City of Phoenix

Information Technology Standard

Domain:	Number:	Standard Title:	
Network and Telecommunications	nt1.10	Telecommunications Cabling System Standard	
Original Approval	November 01, 2001	**Last Updated/Approved**	12/28/2016
Compliance Date	November 01, 2001	**Last Reviewed**	12/28/2016
Owner	Enterprise Infrastructure Services		
Approvals	Chief Information Officer		

I Purpose – Summary of Intent

This standard establishes the requirements for deploying and managing the physical layer, both inside and outside plant, of the City's telecommunications infrastructure. The goal is to ensure the City's telecommunications infrastructure meets customer needs, industry safety standards, technical and performance specifications, and warranty requirements.

II Definitions – Terms Specific to the Standard

Authority having Jurisdiction (AHJ) – This includes the fire marshal, building inspector, or any other local, state, or federal inspector having jurisdiction over a City facility.

American National Standards Institute (ANSI) – ANSI coordinates the U.S. voluntary consensus standards system, providing a neutral forum for the development of policies on standards issues and serves as a watchdog for standards development and conformity assessment programs and processes.

American Standard for Testing and Materials (ASTM) – An international **standards** organization that develops and publishes voluntary consensus technical **standards** for a wide range of **materials**, products, systems, and services.

American Wire Gauge (AWG) – A standardized **wire gauge** system used since 1857 predominantly in North **America** for the diameters of round, solid, nonferrous, electrically conducting **wire**.

Building Industry Consulting Service International (BICSI) – BICSI provides information, education and knowledge assessment for individuals and companies in the Information and Communications Technology industry.

Cable Television (Community Access Television) (CATV) – a cable television system that receives television broadcasts by antenna and relays them by cable to paying subscribers.

Closed Circuit Television (CCTV) – a TV system in which signals are not publicly distributed but are monitored, primarily for surveillance and security purposes.

Communications Plenum Cable (CMP) – A cable jacketed with a fire-retardant plastic jacket of either a low-smoke polyvinyl chloride (PVC) or a fluorinated ethylene polymer.

Electro Magnetic Interference (EMI) – is a disturbance generated by an external source that affects an electrical circuit by electromagnetic induction, electrostatic coupling, or conduction.

Electrical Metallic Tubing (EMT) – is an unthreaded listed steel raceway of circular cross section. Also commonly called thin-wall.

Equipment Room (ER) – is an environmentally controlled centralized space for telecommunications equipment that usually houses a main or intermediate cross-connect.

House Fiber (HF) – A fiber optic cable that is installed within a building. Also referred to as an intra-building fiber cable.

Insulation Displacement Connectors (IDC) - An electrical connector designed to be connected to the conductor(s) of an insulated cable by a connection process which forces a selectively sharpened blade or blades through the insulation, bypassing the need to strip the jacket.

International Electrotechnical Commission (**IEC**). An international standard-setting body to develop, maintain and promote standards in the fields of Information Technology and Information and Communications Technology.

Intermediate Metal Conduit (IMC) – A threaded steel tubing heavier than EMT but lighter than rigid metallic conduit.

International Standards Organization (ISO) – An international standard-setting body composed of representatives from various national standards organizations promoting worldwide proprietary, industrial and commercial standards.

Local Area Network (LAN) – A network within a City facility or campus.

Main Telecommunications Room (MTR) - Serves as the main inter-building termination point for communications services. The MTR is the room that houses the telecommunications equipment that meets the voice, data, and other low voltage needs

of an entire building. This equipment may include the phone system, service provider equipment, LAN/MAN/WAN equipment, and video distribution equipment. It contains cross connect facilities for terminating cables and for connecting the horizontal and backbone segments to each other and to telecommunications equipment. The MTR may also support other building information systems such CATV, alarms, security, audio and other telecommunications systems. An MTR can be co-located with a TR and/or a Building Entrance Facility and/or Equipment Room. MTR, ER, and EF specifications are the same for all three rooms.

Metropolitan Area Network (MAN) – A network that interconnects multiple City facilities, that are not located within a campus, over City owned fiber optic cable.

National Electrical Code (NEC) – A regionally adoptable standard for the safe installation of electrical wiring and equipment in the United States. It is part of the National Fire Codes series published by the National Fire Protection Association (NFPA), a private trade association.

National Fire Protection Association (NFPA) - A United States trade association, albeit with some international members, that creates and maintains private, copyrighted, standards and codes for usage and adoption by local governments.

Remote Copper (RC) – A fiber optic cable that originates inside a building but terminates outside a building. Also referred to as an inter-building fiber cable.

Registered Communications Distribution Designer (RCDD) – A BICSI certification for an individual who has demonstrated knowledge in the design, integration and implementation of telecommunications and data communications/technology systems and related infrastructures.

Remote Fiber (RF) – A copper cable that originates inside a building but terminates outside a building. Also referred to as an inter-building copper cable.

Radio Frequency Interference (RFI) – Electromagnetic radiation which is emitted by electrical circuits carrying rapidly changing signals, as a by-product of their normal operation, and which causes unwanted signals (interference or noise) to be induced in other circuits.

Telecommunications Industry Association (TIA) – Accredited by ANSI to develop voluntary, consensus-based industry standards for a wide variety of Information and Communication Technologies products, and currently represents nearly 400 companies.

Telecommunications Ground Bar (TGB) – A predrilled copper bus bar with standard National Electrical Manufacturers Associations (NEMA) bolt-hole sizing. It centrally connects systems and equipment served by a telecommunications room.

Telecommunications Main Ground Bus bar (TMGB) - The dedicated extension of the building grounding electrode system for the telecommunications infrastructure. All telecommunications grounding bus bars and associated equipment are bonded to the TMGB.

Telecommunications Room (TR) – A room dedicated to distribute horizontal cable on the floor on which it is located. A TR may also be used for intermediate and main cross-connects. It serves as the connection point between the work area and the Equipment Room or MTR.

Telecommunications Service Request (TSR) – A form in SAP used by departments to formally request services from ITS Unified Communications Section.

Underwriters Laboratories (UL) – A global independent safety science company with more than a century of expertise innovating safety solutions from the public adoption of electricity to new breakthroughs in sustainability, renewable energy and nanotechnology.

Unshielded Twisted Pair (UTP) – The most common kind of copper cable. Twisted pair is the copper wire that connects the work area to the TR. To reduce crosstalk or electromagnetic induction between pairs of wires, two insulated copper wires are twisted around each other without a shield.

Wide Area Network (WAN) – A network that interconnects multiple City facilities using a service provider.

III Applicability

This standard applies to all departments, architects, contractors, and design professionals who are involved in telecommunications cabling projects for the City of Phoenix. This standard must be used for all projects involving the provision of telecommunications cabling and services.

IV Background

A structured cabling system is defined as the complete collective configuration of cabling and associated hardware at a given site installed to provide a comprehensive telecommunications infrastructure. This infrastructure is intended to serve a wide range of usage (i.e. telephone service, wired and wireless computer networks, CCTV, building automation, telecommunications rooms, etc.) and is not device dependent.

This standard assumes the user is familiar with telecommunications distribution systems, with the cable and hardware used in them, and with the installation of cabling in many different environments; including, but not limited to, LANs, MANs, and WANs as defined by the City. It is not intended to be a training manual in telecommunication distribution systems or to replace existing industry standards.

V Standard

Approval authority of a telecommunications infrastructure design, inspection, and acceptance rests solely with the City's Information Technology Services (ITS). ITS'

Communications Engineers will design telecommunications solutions that are technically appropriate to meet a department's present operational and business needs, and those of the foreseeable future. The design for specific facilities must be developed by the staff of the department or functional area in partnership with the ITS, as part of the normal facilities design, review and approval process.

ITS is responsible to ensure that the installation of all materials shall be completed in a good and workmanlike manner and in accordance with the highest standards of the telecommunications industry. All work and materials must be in full accord with the requirements of the Arizona Administrative Code, the State Fire Marshall, the Division of Industrial Safety, the National Electric Code and other applicable City and state laws or regulations. Nothing in the specifications shall be construed to permit work not conforming to these codes and orders.

1.0 Information Technology Services (ITS) Responsibilities

1.1 ITS is responsible for City of Phoenix inside and outside plant voice and data communications system facilities, network connectivity and the associated backbone cabling per Administrative Regulation (A.R.) 1.73. These responsibilities include the review of all project plans including:

1.1.1 Schematic - These are the initial planning documents and design drawings that assist departments in the early stage of the project. The Schematic Design documents shall consist of system narrative, including MTR/TR information, and campus connection points. The schematic design documents should also include drawings composed of a title sheet, single line diagrams, and site plans. These plans may be part of the overall site and or electrical plan. Schematic Design documents shall be provided for ITS review at each stage of the schematic design process with a minimum of ten workdays allowed for ITS review and comments.

1.1.2 Design Development -- As the architectural design process progresses, overlays are developed to show the various structures and systems planned for the building. Design Development documents shall consist of outline specifications. Drawings should include title sheet, single line diagram site plan, enlarged floor plans of the proposed MTR/TR and details. Design Development documents shall be provided for ITS review at each stage of the design development process with a minimum of ten workdays allowed for ITS review and comments.

1.1.3 Construction Documents - These documents depict the final design before bid submittal is undertaken. The Construction Documents shall consist of a completed cabling specification and drawing set. Construction Documents shall be provided for ITS review at each stage of the construction document process with a minimum of ten workdays allowed for ITS review and comments.

1.1.4 Working Copy – This is the bid copy.

1.1.5 Final Documentation and Drawings - These drawings and documents represent the project as it is finally constructed and delivered.

2.0 The Telecommunications System Design and Install Process

This standard provides a minimum configuration that ITS uses when planning new construction, remodeling and/or any Adds, Moves, or Changes of an existing facility. ITS shall be consulted during the early planning phase of any project.

2.1 The City of Phoenix' telecommunications distribution system design process is broken down into eight segments:

2.1.1 The **Functional Requirements** explains the functional vision that the City of Phoenix has planned for in the future.

2.1.2 The **Horizontal Segment** consists of the workstation outlets, cabling to the TR and all associated pathways.

2.1.3 The **Inside Plant Backbone Segment** refers to the Backbone cable, and the sleeves, slots, and conduits that enable the cable to pass from floor to floor: Main Telecommunication Room (MTR) to the TRs.

2.1.4 The **Outside Plant Backbone Segment** refers to the cabling and infrastructure that interconnect buildings on a campus or buildings within a metro area to form a MAN.

2.1.5 **Main Telecommunication Room (MTR), Equipment Room (ER), and Entrance Facility (EF**). The MTR is the room that houses common system equipment and hardware for terminating the campus and Backbone cables. The **Equipment Room (ER)** provides space and maintains a suitable operating environment for large telecommunications and/or computer equipment. The **Entrance Facility (EF**) is the space or room where outside telecommunications utilities enter the building. This space is usually used as the demarcation point for telecommunications terminations for the building. These rooms may all be contained within the same space.

2.1.6 The **Telecommunication Room (TR)** contains the hardware (i.e., patch panels, punch down blocks, and racks) for terminating the cabling from the workstation outlets, electronic equipment, and Backbone cables.

2.1.7 The **Special Systems** refers to any cabling system outside of the Unified Communication system. Examples are Cable Television (CATV), Closed Circuit Television (CCTV), Fire Alarm, Access Control, and paging.

2.1.8 The **Infrastructure Documentation** defines a set of guidelines for documentation related to all cabling system projects (i.e., floor plans, splice details, jack numbers, etc.).

3.0 Functional Requirements

Functional Requirements refer to the physical elements required to support telecommunications needs within a specific environment. ITS shall determine the specific telecommunications infrastructure required with the expected life cycle for telecommunications infrastructure being a minimum of 15 years.

4.0 The Horizontal Segment

4.1 General Design Considerations

4.1.1 Complete testing shall be done on all horizontal cabling and backbone cabling between the MTR/TR, Building entrance, and workstations.

4.1.2 All 4-pair UTP or fiber optic cables shall be installed using a star topology from the TR on each floor to every individual work area outlet. All cable routes shall be approved by ITS prior to installation.

4.1.3 All horizontal cables, serving the floor areas, shall originate from this one MTR/TR.

4.1.4 The horizontal cables shall be installed in cable trays, hard walls, surface mount raceways, conduit, and modular furniture poles. Pathways will be constructed from J-hooks and wire basket trays.

4.1.5 Wire basket tray is the preferred method of installation. Cable pathways shall be designed to avoid sources of Electro Magnetic Interference (EMI) and Radio Frequency Interference (RFI) (i.e., fluorescent lighting fixtures, air handling motors, power distribution panels).

4.1.6 Horizontal cables shall not be installed parallel with electrical conduits. Electrical conduits shall not be used as a method of support. Every cable, whether an individual or many grouped together, shall be self-supported. Wherever possible, cable shall be grouped together in pathways. Velcro straps shall be used for cable management. Plastic cable ties shall not be used.

4.1.7 All material in plenum spaces shall be plenum rated.

4.1.8 In hard wall offices, cables are to be routed within walls. At modular furniture workstations (cubicles), route horizontal cables within modular furniture poles and chases to non-metallic faceplates. When cubicle chases or poles are not available, a non-metallic gray liquid tight flexible conduit with corresponding wall adapter will be used to protect the cable.

4.1.9 Horizontal cables will not be connected directly to telecommunications equipment. Suitable connecting hardware (i.e. patch panels, patch cables,

jack modules, and punch-down blocks) shall be used to make the connection.

