in the horizontal distribution. (Please see Appendix I Equipment Specification)

C. Field terminated patch cords are not acceptable. It has been common practice to assemble patch cords in the field using leftover solid-conductor cable. Field assembled patch cables will not perform to Category 6 standards, frequently do not perform to Category 5 standards, and can not be tested for proper performance using currently available field testing equipment. Patch cables shall always be made from stranded copper wire to withstand the flexing associated with patch cords. **Any existing field assembled patch cords shall be replaced with factory assembled Category 6 patch cords, before any Texas State upgrades data speeds to 100 Mbps. Do not attempt to use Category 5 patch cords for Category 6 connections.**

D. Telecommunications Contractor will be required to provide (1) fiber optic patch cord per termination. The fiber optic patch cord will be consistent with termination type and fiber optic mode. (i.e. singlemode or multimode)

27 20 00 Data Communications

1.01 Texas State Telecommunications will provide all equipment necessary for data communications. If this equipment is ordered through the contract it must be pre-approved by the Office of Telecommunications Services.

27 30 00 Voice Communications

1.01 Texas State Telecommunications will provide all equipment necessary for voice communications. If this equipment is ordered through the contract it must be pre-approved by the Office of Telecommunications Services.

EQUIPMENT SPECIFICATIONS DATA AND VOICE

1.01 DEVIATION FROM LISTED SPECIFICATIONS OR MANAFACTURES MUST BE PRE-APPROVED BY TEXAS STATE TELECOM AS PER SECTION 27 01 00.

2.01 NOT ALL OF THE FOLLOWING ITEMS WILL BE APPLICABLE TO ALL PROJECTS. PRIOR TO ORDER CONTRACTOR MUST SUBMIT, FOR APPROVAL FROM TEXAS STATE TELECOMMUNICATIONS, A COMPLETE LIST OF MATERIALS FOR PROJECT.

3.01 OTHER ITEMS MAY BE REQUIRED FOR SPECIFIC CONTRACT; IF ITME IS NOT ON FOLLOWING LIST IT MUST BE PRE-APPREOVED BY TEXAS STATE OFFICE OF TELECOMMUNICATIONS.

ITEM	MANAFACTURE	PART NUMBER	NOTE
24 port Clarity Cat6 High Density Patch Panel	Ortronics	OR-PHD68424	T568A wiring
48 port Clarity Cat6 High Density Patch Panel	Ortronics	OR-PHD68448	T568A wiring
Mighty Mo 6 (16.25”channels)	Ortronics	OR-MM6716	ER ONLY
Mighty Mo 6 (10.5”channels)	Ortronics	OR-MM6710	TC ONLY
Mighty Mo 6 Vertical Cable Management	Ortronics	OR-MM6VMD710	Must provide 2 sets of Bend Limiting Clips per vertical (OR-MM6BLC)
Mighty Mo 6 Vertical Cable Management	Ortronics	OR-MM6VML706	For use with single rack or end of row
Wall Mount Relay Rack	Ortronics	OR-604045450	Use must be approved as per section 27 01 00
Grounding Kit for Rack	Ortronics	OR-60400010	
Series II Faceplates (Fog White)	Ortronics	OR-40300158	

Series II Blank Module	Ortronics	OR-40300191	
Series II 1 unit module, Clarity Category 6	Ortronics	OR-S21600	
Series II 1 unit module, Clarity Category 6	Ortronics	OR-S22600	
Clarity Category 6 Modular Patch Cord 5’ (blue)	Ortronics	OR-MC605-06	
Clarity Category 6 Modular Patch Cord 15’ (white)	Ortronics	OR-MC605-09	
110 Wiring Block with Legs	Ortronics	OR-30200145	
110C Connecting Blocks-4 pair 110C4	Ortronics	OR-30200109	For UTP
110C Connecting Blocks-5 pair 110C5	Ortronics	OR-30200110	For Distribution
Single Channel Trough (300 Pair)	Ortronics	OR-806003194	
Dual Channel Trough (300 Pair)	Ortronics	OR-806003197	
110 Wall Mount Horizontal Cable Management Bracket	Ortronics	OR-60400020	
110 Protected Blocks	Circa	1880ENAI/NSC-100G	
Telzon Blocks, Switch Tail blocks (wire-wrap)	Telzon	284-2004-000	
Preformed Splice Closure 6.5”x28” for copper. (1200 pair or less)	Preformed	8000626	
Preformed Splice Closure 9.5”x28” for copper splices (1200 pair or more)	Preformed	8000630	
Preformed Splice Closure 12.5”x28” for copper splices	Preformed	80006219	
Preformed Splice	Preformed	80006252	For Restoration

Closure 12.5"x38" for copper splices			Purposes Only
MS ^{2} Slicing Module 25pr	3M	4000-GT/TR	
24 Port Housing	Corning	CCH-02U	SC
48-72 Port Housing	Corning	CCH-04U	SC
72 Port Connector/ Splice Housing	Corning	FDC-002	SC
Splice Trays	Corning	M67-081	
Indoor buffer tube fan out kits-6 strand	Corning	FAN-BT25-06	
Indoor buffer tube fan outkits-12 strand	Corning	FAN-BT25-12	
Category 6 UTP (blue)	Any manufacture Certified to Comply with Ortronics Category 6 warranty is acceptable.		
ATTENTION ELECTRICIANS, TELECOMMUNICATIONS AND FURNITURE CONTRACTORS			
Tombstones	Careful consideration must be taken when purchasing these items. Not all bezels are compatible with Ortronics Series II modular jacks. Do not install incompatible fixtures where Telecommunications outlets are required.		
Polk-Throughs			
In floor boxes			
Modular Furniture			

END OF DIVISION 27