4.1.10 The installation for all horizontal cable shall adhere to the specifications identified in the current Telecommunication Industry Association (TIA) 568 Commercial Building Wiring Standards and Building Industry Consulting Service International (BICSI) standards. Care shall be taken with installation not to over pull, kink, and/or over-bend the cable. Care shall also be taken to ensure that during the installation, nicks, abrasions, burning, and scuffing of cable is prevented. Cables found to be damaged shall be replaced at the contractor's expense regardless of whether the cable passes Category 6 testing standards.

4.1.11 Care is required in the management of the horizontal cable as it enters telecommunications rooms. All cables shall be neatly organized, routed, and secured with Velcro straps to the cable support systems and management hardware in an aesthetically pleasing manner. Cable shall have the appearance of being combed, with no tangles. Cable overlap shall be kept to a minimum.

4.1.12 All Category 6 cable shall be tested per Category 6 permanent link performance level standards.

4.1.13 Category 6 termination methods shall be followed for termination at patch panels and at work area outlets. Specific care shall be taken to maintain pair twists up to point of termination within 1/2".

4.1.14 Horizontal UTP cable shall never be spliced.

4.1.15 All conductive cabling and associated components shall comply with the current version of The National Fire Protection Association (NFPA) 75, National Electrical Code (NEC). Furthermore, all fiber optic cabling shall comply with Article 770 of the NEC.

4.2 The Configuration of Outlets

4.2.1 Work area outlets have two configurations:

4.2.1.1 The **Standard** design consists of two (2) 8 pin 8 conductor (8p8c) jacks or connectors terminated on two (2) Category 6 plenum UTP cables. Both cables terminated on rack mounted patch panels in the TR.

4.2.1.2 The **Enhanced** design consists of three (3) 8p8c jacks terminated on three (3) Category 6 plenum UTP cables. One of these cables shall be terminated on a 110 termination block in the TR. Two (2) cables shall be terminated on a rack mounted patch panel in the TR.

4.3 Cable Types and Lengths

4.3.1 Two types of cables shall be used in the horizontal segment:

4.3.1.1 UTP cable will be 4-pair plenum, solid conductor Category 6 cabling that meets or exceeds all of the current TIA 568 Commercial Building Cabling Standards.

4.3.1.2 Fiber optic cable will be single mode or 50-micron laser-optimized multi-mode, graded index, and loose or tight-buffered cable.

4.3.2 Approved manufacturers for copper and fiber are: Berk-Tek copper/fiber, Superior Essex copper, Corning fiber, Prysmian fiber, or an pre-approved equal.

4.3.3 All cables shall be installed per current TIA 568 building standards to designated work area. All cable shall be terminated on Category 6 patch panels within the TR's and on Category 6 rated 8p8c modular jacks or connectors at the work area.

4.3.4 The maximum lengths of horizontal distribution cables, including service loop from the work area to the TR, shall not exceed 295 feet.

4.3.5 Patch cables and cross-connect jumpers in the TR will not exceed 20 feet.

4.3.6 All horizontal cabling will be Underwriters Laboratories Incorporated (UL) Listed Type Communications Plenum Cable (CMP). The cable sheath will be marked with the UL listing.

4.3.7 All patch cables and cross-connects that attach directly to active equipment shall meet the same performance requirements as the installed cabling system.

4.3.8 Care shall be taken to maintain minimum bending radii and to avoid kinking when dressing excess cable at termination locations.

4.3.9 Cable service loops shall be provided at both ends of cable runs to accommodate future cabling system changes.

4.3.10 The minimum amount of slack shall be 8 feet for all horizontal cables at each termination point.

4.3.11 Service loops placed during installation of 4-pair horizontal cables should be coiled neatly above the ceiling in a figure-eight configuration.

4.3.12 Service loops placed during installation of fiber optic cables should be coiled neatly above the ceiling in a large loop configuration that will meet the manufactures, minimum bend radius requirements.

4.4 Termination Hardware Requirements at the Outlet

4.4.1 Each UTP plenum Category 6 cable will terminate all 4 pairs at the outlet with an 8-pin, 8-conductor universal T568 modular jack or plug. Modular plugs shall be used for facility administered outlets (i.e. CCTV, card access, Wifi). All jacks, plugs, and patch panels will be terminated in a T568-B configuration.

4.4.2 Faceplates for any designated outlets shall be from the same manufacturer with coinciding part numbers for the jacks being used.

4.4.3 For Standard Jack Configurations, faceplates shall be a single-gang 2-position configuration, for hard walls and furniture applications.

4.4.4 For Enhanced Jack Configurations, faceplates shall be a single-gang 3-position configuration, for hard walls and furniture applications.

4.5 Workstation Identification

4.5.1 The workstation identification numbers are assigned by ITS and are crucial to the implementation of service to the project.

4.5.2 Workstation identifications shall be labeled with either computer-generated labels or by an ITS approved label maker. No workstation identification numbers will be handwritten.

4.5.3 Workstation identification numbers are to be completed at the beginning of Construction Document preparation. A hard copy of the workstation identification numbers shall be provided to the installation team.

4.5.4 The workstation identification number will be placed above the workstation identification on the faceplate, outlet and cubical area. Hard wall offices will have a label placed approximately 60” Above finished floor on the hinged side of the door frame.

4.5.5 All cables shall be labeled with a computer-generated label within 6” of the Jack and within 2” to 4” from the Patch Panel. Cable 1 will be labeled with an (A); Cable 2 will be labelled with a (B) (Example: PCH-01NC001A PCH-01NC001B). If a cable for a voice installation needs to be added each cable will be labelled as follows Cable 1 with a V1 (Example: PCH-01NC001V1).

4.6 Structures for Supporting the Horizontal Cabling

4.6.1 Special attention shall be given when designing and installing the type and layout of structures to support the horizontal cabling. The design and install shall accommodate all foreseeable cabling changes needed for future capacity and applications.

4.6.2 The City of Phoenix requires that the spaces above the ceiling grid and or under a raised floor be used to route the horizontal cabling.

4.6.3 Hard walls and power poles shall be used at the work area.

4.6.4 Free standing relay racks, Heavy Duty 19" x 84", drilled both sides per TIA with universal thread standards, properly anchored will be used. Wall mount racks will only be used with ITS written approval.

4.6.5 When cable tray is not feasible to install, cable supports (J-Hooks) or pipe (EMT or IMC if required) shall be used. J-Hooks shall be installed by means that are structurally independent of the suspended ceiling, its framework, or supports. These cable supports shall be spaced no more than 5-feet apart.

4.6.6 Cable trays shall be wire basket trays. They shall be at least 18-inches wide and 2 inches deep. Smaller buildings and secondary tray sections serving fewer than 50 work areas may utilize a 12-inch wide tray.

4.6.7 In the TR where cable trays or cable racking are used, the appropriate means of cable management, such as reusable Velcro cable ties, shall be used to create a neat and practical installation.

4.6.8 Cable trays shall be secured on 5-foot centers using single center-mounted steel supporting rods and bottom "T" connector (for 12” tray or smaller), angled wall supports, or a standard trapeze type support system.

4.6.9 It is important that the path for the cable tray is free and clear of obstructions, such as HVAC ducts, large pipes and structural beams within the building. Specified Technologies, Inc. EZ Path fire rated pathways or approved equivalent shall be used to penetrate fire rated walls.

4.6.10 Cable trays shall be grounded and bonded as required by the NEC.

4.6.11 Cable trays will not be placed within 5 inches of any overhead light fixture and within 12 inches of any electrical ballast.

4.6.12 Cable trays shall not be installed parallel to the building lighting system.

4.6.13 A minimum clearance of 8 inches above the cable tray shall be maintained at all times. All bends and joints in the cable trays shall be fully accessible.

4.6.14 A minimum size ¾-inch EMT conduit shall be used from the workstation outlets and stubbed into the nearest accessible ceiling space. Furniture feed cables will be installed in either a power pole or down a wall with the appropriate conduit size. Conduit size will be based off a 40% fill ratio.

4.6.15 All fire walls requiring penetration for low voltage cabling pathways shall be fire-stopped in accordance with the NEC NFPA-75 and all local and statutory codes. Use of STI EZ Path products or approved equivalent is recommended. Otherwise, sleeves shall have connectors and plastic bushings on both ends and be properly anchored to walls (e.g., anchored unistrut with strut clamps).

4.6.16 Conduit will be installed with a pull string with a minimum test rating of 200 pounds.

4.6.17 The ends of all conduits will be reamed and have plastic bushings to eliminate sharp edges that can damage cables during installation.

4.6.18 Conduit runs shall be designed and installed to:

4.6.18.1 Follow the most direct route possible with no more than two 90-degree bends between pull points.

4.6.18.2 Contain no continuous sections longer than 100 feet. Pull points shall be used for runs that exceed 100 feet in length. Pull box sizes shall be specified to meet the bend radius requirements for the cable.

4.6.19 Conduit will be bonded to ground on one or both ends.

4.6.20 Conduit shall not be installed through areas in which flammable materials may be stored or over or adjacent to boilers, incinerators, hot water lines, or steam lines.

4.6.21 The radius of a conduit bend shall be at least 6 to 10 times the diameter of the conduit, depending on its size. Choose the bend radii for conduit using the cable manufacturer specifications for installation.

4.6.22 A 4 “x4”x2½-inch back box with a single gang plaster ring shall be used at each work area for cable installations.

4.6.23 A metal/plastic single gang box eliminator will be required for existing installations.

4.6.24 For additional information on conduit bend radius requirements and recommendations, see specifications in ANSI/NFPA 75 and TIA 569.

5.0 The Inside Plant Backbone Segment

5.1 General Design Considerations

5.1.1 The Inside Plant Backbone Segment provides copper and optical fiber connectivity between the MTR, and EF, and the MTR to the TR.

5.1.2 The Inside Plant Backbone Segment consists of the backbone cable and the supporting infrastructure within a building.

5.1.3 All copper backbone cable shall be terminated on a 110 type termination block in the MTR and in the TR for all new construction. For installations on existing termination blocks, a 66 style punch down block will be accepted.

5.1.4 All punch down blocks shall be wall mounted on a minimum 4ft x 8ft x ¾ in. A/C rated fire retardant treated plywood with stamp clearly visible, on all applicable walls of the MTR and the TR. Non fire retardant treated plywood may be used if plywood is painted with 2 coats of fire retardant paint. The stamp on any painted fire retardant treated plywood shall remain visible.

5.1.5 Inside plant copper backbone cables shall consist of 24 AWG, category 3 or better, multi-pair cables, riser or plenum rated as applicable.

5.1.6 All singlemode backbone fiber shall be terminated using SC connectors. All multimode backbone fiber shall be terminated using LC connectors.

5.2 The Size of the Copper Backbone Cable

5.2.1 The size of the backbone cable is dependent on the number of service provider circuits (i.e., DSL, 1FB, etc.) being supported by the TR on that floor.

5.2.2 The most commonly available cable sizes are 50, 100, 200, and 300 pairs.

5.2.3 The minimum number of copper cable pairs required for each type of outlet is project specific and will be determined by the ITS Communications Engineer during the design phase.

5.3 The Size of the Fiber Optic Backbone Cable

5.3.1 The size of the fiber optic cable from the MTR to the TR will be no less than a 12-strand multimode or singlemode. ITS shall determine the fiber type during the design phase.

5.4 Structures to Support Vertically Aligned TR's

5.4.1 TR's that are vertically aligned shall be connected with EZ Path or approved equivalent.

5.4.2 Floor penetrations shall be positioned 6 inches away from near wall on which the backbone cables can be supported.

5.4.3 Penetrations shall not be placed directly above or below the termination fields.

5.4.4 All floor penetrations installed shall conform to the NFPA, NEC, and local fire codes.

5.4.5 Penetrations shall be properly fire-stopped at all times in accordance with all applicable building codes.

5.4.6 If sleeves are used, they shall have connectors or plastic bushings on both ends and be properly anchored to walls (e.g., anchored unistrut with strut clamps).

5.4.7 Conduit sleeves shall be 4 inches in diameter unless a structural engineer requires a smaller size or obstructions are present and shall be fitted with plastic bushings on both ends and equipped with pull strings. Sleeves will not exceed 40% of the conduit fill ratio.

5.5 Structures to Support Horizontally Offset TR

5.5.1 ITS recommends stacking all TRs within a building. ITS understands that there are times when this is not possible.

5.5.2 TRs that are not vertically aligned shall be connected with cable trays and/or conduits.

5.5.3 ITS Communications Engineers will determine the number of conduits required. Conduit capacity shall not exceed 40 % fill ratio.

5.5.4 Pull boxes are required in sections of conduit that are 100 feet or more in length or that contain more than two 90° bends. Pull boxes shall not be used in lieu of a bend.

5.5.5 Cable trays and conduit that are used to support horizontal cabling may be used to support backbone cables provided the following conditions are met:

5.5.5.1 The cable trays' carrying capacity can accommodate the backbone cables.

5.5.5.2 The backbone cables shall be UL Listed Type CMP if they are installed in air-handling plenums without conduit.

5.5.5.3 The backbone cables conform to NEC, and comply with the State of Arizona and other AHJ fire codes as interpreted by the State Fire Marshal's department.

5.5.5.4 Conduit shall be used to route the backbone cables between the TR wherever feasible.

5.5.5.5 Conduit shall be grounded and bonded at each end.

5.5.5.6 Conduit shall be installed with a mule tape with footage markers along with bushings at both to protect the cable from damage.

5.5.6 Cable trays and conduits that enter the TR shall be placed near the corner and as close as possible to the wall where the backboard is mounted to allow for proper cable racking and to minimize the cable route inside the TR.

5.5.7 Cable trays and conduit located in the ceiling shall protrude into the TR 4 inches and a minimum of 7½ feet above the finished floor.

5.5.8 All backbone cables are to be labeled based on a cable number assigned by ITS. The number of cable pair will also be included.

5.5.9 Performance tests are required for acceptance of newly installed cables. All field-testing shall comply with the latest version of the TIA 568 Commercial Building Telecommunications Wiring Technical Service Bulletin specification and shall be used as a framework for testing all UTP cables.

6.0 The Outside Plant Backbone Segment

6.1 General Design Considerations

6.1.1 The Outside Plant Backbone Segment consists of the cables and structures needed to interconnect building to building and building to metro area distribution frames (MADFs). It includes underground conduit, underground cables, splice boxes, manholes, pull boxes, outside terminals, and support structures.

6.1.2 ITS shall be consulted during the early utilities planning phase of a project to provide technical requirements for the Outside Plant Backbone Segment.

6.1.3 ITS Communications Engineers will identify cable routes from building to building, select cable distribution methods, determine the underground cable requirements, identify the types of cable used in the segment, determine splice boxes, manholes, and pull box requirements, and satisfy electrical protection and bonding/grounding requirements.

6.1.4 All Outside Plant Backbone Segment shall be designed and installed to BICSI Telecommunications Distribution Methods Manual (TDMM), BICSI Customer-Owned Outside Plant manual, and TIA-758 Specifications for Outside Plant Construction.

6.2 Cable Distribution

6.2.1 ITS Communication Engineers will determine the best cable distribution method along a proposed cable route. ITS requires all outside plant cabling

be placed in conduits. Neither direct buried nor aerial cable are approved distribution methods.

6.3 Conduit Requirements

6.3.1 Underground cabling in conduit cable projects shall be installed based on engineering drawings approved by ITS.

6.3.2 All submitted drawings and documentation shall include the following:

6.3.2.1 Submittals and/or details of a typical trench cross section showing cable and duct locations in the trench, clearances from final grade, backfill materials and depths, pavement cutting information, and compacting requirements for both paved and unpaved areas.

6.3.2.2 Construction notes applicable to the work being performed.

6.3.2.3 Scale drawings showing location ties to existing structures, cable, conduit, utility boxes, and any conflicting substructures and profile drawings of congested areas where vertical and horizontal separation from other utilities is critical during cutting and placing operations.

6.3.2.4 Legends explaining symbols of all relevant structures and work operations.

6.3.2.5 Cable type and counts, and directions of feed.

6.3.2.6 Conduit types, dimensions, and wall-to-wall measurements when used with pull boxes or manholes.

6.3.3 All areas around the conduit entrances shall be free of any construction, storage, or mechanical apparatus.

6.3.4 Conduit stubs entering the building shall extend beyond the perimeter landscaping. All conduit ends adjacent to the building shall be flagged for easy identification.

6.3.5 All entrance conduits shall be securely fastened to the building.

6.3.6 All unused entrance conduits shall be capped and installed with 1250-pound detectable mule tape.

6.3.7 Conduit entering from a below grade point shall extend 4 inches above the finished floor.

6.3.8 Conduit entering from ceiling shall terminate 4 inches below the finished ceiling.

6.3.9 All cables entering a building shall conform to the grounding and bonding requirements listed in NEC Articles 250 and 800.

6.3.10 All utilities shall be identified and located prior to any digging, including all subsurface facilities such as power, gas, water, traffic and outdoor lighting.

6.3.11 Orange warning tape containing metallic tracings shall be placed a minimum of 18 inches above the buried conduits to minimize any chance of an accidental dig-up.

6.3.12 The minimum depth of a trench shall allow 24 inches of cover from the top of the cable to the final grade point. See NEC 300 for condition pertaining to other depths. Thirty-six (36) inches of cover is recommended. For trench detail information, see Attachment #1.

6.3.13 The following minimum vertical or horizontal separations shall be maintained between telecommunications facilities and other facilities sharing a common trench.

6.3.13.1 Power or other foreign conduits: 3 inches of concrete, 4 inches of masonry, or 12 inches of well-tamped earth.

6.3.13.2 Pipes such as gas, oil, water: 6 inches when crossing, 12 inches when parallel.

6.3.13.3 Railways: 3 feet below top of rails.

6.3.14 Conduit shall be encased in concrete when the following conditions exist:

6.3.14.1 Minimum conduit depth cannot be attained.

6.3.14.2 Conduit shall pass under roads, driveways, railroad tracks, or when bend points are subject to movement.

6.3.14.3 Conduit contains high priority/mission critical services as determined by ITS.

6.3.15 Reinforcing bars and/or crutches within the concrete shall be used at any location subject to potentially extreme stress.

6.3.16 The conduit shall be sealed inside the building to prevent rodents, water, or gases from entering the building.

6.3.17 All bends shall be long, sweeping bends with a radius not less than 6 times the internal diameter of a conduit 2 inches or smaller, or 10 times the internal diameter of a conduit larger than 2 inches.

6.3.18 Underground conduit shall be PVC Schedule 40, corrosion-resistant plastic.

6.3.19 There shall be no more than two 90-degree bends or 600 feet between pulling points on all underground cables without prior ITS approval.

6.3.20 Conduit bends that extend above ground shall be metallic.

6.3.21 All metallic conduit and sleeves shall be reamed, bushed, and capped.

6.3.22 Metal sleeves through foundation floors and/or walls shall extend to undisturbed earth to prevent shearing.

6.3.23 All open conduits shall be provided with a continuous run of 1250-pound detectable mule tape.

6.3.24 The minimum number of conduits for any installation of cable shall be two 4 inch conduits with a continuous 1250-pound detectable mule tape.

6.3.25 The quantity and size of underground entrance conduit are based on the anticipated number and type of telecommunications circuits that will be brought into the building.

6.3.25.1 Telephone entrance copper pairs with conduit - for less than 1000 pairs utilize one 4-inch conduit and a spare 4-inch conduit.

6.3.26 All conduits containing fiber or copper shall provide a continuous run of 1250-pound detectable mule tape.

6.3.27 Contractor shall schedule inspection with a minimum of 24-hour advance notice with the ITS Communications Engineer after conduit and manholes are installed but before slurry and dirt backfill.

6.3.28 All underground conduits shall be mandreled and free of debris prior to ITS inspection.

6.4 Cable Requirements

6.4.1 ITS requires two types of cable for outside use in the outside plant backbone segment: copper cable and fiber optic cable.

6.4.2 Filled polyethylene-insulated conductor (PIC) cable shall be used for all outside plant copper cable. Filled cable preserves the integrity of the cable by providing physical protection against moisture penetration.

6.4.3 All underground copper cable requires an armored sheath to resist rodent and penetration type damage.

6.4.4 All cables shall be marked with cable length, cable code, date and location of manufacturer.

6.4.5 Outdoor optical fibers shall be contained in loose buffer tubes with each buffer tube containing 12 fibers. The fibers shall not adhere to the inside of the buffer tube. Each fiber shall be distinguishable by means of color coding in accordance with EIA- 598, Optical Fiber Cable Color Coding.

6.4.6 The cable shall contain at least one ripcord under the inner sheath and under the steel armor for armored cable.

6.4.7 All cable jackets or sheaths shall be free of holes, splits, and blisters.

6.4.8 The cable jacket shall contain no metal elements and shall be of a consistent thickness.

6.4.9 The actual length of the cable shall be within -0/+1% of the length markings.

6.4.10 The cable jacket of a cable containing two different fiber types (hybrid construction) shall be marked to indicate quantity of each fiber type, identity of each fiber type, and the fiber sequence.

6.4.11 The manufacturer maximum pulling tensions shall not be exceeded during cable installation.

6.4.12 ITS approved manufacturers include Corning, Berk-Tek, Prysmian, or pre-approved equivalent.

6.4.13 ITS approved fiber types are OM3 and OM4 laser optimized, and single mode fiber.

6.4.14 All singlemode backbone fiber shall be terminated using SC connectors. All multimode backbone fiber shall be terminated using LC connectors.

6.5 Manhole and Hand Hole Requirements

6.5.1 A standard manhole size shall be 4 feet wide, 4 feet long, and 4 feet deep.

6.5.2 A standard hand hole size shall be 2 feet wide, 3 feet long, and 18 inches deep. See Attachment #3 for more information.

6.5.3 Manholes shall be used when a pull point is needed within any right of way or when conduit in excess of 3 inches in diameter is installed. Hand holes shall be used in landscape areas and where conduits 3 inches or less in diameter are installed. The ITS Communications Engineer will make the final determination on which type of pull point is required.

6.5.4 For detailed information regarding traffic rated lid specifications, cable racking, and manholes, see Attachment #2.

7.0 The Main Telecommunications Room (MTR), Equipment Room (ER), and Entrance Facility (EF)

7.1 Design Requirements

7.1.1 Rooms shall adhere to requirements defines in the NEC, NFPA 75, and other applicable codes.

7.1.2 Minimum ceiling height shall be 8 feet, 6 inches.

7.1.3 The doors shall be a minimum of 3 feet wide and 6 feet, 8 inches tall. The doors must be lockable.

7.1.4 The floor shall be sealed concrete or static dissipative tile to minimize dust and static electricity.

7.1.5 Rooms shall contain continuous and dedicated environmental control (24 hours per day, 365 days per year). The heating, ventilation, and air conditioning system shall maintain the room temperature between 64° F and 75° F. The relative humidity shall be sustained between 30% and 55%.

7.1.6 The room should not have a drop tile or other false ceiling. Open ceiling is preferred.

7.1.7 The lighting shall provide a minimum equivalent of 50 foot-candles when measured 3 feet above the finished floor.

7.1.8 All light fixtures shall be mounted a minimum of 8 feet 6 inches above the finished floor.

7.1.9 All controls and light switches shall be located inside the room.

7.1.10 All walls shall be lined with ¾-inch fire treated plywood with stamp clearly visible. ¾-inch A/C Grade non-treated plywood can be used if painted with two coats of white fire-retardant paint. The plywood shall be securely fastened to the wall-framing members.

7.1.11 Outlets shall be located on cable trays above equipment racks or within equipment racks as specified by the ITS engineer.

7.1.12 Separate duplex 120V AC convenience outlets (for tools, test sets, etc.) shall also be installed at 18 inches above the finished floor at 6 foot intervals around perimeter walls.

7.1.13 The MTR shall be provided with an electrical ground pursuant to NEC Article 250, TIA-607.

7.1.14 Acoustic noise levels in the MTR shall be maintained to a minimum by locating noise-generating equipment outside the MTR.

7.2 The Size of the MTR

7.2.1 The size of the MTR depends on the size and variety of the equipment to be installed and the size of the area that the room will serve. The MTR shall provide enough space for all planned equipment and cables, including any environmental control equipment, power distribution units/conditioners, and uninterrupted power supply systems that will be installed in the room.

7.2.2 The MTR should be sized according to the equipment's needs and not by the square footage of the floor or building. The minimum size of the MTR is 10 feet x 12 feet.

7.3 The Location of the MTR

7.3.1 The MTR shall be located on the first floor and as close as possible to a building entrance so that it is accessible for the delivery of large equipment.

7.3.2 The MTR shall not be located in any place that may be subject to water or steam infiltration, humidity from nearby water or steam, heat, or any other corrosive atmospheric or environmental conditions.

7.3.3 The MTR shall not be located near electrical power supply transformers, motors, generators, transmitters, radar transmitters, induction heating devices, and other potential sources of electromagnetic interference.

7.3.4 The MTR shall not share space in or be located near electrical closets, boiler rooms, washrooms, janitorial closets, or storage rooms.

7.4 Termination Hardware Requirements in the MTR

7.4.1 The MTR serves as the main cross connect for backbone cables and equipment. Inter-building backbone cables and service provider cables are also cross connected in the MTR.

7.4.2 Cabinets are used in lieu of equipment racks based upon security or other factors deemed necessary.

7.4.3 Space for voice and data cable terminations shall be located on one continuous wall or rack.

7.4.4 There shall be a clear space of 8 inches above the top 110 block and 8 inches below the bottom 110 block for cable placement.

7.4.5 There shall be additional backboard space for routing cables, patch cables, and/or cross connects jumpers.

7.4.6 Termination hardware shall be wall mounted, or rack mounted in either equipment racks or enclosed data cabinets.

7.4.7 Space for terminations of each type of cable shall be located on one continuous wall or rack.

7.4.8 A clear space of at least 8 inches above and below the connecting hardware shall be provided for cabling handling.

7.4.9 There shall be additional backboard space for routing cables, and/or cross-connect jumpers.

7.4.10 The horizontal data cabling shall be terminated on 110-type independent insulation displacement connectors (IDC) placed in patch panels for data cabling in the TR.

7.4.11 All UTP data cables shall be terminated on 48 fixed-port high density Category 6 patch panels which are mounted on wall racks, in a free standing equipment rack, or in an enclosed data cabinet. Cables shall be terminated in the T568-B configuration.

7.4.12 For smaller installations, smaller port density patch panels can be used if approved by ITS.

7.4.13 Patch panels shall be clearly labeled with a type or computer generated label above the 8p8c module.

7.4.14 The approved manufacturer for all data patch panels are Ortronics or an ITS approved equivalent.

7.4.15 110-type Wiring Blocks for all voice cabling will be used if separate voice cable is needed.

7.4.16 The connecting block shall support the appropriate Category 6 applications and will use either cross-connect wire or patch cables.

7.4.17 The blocks shall be made of flame-retardant thermoplastic, with the base consisting of horizontal index strips for termination up to 25 pairs of conductors.

7.4.18 The block shall be available in 50-, 100-, and 300-pair sizes and have detachable standoff legs.

7.4.19 The blocks shall have termination strips on the base to be notched and divided into 4- or 5-pair increments.

7.4.20 The block shall have clear label holders with the appropriate inserts available. The insert labels provided with the blocks shall contain vertical lines spaced on the basis of circuit size (1-, 3-, 4- or 5-pair) and shall not interfere with running, tracing or removing cross connect wire/patch cables.

7.4.21 All blocks and patch panels will have bases available in 19-inch panels and high-density frame configurations for rack or wall mounting with cable management hardware.

7.4.22 All blocks and patch panels will have connecting blocks used for either the termination of cross-connect (jumper) wire or patch cables.

7.4.23 All connecting blocks shall be available in 2-, 3-, 4-, and 5-pair sizes.

7.4.24 All connecting blocks shall have color-coded tip and ring designation markers and be single piece construction.

7.4.25 The blocks shall have connecting blocks with a minimum of 200 re-terminations without signal degradation below standards compliance limit.

7.4.26 All connecting blocks shall support wire sizes of solid 22-26 AWG.

7.4.27 All bases and blocks shall be UL Listed 1863, TIA-568, ISO/IEC 11801 and Category 6 compliant and meet TIA Category 6 electrical performance.

7.4.28 Fiber optic cables will be terminated on connector panels in a fiber distribution panel.

7.4.29 All terminated fibers shall be properly dressed and mounted in rack mount fiber panels. All patch panel bulkhead spaces shall contain either connector panels or blank panels.

7.4.30 The connector panels shall contain multimode and/or single mode (ceramic ferrule) connector coupling compatible with the SC and LC connectors.

7.4.31 All fiber optic cables shall have fusion spliced using factory polished connectors. Field terminated connectors are not acceptable.

7.4.32 The fiber housing unit shall be configured with fiber patch cable troughs to assist in cable management.

7.4.33 Relay racks shall be freestanding, properly anchored relay racks, heavy duty 19" x 84", drilled both sides per TIA universal thread standards, rack unit markings. Each relay rack shall be equipment with an attached 6-inch wide vertical management trough with a bi-directional opening cover.

7.4.34 Cross-connect fields, patch panels, and active equipment in the TR shall be placed to allow all cross-connections and interconnections via jumpers,

patch cables, and equipment cables. Lengths will not exceed the following channel specifications:

7.4.34.1 20 feet per patch cables or jumpers in the horizontal cross-connect.

7.4.34.2 33 feet total for patch cables, jumpers and/or line cables used to connect to the outlet.

7.4.35 Total channel length should not exceed 328 feet.

7.5 Structures to support the cabling in the MTR

7.5.1 Structures to support the cabling in the MTR are the same as the TR.

7.5.2 Basket tray, equipment racks, data equipment cabinets, and wire management troughs shall be used in the MTR to keep the cabling and equipment organized.

7.5.3 Basket tray shall be used to route bulk telecommunications cables within the MTR.

7.5.4 Basket tray shall be at least 12 inches wide and placed under a raised floor or 7 feet above a finished floor to coincide with the top of the equipment racks and cabinets.

7.5.5 Basket tray shall provide a proper clearance from HVAC ducting or other obstacles.

7.5.6 All basket tray shall be bonded and earthed.

7.5.7 Free standing equipment racks shall be 19 inches wide by 84 inches tall, double sided with ANSI/EIA-310D spacing and 12-24 threads. Enclosed cabinets will be equipped with 10-32 threads.

7.5.8 A three foot working clearance shall be maintained in the front and back of each equipment rack. This clearance shall be measured from the outermost surface of the equipment and connecting hardware rather than from the equipment rack since some of these devices may extend beyond the equipment rack.

7.6 Cable pathway entering the MTR

7.6.1 Sleeves, slots, EZ Paths, and conduits are used to route the cables entering and exiting the MTR.

7.6.2 Sleeves shall conform to the fire stopping requirements as established by the National Electrical Code and local fire codes. Underwriters

Laboratories (UL) listing of each fire stopping system shall be provided to the ITS Engineer by the installation contractor.

7.6.3 Sleeves shall not be left open after cable installation and they shall be properly fire stopped in accordance with applicable building codes. All conduits will be fire stopped in accordance with fire codes as interpreted by the State Fire Marshall Authority Having Jurisdiction (AHJ).

7.6.4 Conduit will be metallic conduit, 4 inches in diameter.

7.6.5 The conduit will be grounded, equipped with a pull string, and conduit ends will be bushed to protect the cable.

7.6.6 STI EZ Path or approved equivalent shall be used over standard sleeve penetrations through fire rated walls unless the fire wall is required to be sealed for additional fire suppression requirements.

8.0 Telecommunication Room (TR)

The Telecommunication Room (TR) is the space where the horizontal cable is terminated on patch panels, 110-blocks, connector panels, and is where the horizontal cable cross-connects to the inside plant backbone cable. The TR houses equipment for the voice, data, and other low voltage needs of one floor of a building. The TR may also be used to support other building information systems such CATV, alarms, security, audio/Video, 800 MHz radio, other wireless systems, and other telecommunications low voltage systems. An MTR and TR may be co-located within the same room. Additional space, racks, electrical and cable management are required to support the MTR.

8.1 The minimum TR sizes shown are based on providing telecommunications service to one individual work area of 100 square feet as specified in the BICSI Telecommunications Distribution Methods Manual.

8.1.1 5,000 square feet or less = 10 feet × 8 feet

8.1.2 5,000 to 8,000 square feet = 10 feet × 10 feet

8.1.3 8,000 to 10,000 square feet = 10 feet × 12 feet

8.2 Additional floor space in the TR shall be required for applications such as video cabling and equipment, fire alarm panels and/or building monitoring equipment.

8.2.1 Multiple TRs are required if the usable floor space to be served exceeds 10,000 square feet or the cable length between the work area outlet and the horizontal cross-connect in the TR exceeds 295 feet.

8.3 The Location of the TR

8.3.1 The TR is the main focal point for communications services serving a specific floor and shall be designed as an integral part of the overall building.

8.3.2 The TR shall be located as close as possible to the center of, and on the same floor as, the workstation area it serves to minimize the horizontal cable lengths.

8.3.3 Access to the TR shall be located directly from hallways and not from conference rooms, offices, electrical space, or mechanical spaces.

8.3.4 The TR shall not be located near any threat of flooding. All water threats shall be removed or contained. A TR with a water threat requires prior approval by ITS, and if approved, will require a drain.

8.3.5 At no time is a TR to be located near power supply transformers, elevator or pump motors, generators, radio transmitters, and other potential sources of EMI.

8.3.6 TRs shall not share space with electrical, janitorial, or storage facilities.

8.3.7 TRs shall be stacked vertically in a multi-story building.

8.3.8 When secure and controlled access to a TR cannot be guaranteed, free standing or wall mounted lockable cabinets will be used.

8.3.9 Free standing or wall mounted lockable cabinets will be used in joint use facilities or in facilities not owned by the City of Phoenix where non-city staff have access to a TR.

8.4 Design Requirements

8.4.1 Rooms shall adhere to requirements defines in the NEC, NFPA 75, and other applicable codes.

8.4.2 Minimum ceiling height shall be 8 feet 6 inches.

8.4.3 The doors shall be a minimum of 3 feet wide and 6 feet 8 inches tall. The doors must be lockable.

8.4.4 The floor shall be sealed concrete or static dissipative tile to minimize dust and static electricity.

8.4.5 Rooms shall contain continuous and dedicated environmental control (24 hours per day, 365 days per year). The heating, ventilation, and air conditioning system shall maintain the room temperature between 64° F and 75° F. The relative humidity shall be sustained between 30% and 55%.

8.4.6 The TR should not have a drop tile or other false ceiling. Open ceiling is preferred.

8.4.7 The lighting shall provide a minimum equivalent of 50 foot-candles when measured 3 feet above the finished floor.

8.4.8 All light fixtures shall be mounted a minimum of 8 feet, 6 inches above the finished floor.

8.4.9 All controls and light switches shall be located inside the room.

8.4.10 All walls shall be lined with 3/4-inch fire treated plywood with stamp clearly visible, 8 feet high, as measured 4 inches from finished floor.

8.4.11 ¾-inch A/C Grade plywood can be used if painted with two coats of white fire-retardant paint. The plywood shall be securely fastened to the wall-framing members.

8.5 Electrical requirements

8.5.1 ITS will establish the electrical requirements for each TR based on equipment specified for the facility. But, at a minimum, a TR will have four dedicated 3-wire 120 VAC quad electrical outlets on separate 20-ampere rated branch circuits.

8.5.2 Separate duplex 120 VAC convenience outlets (for tools, test sets, vacuums.) installed at least 18-inches above the finished floor at 6-foot intervals around perimeter walls.

8.5.3 Each TR shall be provided with an electrical ground on a system and building sized buss bar as defined by NEC Article 250.

8.5.4 Buss bars shall be mounted 6 feet 6 inches above the finished floor if basket tray is included in the design. If basket tray is not part of the design, buss bars shall be located near, but not behind, the backbone sleeves between floors. The Telecommunications Ground Bus bar (TGB) shall be sized to accommodate all racking and systems grounding lugs. The TGB shall be required to achieve a maximum resistance reading of 5-ohms. The TGB should be at least 6 mm thick by 50 mm wide.

8.5.5 This grounding bar shall be connected to a main building ground electrode, and shall be common to all TRs.

8.5.6 All grounding systems shall be provided in the TR, and MTR which shall include but not limited to, cable bonding, cabinet and relay rack ground kits with #6 THHN wire, ground busses, and ground clamps.

8.5.7 All grounds are to be installed per TIA-607, Grounding and Bonding Requirements for Telecommunications in Commercial Buildings.

8.6 Termination Hardware Requirements

8.6.1 Termination hardware shall be wall mounted, or rack mounted in either equipment racks or enclosed data cabinets.

8.6.2 Space for terminations of each type of cable shall be located on one continuous wall or rack.

8.6.3 A clear space of at least 8 inches above and below the connecting hardware shall be provided for cabling handling.

8.6.4 There shall be additional backboard space for routing cables, and/or cross-connect jumpers.

8.6.5 The horizontal data cabling shall be terminated on 110-type independent insulation displacement connectors (IDC) placed in patch panels for data cabling in the TR.

8.6.6 All UTP data cables shall be terminated on 48 fixed-port high density Category 6 patch panels which are mounted on wall racks, in a free standing equipment rack, or in an enclosed data cabinet. Cables shall be terminated in the T568-B configuration.

8.6.7 For smaller installations, smaller port density patch panels can be used if approved by ITS.

8.6.8 Patch panels shall be clearly labeled with a type or computer generated label above the 8p8c module.

8.6.9 The approved manufacturer for all data patch panels are Ortronics or an ITS approved equivalent.

8.6.10 110-type Wiring Blocks for all voice cabling will be used if separate voice cable is needed.

8.6.11 The connecting block shall support the appropriate Category 6 applications and will use either cross-connect wire or patch cables.

8.6.12 The blocks shall be made of flame-retardant thermoplastic, with the base consisting of horizontal index strips for termination up to 25 pairs of conductors.

8.6.13 The block shall be available in 50-, 100-, and 300-pair sizes and have detachable standoff legs.

8.6.14 The blocks shall have termination strips on the base to be notched and divided into 4- or 5-pair increments.

8.6.15 The block shall have clear label holders with the appropriate inserts available. The insert labels provided with the blocks shall contain vertical lines spaced on the basis of circuit size (1-, 3-, 4- or 5-pair) and shall not interfere with running, tracing or removing cross connect wire/patch cables.

8.6.16 All blocks and patch panels will have bases available in 19-inch panels and high-density frame configurations for rack or wall mounting with cable management hardware.

8.6.17 All blocks and patch panels will have connecting blocks used for either the termination of cross-connect (jumper) wire or patch cables.

8.6.18 All connecting blocks shall be available in 2-, 3-, 4-, and 5-pair sizes.

8.6.19 All connecting blocks shall have color-coded tip and ring designation markers and be single piece construction.

8.6.20 The blocks shall have connecting blocks with a minimum of 200 re-terminations without signal degradation below standards compliance limit.

8.6.21 All connecting blocks shall support wire sizes of solid 22-26 AWG.

8.6.22 All bases and blocks shall be UL Listed 1863, TIA-568, ISO/IEC 11801 and Category 6 compliant and meet TIA Category 6 electrical performance.

8.6.23 Fiber optic cables will be terminated on connector panels in a fiber distribution panel.

8.6.24 All terminated fibers shall be properly dressed and mounted in rack mount fiber panels. All patch panel bulkhead spaces shall contain either connector panels or blank panels.

8.6.25 The connector panels shall contain multimode and/or single mode (ceramic ferrule) connector coupling compatible with the SC and LC connectors.

8.6.26 All fiber optic cables shall have fusion spliced using factory polished connectors. Field terminated connectors are not acceptable.

8.6.27 The fiber housing unit shall be configured with fiber patch cable troughs to assist in cable management.

8.6.28 Relay racks shall be freestanding, properly anchored relay racks, heavy duty 19" x 84", drilled both sides per TIA universal thread standards, rack unit markings. Each relay rack shall be equipment with an attached 6-inch wide vertical management trough with a bi-directional opening cover.

8.6.29 Cross-connect fields, patch panels, and active equipment in the TR shall be placed to allow all cross-connections and interconnections via jumpers,

patch cables, and equipment cables. Lengths will not exceed channel specifications:

8.6.29.1 20 feet per patch cables or jumpers in the horizontal cross-connect.

8.6.29.2 33 feet total for patch cables, jumpers and/or line cables used to connect to the outlet.

8.6.29.3 Total channel length should not exceed 328 feet.

8.7 Structures to Support the Cabling in the TR

8.7.1 A 3-foot working clearance shall be maintained in the front and in the back of each equipment rack, and a 2-foot working clearance shall be maintained at both ends of the equipment rack or rack rows. This clearance shall be measured from the outermost surface of the equipment and connecting hardware rather than from the equipment rack.

8.7.2 Wire basket tray, equipment racks, plywood backboards, data equipment cabinets, and wire management brackets shall be used in the TR to keep the cabling and equipment organized.

8.7.3 Wire basket tray shall be at least 12 inches wide and placed 7 feet above the finished floor to coincide with the top of the equipment racks and/or cabinets.

8.7.4 All wire basket trays, racks, and cabinets shall be bonded and grounded to the ground point in the TR.

8.7.5 Equipment and connecting hardware may be wall mounted on a fire rated plywood backboard that is permanently attached to the wall and treated with a nonconductive, fire-resistant covering.

8.7.6 Wire management troughs shall be used to manage cables and jumpers.

9.0 Special Systems

9.1 Special Circuits. Since special circuits (i.e. data circuits, T1s, or alarms) are usually non-switched, they shall be treated differently than voice and modem circuits. The special circuits shall be cross connected to designated blocks on the horizontal side.

9.2 When CATV or CCTV requirements are identified, either a broadband coaxial cable, UTP, or fiber optic cable system shall be installed. When a coaxial system is installed, care shall be taken to ensure the correct cable is used. Cable Distance, RG-6 Quad Shield <=250 feet, RG-11 <=400 feet.

9.3 Any special system owned and operated by the City of Phoenix that is connected to any city owned network or telecom service provider via UTP or fiber optic cable shall be governed by this standard as required under AR 1.73. This includes CCTV, building automation, card access systems, etc.

10.0 Infrastructure Documentation

The purpose of this section is to define a set of guidelines for the collection of documentation related to all cabling system projects within the City of Phoenix. These policies set the minimum requirements for all documentation that is provided by contractors, architects, or any design professional involved in the installation of telecommunications infrastructure. Following these guidelines will ensure that all documentation that is associated with cabling system projects will fit the criteria for entry into the City of Phoenix cable management system, including spatial and non-spatial elements. These guidelines will also ensure that future cabling projects will utilize existing and accurate documentation for the design and placement of new infrastructure. The City of Phoenix reserves the right to revise these guidelines in the event that industry standards change or business/operational needs.

The final acceptance of documentation for all projects is at the discretion of ITS Communications Engineers, Project Coordinators, or City personnel responsible for the management of cabling system projects. Any alternatives or recommendations relating to a specific cabling project should be presented to city personnel and will be considered on an individual basis. The acceptance of any documentation that deviates from these guidelines will be considered an exception and shall not set a precedence for future submittals.

10.1 ITS Responsibilities

10.1.1 ITS is responsible for supervision and final acceptance of all documentation related to all cabling system projects.

10.1.2 Inside Plant Documentation

10.1.2.1 ITS will review and sign off as-builts for workstation locations and labeling scheme. It is the contractor's responsibility to acquire the most current floorplans and or site plans for the purpose of labeling workstation locations. As-builts should include the entire floor/building involved. As-builts containing only a portion of floorplan/building and not the entire footprint will not be accepted.

10.1.2.2 ITS will coordinate with the contractor to collect spatial location of all workstation locations using the City approved GIS/GPS application.

10.1.2.3 ITS will review and sign off on labeling schemes for the telecom rooms, intra-building backbone, patch panels, fiber distribution panels, or telecommunications termination blocks.

10.1.2.4 ITS will create or acquire location codes for all buildings related to cabling projects and provide them to the contractor for inclusion into the labeling scheme.

10.1.3 Outside Plant Documentation

10.1.3.1 ITS will review and sign off as-builts. As-builts should be completed in a city accepted software package. If as-builts are not geo-referenced, a minimum level of surveying will be completed by the contractor. The acceptable level of surveying includes wheeled measurements of all segments of conduit, offset dimensions from a known location (e.g. street centerline, building).

10.1.3.2 ITS will review and sign off on all newly placed or modified conduit systems and their contents. Contents of conduit systems include, but are not limited to, copper cable, fiber optic cable, coaxial cable, inner duct, flexible inner duct (MaxCell) and detectable tracer wire. The required amount of documentation expected is the make, manufacturer, size, diameter, serial number, and cable footage markings. For more details, see Attachment #6.

10.1.3.3 ITS will review and sign off on the labeling scheme for inter-building backbone, patch panels, fiber distribution panels and telecommunications termination blocks. All newly placed cables should have approved cables tags attached each entry/exit point.

10.1.3.4 ITS will review and sign off on manhole fold flats. Fold flats are required for any newly placed manhole or an existing manhole that has new or modified infrastructure added. ITS is responsible for providing to contractor any existing fold flat for manholes effected. For more details, see Attachment #6.

10.1.3.5 ITS will review and sign off on fiber optic splice details. Splice details are required for any new splice or an existing spliced that has been modified. ITS is responsible for providing to contractor any existing splice details for cables effected. For more details, see Attachment #5.

10.2 Contractor's Responsibilities

10.2.1 Inside Plant Documentation

10.2.1.1 Creation of as-builts for workstation location and labeling scheme. All effort will be made by city personnel to acquire electronic as-builts, but it is the contractor's responsibility to acquire these documents for the purpose of labeling workstation location. As-

builts should include the entire floor/building involved. As-builts containing only portion of floorplan/building and not the entire footprint will not be accepted.

10.2.1.2 Coordination with ITS personnel to collect spatial locations of all workstation locations with city approved GIS/GPS application. Buildings may require the collection of outlets, please verify and coordinate with ITS personnel on all projects relating to the placement of new or modified workstations.

10.2.1.3 Comply with TR and MTR labeling scheme, including telecom room directional acronym. Contractor will supply a placard in each MTR and TR that currently does not have one. The placard will include the SAP location code and the floor and directional acronym. See Attachment #8.

10.2.1.4 Comply with intra-building backbone labeling scheme. The City defines intra-building backbone as house copper cable (HC) or house fiber cable (HF). All newly placed cables should have approved cable tags attached. See attachment #9.

10.2.1.5 Comply with labeling scheme for all patch panels, fiber distribution panels or telecommunications termination blocks. All three types of hardware should be labeled with the appropriate HC or HF labeling scheme accepted by city personnel.

10.2.1.6 Utilize SAP location codes on all buildings related to cabling projects. Location codes will be provided to contractor for the inclusion into labeling scheme. Contractor shall correct any documentation and labeling discrepancies as required by ITS.

10.2.2 Outside Plant Documentation

10.2.2.1 As-builts must be completed in a city accepted software package (latest version of AutoCAD or Visio). Identification of all newly placed or modified infrastructure is required. If as-builts are not geo-referenced (to scale or matched to a known coordinate system), a minimum level of surveying should be completed. The acceptable level of surveying includes wheeled measurements of all segments of conduit and offset dimensions from a known location (street centerline, building, etc.). Exceptions to this standard will be considered if no known location exists. All requests for an exception to the standard should be submitted to city personnel.

10.2.2.2 Documentation for all contents of conduit systems. This includes, but is not limited to, copper cable, fiber optic cable, coaxial cable, inner duct, flexible inner duct, (MaxCell) and detectable tracer wire. Included in this standard is the documentation of all newly

placed cables. A reasonable amount of specifications is expected (make, manufacturer, size, diameter, serial number, etc.). Verify with ITS Engineer for any additionally required specifications.

10.2.2.3 Comply with inter-building backbone labeling scheme. The City of Phoenix defines inter-building backbone as remote copper cable (RC) or remote fiber cable (RF). All newly placed cables should have approved cable tags attached. A cable tag label should be placed in every manhole, hand hole, pull box or pull point.

10.2.2.4 Comply with labeling scheme for all patch panels, fiber distribution panels or telecommunications termination blocks. All three types of hardware should be labeled with the appropriate RC or RF labeling scheme.

10.2.2.5 Creation or modification of manhole fold flats. Fold flats are required for any manhole that has new or modified infrastructure added. ITS Engineers are responsible for providing to contractor any existing fold flat for manholes effected. See Attachment #6 for detailed information.

10.2.2.6 Creation of splice details. Any newly placed of existing copper cable of fiber optic cable that is spliced shall be documented. See Attachment #5 for more detailed information.

10.2.2.7 These detailed drawings are required for any structure that is part of the project scope of work. Maintenance Hole and Hand Hole AutoCAD drawings shall include the following layout tabs: cover sheet, butterfly, photo, and (if applicable) splice detail. Each AutoCAD drawing file shall depict ONLY one communication space structure.

10.2.2.8 The project cover sheet layout shall be the first layout tab of the AutoCAD detailed drawing file. See attachment #11 for more information.

10.2.2.8.1 Project information must include the project name, address and location, City of Phoenix-ITS work order number, and date.

10.2.2.8.2 Contractor information must include company information using the provided text field in the upper right hand corner of the layout.

10.2.2.8.2.1 The Vicinity map accurately represent project area with a leader line.

10.2.2.8.2.2 The sheet index provides an enumerated list of all project sheets with their corresponding file names and a brief description (i.e. “MH/HH & Photo”).

10.2.2.8.2.3 The Project area map provides a scaled base map (i.e. parcels, street centerlines, street names, curbs, or other surveyed data) of the complete project area of work. Contractor shall indicate all conduit pathway lines and communication space within the scope of work with their respective annotation. Contractor shall label the location of each communication space with the asset identification number that corresponds to the detailed drawing file.

10.2.2.8.3 All base map data provided by City of Phoenix-ITS will be georeferenced in the NAD83 HARN coordinate system. The contracting company shall not move, scale or otherwise modify the base map drawings, such that the integrity of the data is preserved.

10.2.2.8.4 The butterfly layout shall be the second layout tab of the AutoCAD detailed drawing file. See attachment #6.

10.2.2.8.5 The butterfly layout is intended to represent the infrastructure exactly as it appears in the field including conduit placement, new and existing cables, innerduct/sub duct, splice cases, etc. Label each wall of the butterfly drawing with the most appropriate compass point (i.e. North, South, East, or West).

10.2.2.8.6 Every conduit in or out of the communication space shall be represented on the corresponding face of the butterfly drawing. Label empty conduits with an

"E" in the center of the conduit symbol. All conduits containing infrastructure shall be annotated with an individualized summary of their contents. All conduit leader annotation shall begin with the conduit length and name of the destination structure. i.e. "517 feet to MH-105", "844 feet to Fire Station 62", "12 feet to traffic cabinet NW corner". All conduits may or may not lead toward the same destination. Annotate all exceptions individually in accordance with the aforementioned convention. This conduit length annotation requirement may only apply to projects that contain the installation of new conduit or new cable within conduit. Acceptable methods of gathering this information may include the use of sequential cable footage markings or calibrated mule tape. Verify with City of Phoenix-ITS engineer(s).

10.2.2.8.7 The details section provides specific detailed information regarding the associated object. Each individual cable or inner duct, splice closure, etc., shall have a detail summary leader in the layout section with a corresponding description in the details section. If the object is a cable, it shall be completed with cable count, cable manufacturer, cable type, cable footage readings, cable coil length, and cable install date. Every cable detail record shall have two sequence footage entries. Indicate the cable sequence number where the cable enters/exits the communication space at a conduit or where the cable enters/exits a splice closure.

10.2.2.8.8 If the object is an innerduct/sub duct, it shall be completed with quantity, size, and description. If any attribute is unknown, do not leave the detail field blank. Fill out the field detail with either "Unknown" or "UNK". For Splice closures, include the manufacturer name and model number.

10.2.2.8.9 An example of a fiber object would be: “144 ST Corning SM; East Wall: 2768’, West Wall: UNK (Unreadable), Coil: UNK; Installed 5/14/2007”

10.2.2.8.10 The title block - CITY OF PHOENIX-ITS area shall not be modified.

10.2.2.8.11 The title block location map area shall illustrate the immediate area surrounding the communication space drawing or the area surrounding the pathway detail drawing. This area shall be a viewport to the base map in model space.

10.2.2.8.12 The title block location information area shall be completed with project detail information that is relative to the respective infrastructure.

10.2.2.8.13 First line attribute is the specific infrastructure identification and shall include the manhole, handhole, or pull box description (i.e. MH-1901 or HH-1001 or PB-0501).

10.2.2.8.14 The second line attribute is the address or intersection of the infrastructure (i.e. 1901 S. 24th Street or SW corner of 5th Street & Adams Street).

10.2.2.8.15 The Third line attribute shall reflect the spatial coordinates of the infrastructure in the NAD 1983 Arizona State Plane (HARN) coordinate system or WGS 1984 coordinates (decimal degrees).

10.2.2.8.16 The Fourth line attribute (photo sheet only) is the photo x-references being used and shall be completed as: i.e. MH-1901-001, MH-1901-002, MH-1901-003, MH-1901- 004, MH-1901-005.

10.2.2.8.17 The fifth line attribute (Splice case detail only) is the detail number designated on the fold flat sheet and

shall include the description (: i.e. Detail #1).

10.2.2.8.18 The first line attribute is the “PROJECT NAME” which is the overall project description.

10.2.2.8.19 The Second line attribute is the “ORIGINAL DATE” of the drawing. This attribute should not be modified if a date exists. If this infrastructure location is new, then the completed project date should be used as the original drawing date.

10.2.2.8.20 The third line attribute is the “REVISED DATE” that the drawing was modified based on the project completion date.

10.2.2.8.21 The fourth line attribute is the “DRAWN BY” which is the contract company and individual who last updated the drawing.

10.2.2.8.22 The fifth line attribute is the City of Phoenix-ITS project SAP work order number.

10.2.2.8.23 The Sixth line attribute is the “SHEET NUMBER” and should be completed with current and total sheet numbers.

10.2.2.9 Photo layout shall be the third layout tab of the AutoCAD detailed drawing file. See attachment #7 for more detailed information.

10.2.2.9.1 Photos shall be externally referenced using relative pathing such that the photo is visible within the drawing regardless of the location of the AutoCAD drawing file.

10.2.2.9.2 Place all photos, logos, and any other externally referenced drawings in an accompanying folder named “Xref.”

10.2.2.9.3 Photos shall be clear and free of distortion and be taken with a minimum 5.0 mega pixel digital camera

at minimum resolution of 1600x1200.

10.2.2.9.4 Photos shall be taken facing the north wall of the structure such that the orientation of the photograph matches the orientation of the butterfly drawing.

10.2.2.9.5 Photos shall have a visible date stamp that is accurate and generated by the digital camera at the time the photo was taken.

10.2.2.9.6 If the maintenance hole is greater than a no. 9 (4'x4'), there shall be (4) photos taken, (1) of each wall without a fisheye lens. (1) Additional photo shall be taken from the street level looking down at the open communication space, facing north with no obstructions. This total number of photos equals (5) per manhole. The photos shall be placed on the layout representative to the butterfly layout depiction, i.e., the photo facing north should be placed on the north side of the photo layout and the photo facing south should be placed on the south side of the photo layout etc. The photo taken from the street level shall be placed in the middle with all photos scaled to be the same.

10.2.2.9.7 If the communication space is less than 4'x4' then only (1) photo shall be taken from street level looking down at the open communication space, facing north with no obstructions. All walls and conduits shall be visible in the photo.

10.2.2.10 The splice detail layout (if applicable) – Shall be the fourth layout tab of the AutoCAD detailed drawing file. (Attachment #5)

10.2.2.10.1 The splice detail layout is intended to graphically depict detailed information regarding the splicing and connectivity of all fiber cables within a specific splice closure. Attention to detail is critical.

10.2.2.10.2 Only one splice closure shall be depicted in any

given splice detail layout tab. If the communication space contains multiple splice closures, each splice closure shall have its own unique splice detail layout tab. If the scope of work contains multiple splice closures at multiple locations, then each location shall have an individual and separate drawing file depicting the infrastructure at that specific location.

10.2.2.10.3 All cables entering the splice closure shall have a cable identification tag. The cable identification tag annotation text shall reference the corresponding detail ID letter on the butterfly layout tab as well as the destination location of the cable. The cable label fields on the identification tag shall be completely filled in with the cable manufacturer, the cable strand count and the date of installation. All buffer tubes and strands from all cables entering the splice closure shall be accounted for in the splice detail diagram (i.e. spliced,through, or dark).

10.2.2.10.4 The pathway detail drawing file shall be a separate AutoCAD drawing file. Pathway detail drawings are intended to depict the location of underground conduit pathways and communication spaces. Documentation for underground conduit pathways must reflect the “real world” location of the infrastructure. A high degree of spatial accuracy is vital and all drawings must be to scale and in units of feet. The AutoCAD drawing file shall include the following layout tabs: cover sheet and pathway. See Attachment #10.

10.2.2.10.5 Line work drawn upon aerial imagery in Google Earth is not an acceptable form of documentation for right of way conduit pathways. “Not to scale” or representational drawings are also not acceptable forms of documentation for right of way conduit pathways. Line work drawn upon aerial imagery may be acceptable for smaller campus

environments where the work is not being performed in the City of Phoenix right of way.

11.0 Quality Assurance

This section addresses requirements for the Quality Assurance for all aspects of the ITS standards.

11.1 Contractor Qualifications

11.1.1 Only City approved vendors shall be used to perform any installation or services.

11.1.2 Shall be certified to install and warranty the Ortronics Structured Cabling System or approved equivalent.

11.1.3 Shall have a BICSI RCDD (Registered Cabling Distribution Designer) under current employment and available for consultation on all projects. Shall demonstrate knowledge and compliance with all BICSI, TIA, UL, and NEC standards and codes.

11.1.4 Contractor shall have the required number of certified installers as mandated by the manufacturer as having completed the necessary training to complete the installation. Resumes of the certified members on the team shall be provided along with documentation of completed training courses.

12.0 Systems Warranty

This section addresses the requirements for obtaining the required warranty coverage for all City of Phoenix projects upon installation completion.

12.1 The cabling installation shall be installed such that it qualifies for the manufacturer System Installation warranty. A Structured Cabling System means a System properly constructed with ITS approved products in accordance with referenced standards; meeting specified link/channel performance and topological (distance and connection) limits. This includes all Manufacturers products that are installed in conjunction with approved solutions. Performance guarantees apply only to installed channels utilizing appropriate patch cords manufactured from partner cable manufacturers cordage. Any warranty repairs, replacements, moves, additions or changes shall be warranted for the balance of this warranty period.

12.2 Warranty shall commence the date of installation registration which shall coincide with installation completion.

12.3 The Warranty shall ensure that the installation:

12.3.1 will be free from Bit errors caused by the structured cabling system components.

12.3.2 will meet or exceed applicable ratified TIA and ISO/IEC transmission performance standards in force at the time of installation for a Structured Cabling Link/Channel;

12.3.3 will support any current or future application which is designed for transmission over a Structured Cabling System as defined by the above referenced standards and the Data Sheet in effect at the time of installation.

12.3.4 will conform to the transmission performance specifications of the Data Sheet in effect at the time of installation; and

12.3.5 will be free from defects in material and workmanship on the products installed.

12.4 Warranty Conditions for this warranty to be valid:

12.4.1 The System components having never been used before;

12.4.2 The System shall have been installed by a Certified Integrator/Installer authorized by the Manufacturer in accordance with the Manufacturer's installation specifications, the requirements of the above mentioned technical standards, and the terms and conditions specified in the manufacturer's Certified Integrator/Installer Program agreement;

12.4.3 All installation records shall be updated to reflect any maintenance, movements, additions or changes, etc. Manufacturer will not be responsible for moves, additions or changes performed by parties other than a Certified Integrator/Installer; and

12.4.4 All warranty claims shall be made to the original Certified Integrator/Installer, or the local Manufacturer representative, within 5 days of discovery of the alleged defect in the System products.

V Compliance Audits

The City Auditor Department may conduct periodic audits to evaluate compliance with the requirements set forth in this standard.

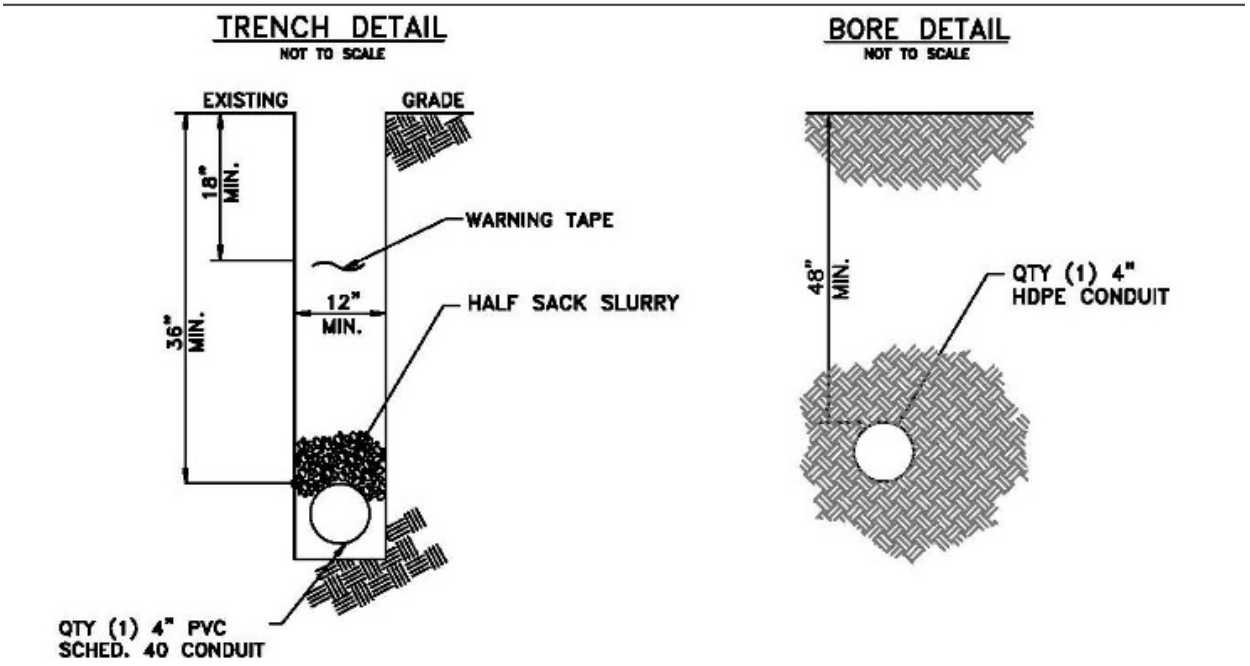
VI Related Policies, Standards, and Procedures

Adherence by the contractor to the industry standards and best practice methods is imperative. Ultimately the success of this structured cabling installation shall be implemented in accordance with the following:

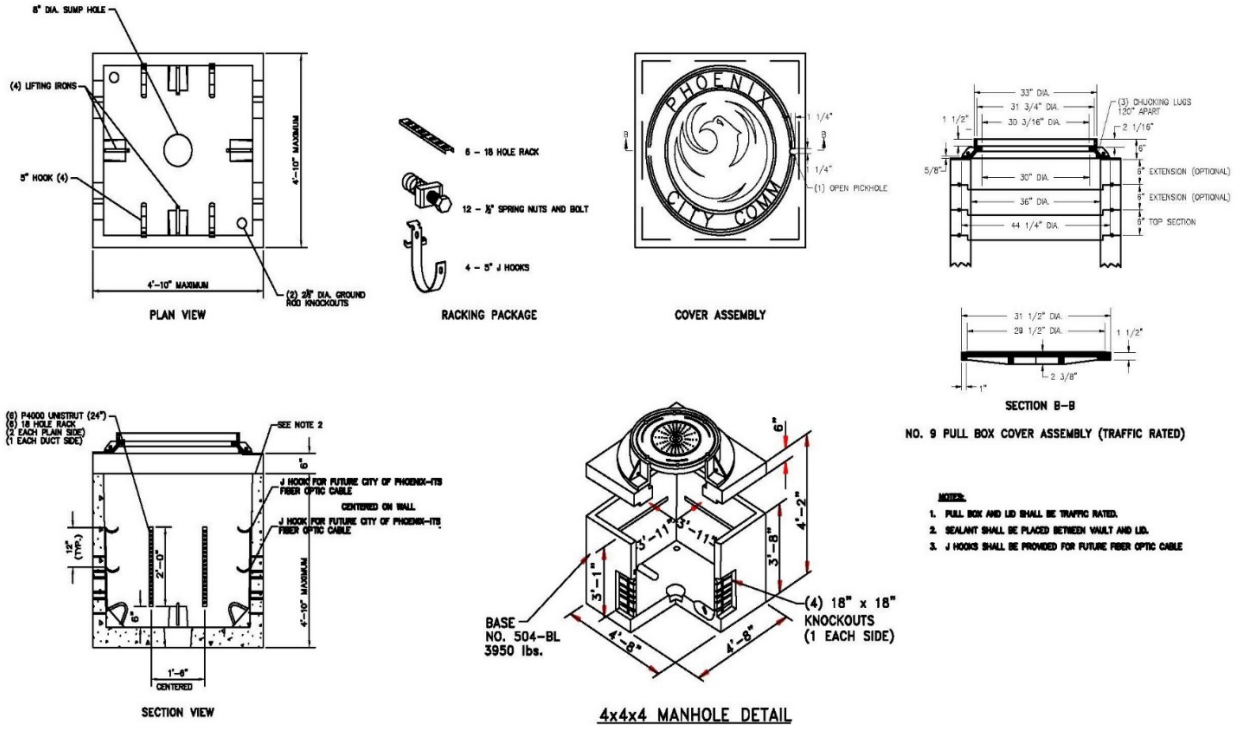
TIA-568: Commercial Building Telecommunications Cabling Standard
TIA-569: Commercial Building Standard for Telecommunications Pathways and Spaces
TIA-606: The Administration Standard for the Telecommunications infrastructure of Commercial Building
TIA-607: Commercial Building Bonding and Grounding (Earthing) Requirements for Telecommunications
TIA-758: Customer Owned Outside Plant Telecommunications Infrastructure Standard
TIA-527 – Optical Power Loss Measurements of Installed Single Mode Fiber Cable Plant – OFSTP-7
TIA-526-14-A: Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant-OFSTP-14A.
TIA-598: – Optical Fiber Cable Color Coding (January 2005).
TIA-942: Telecommunications Infrastructure Standard for Data Centers
BICSI-TDMM, Building Industries Consulting Services International, Telecommunications Distribution Methods Manual
Fire stopping Systems - American Society for Testing and Materials (ASTM) E814, Underwriters Laboratories Inc. (UL) 1479
National Electrical Code
National Fire Protection Association 75 and 76
City of Phoenix Codes, Ordinances, Standards, and Interpretations
City of Phoenix Administrative Regulation (AR) 1.73
b1.3, IT Waiver Standard

VII Attachments

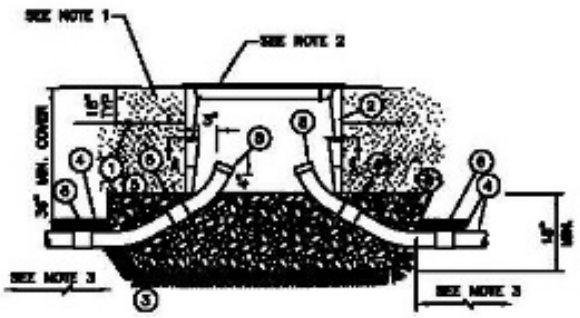
Attachment #1

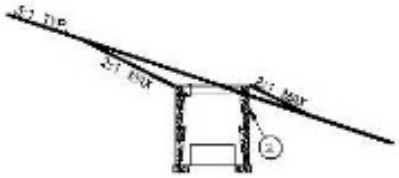


Attachment #2

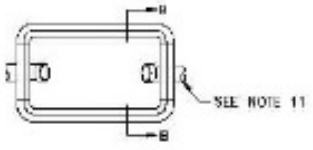


Attachment #3

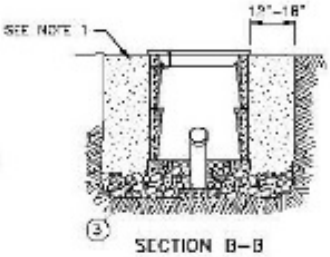




INSTALLATION IN SLOPED AREAS



SECTION A–A



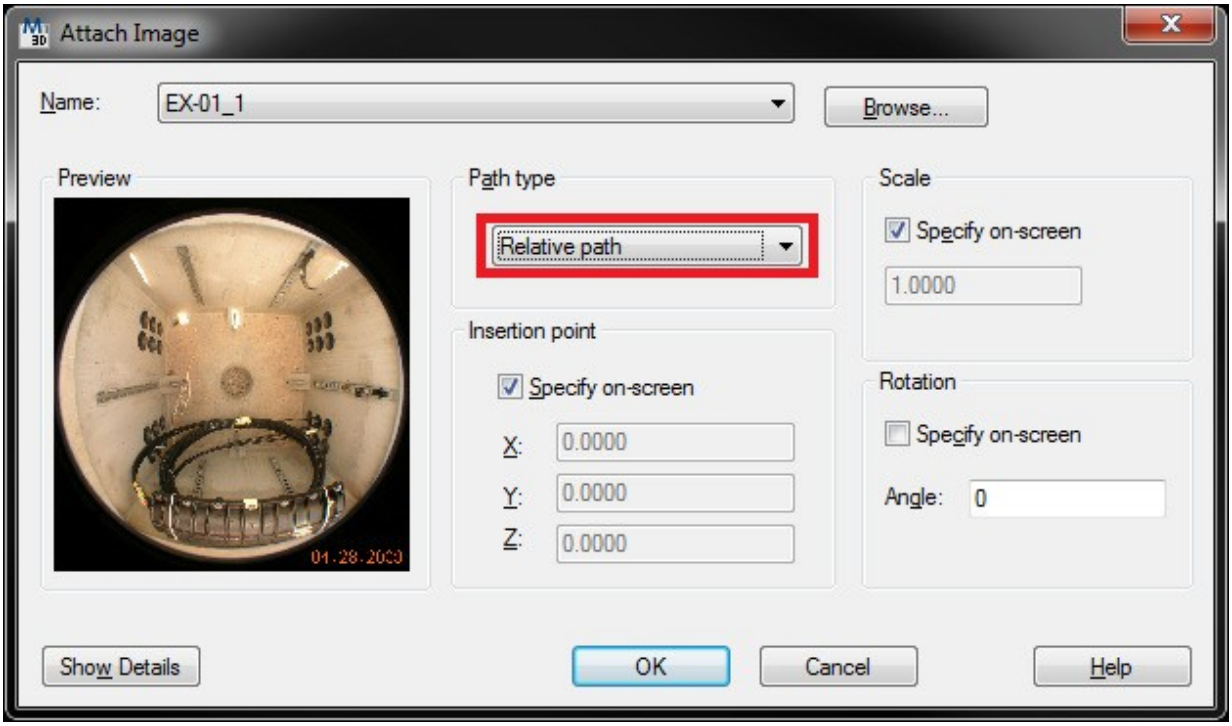
SECTION B–B

NOTES:

1. BACKFILL WITH CLASS "B" CONC. ACC. DESIGNATED SIZE NO. 57 TO BOTTOM OF THE PULL BOX. BACKFILL AROUND SIDES OF THE PULL BOX WITH EXCAVATED MATERIAL AND COMPACT TO 95% OF MAXIMUM DENSITY.
2. ALL PULL BOXES AND COVERS SHALL BE AASHTO H–20 RATED WITH POLYMER CONCRETE OR FIBERLYTE COVERS. USE HUBBELL QUAZITE BOX P/N PG3048BB24 AND HUBBELL QUAZITE COVER P/N PG3048HH00 (OR EQUIVALENT).
3. CONDUIT ALIGNMENT OFFSETS ARE TO BE ACCOMPLISHED BY A UNIFORM RATE OF CONDUIT DEFLECTION OVER A DISTANCE EQUAL TO OR GREATER THAN TWELVE (12) TIMES THE OFFSET DISTANCE.
4. NUMBERS IN CIRCLES REFER TO ITEMS IN MATERIAL LIST. "CITYCOM" SHALL BE CAST ON PULL BOX COVER IN 1" HIGH LETTERS.
5. USE 4" PVC SCHEDULE 40 TO EXTEND INTO PULL BOX.
6. EXPANSION JOINT MATERIAL SHALL BE USED AROUND PULL BOX WHEN INSTALLED IN CONCRETE AREA.
7. ALL 4" PVC CONDUIT SHALL BE PROOFED BY INSTALLATION CONTRACTOR AND FOUND TO BE FREE AND CLEAR OF DEBRIS. THE INSTALLATION OF DETECTABLE MULETAPE SHALL HAVE THE SPECIFICATIONS OF 2500 LBS AND INCORPORATED 22 GAUGE CONDUCTOR. USE NEPTCO P/N 8123CCP (OR EQUIVALENT)
8. FACTORY PVC CONDUIT BENDS ONLY. FIELD BENDS SHALL NOT BE ALLOWED.
9. PVC ELBOWS NOT REQUIRED IF DISTANCE BETWEEN PULL POINTS IS LESS THAN 100 FEET.

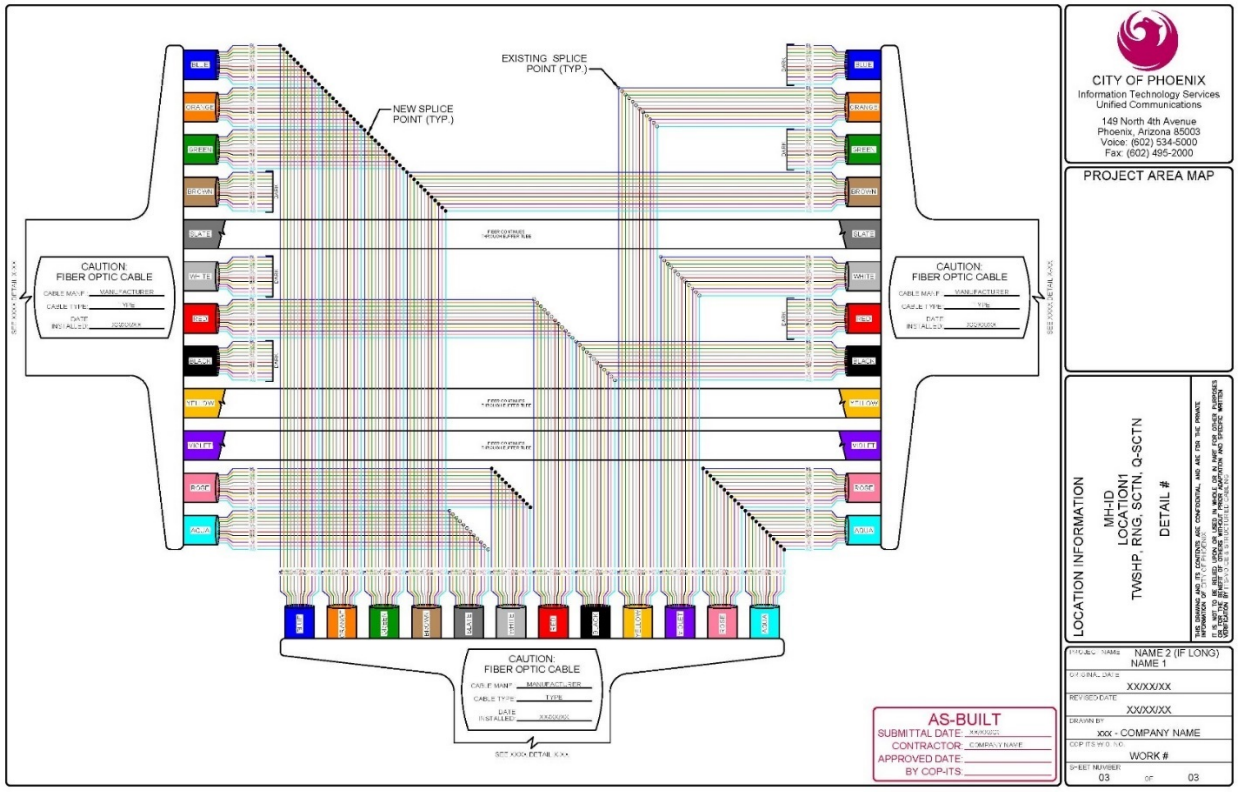
MATERIAL LIST	
ITM	DESCRIPTION
1	MARKER TAPE
2	NO. 7 PULL BOX WITH EXTENSION W/ EXCEPTIONS AS DRAWN
3	CLASS "B" CONC. ACC. DESIGNATED SIZE NO. 57
4	SCHEDULE 40 PVC CONDUIT
5	90 DEGREE PVC ELBOW, 15" RADIUS
6	PVC COUPLING
7	
8	BELL END FOR PVC
9	90 DEGREE PVC ELBOW, 15" RADIUS PER ADOT SECTION 732-3.1(2) & 3.1(3)

Attachment #4

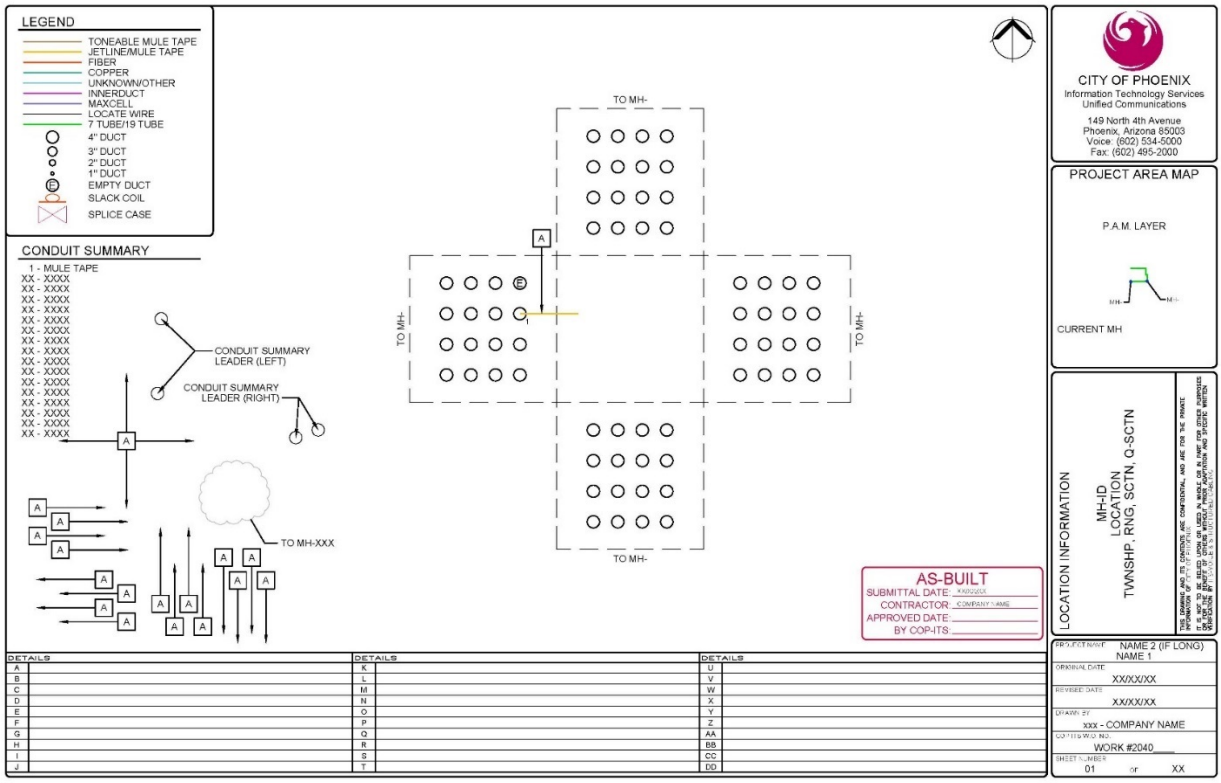


Domain:	Number:	Standard Title:
Network & Telecommunications	NT 1.10	Telecommunications Cabling System Standards

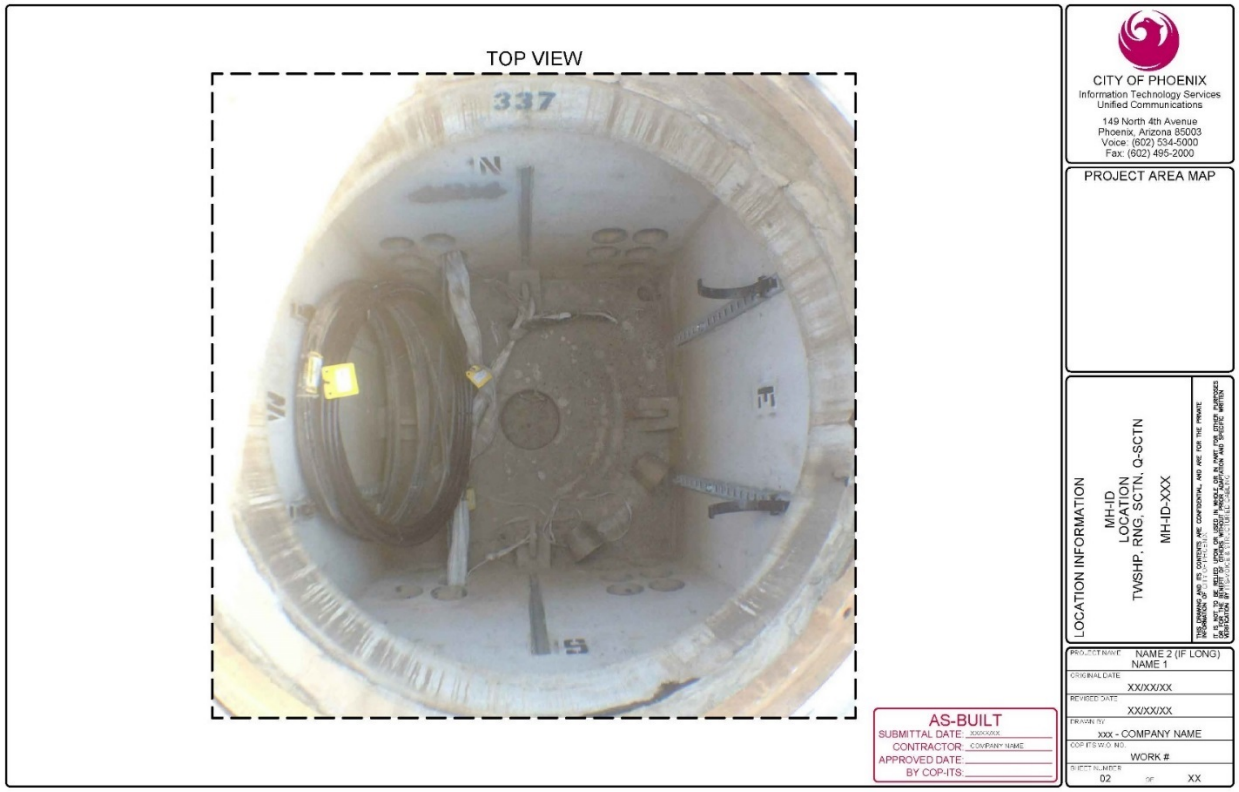
Attachment #5



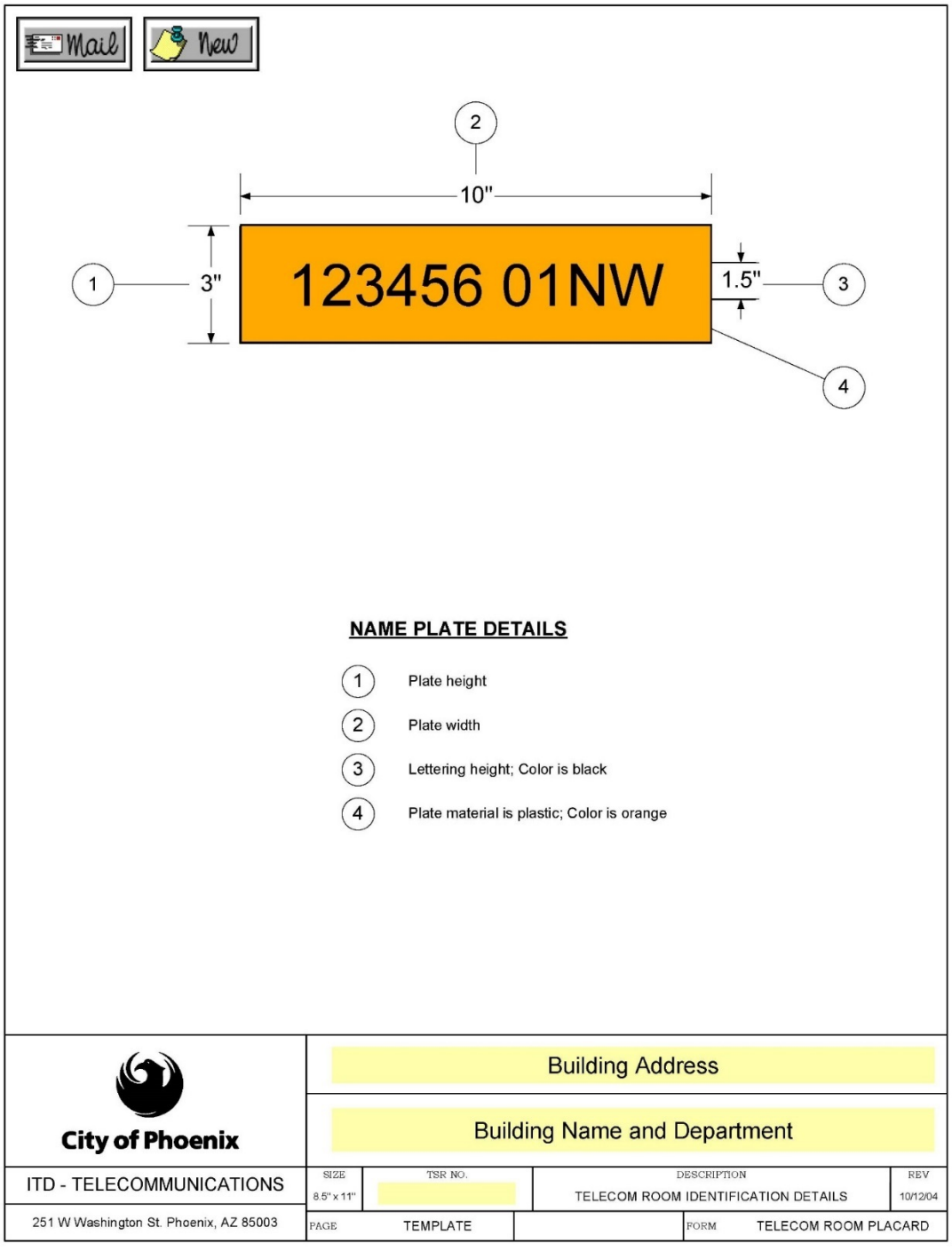
Attachment #6



Attachment #7



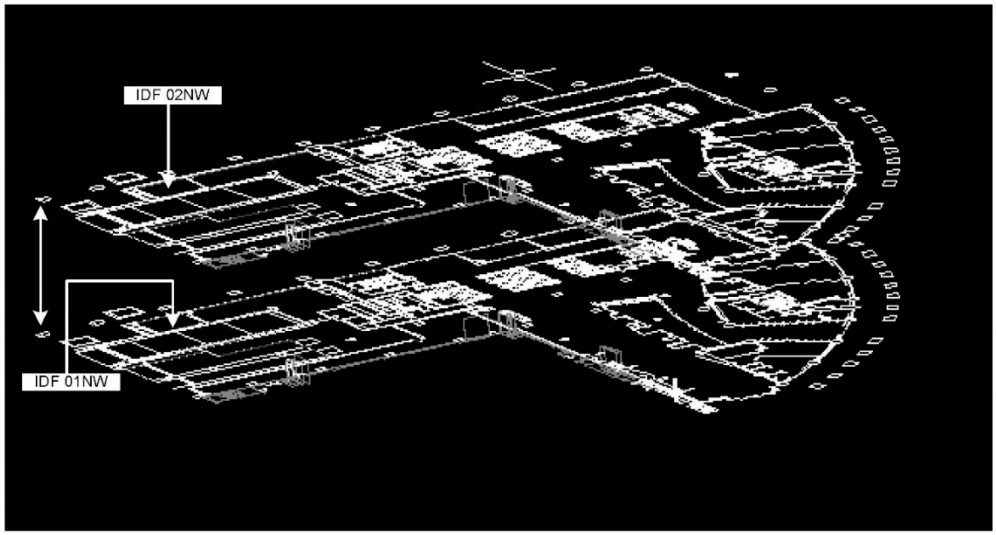
Attachment #8



Attachment #9

House Fiber Cable Tag
Example

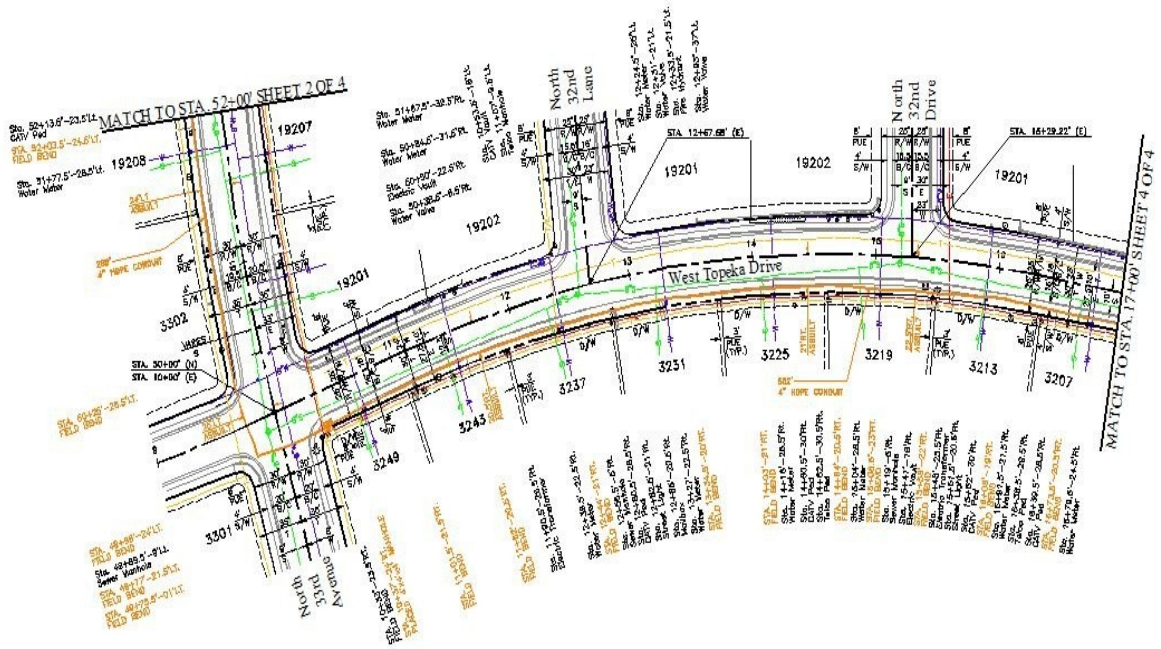
House Fiber Cable Example in
GIS

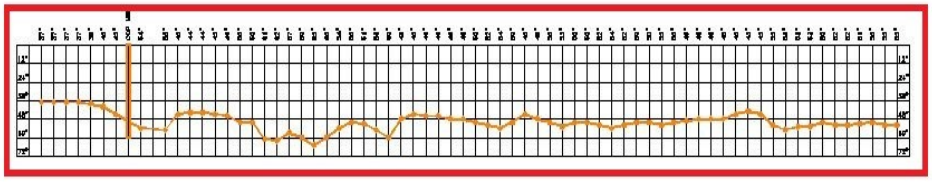


City of Phoenix				
ITD - TELECOMMUNICATIONS	SIZE 8.5" x 11"	TSR NO.	DESCRIPTION HOUSE FIBER CABLE LABELING SCHEME	REV 10/12/04
251 W Washington St. Phoenix, AZ 85003	PAGE EXAMPLE		FORM HOUSE FIBER CABLE	

Domain: Network & Telecommunications	Number: NT 1.10	**Standard Title:** Telecommunications Cabling System Standards

Attachment #10





Domain:	Number:	Standard Title:
Network & Telecommunications	NT 1.10	Telecommunications Cabling System Standards

Attachment #11