Pima County Enterprise Communications Division
Voice and Data Communications Cabling Standards

(revised 06/27/11)

Specification Minimum Requirements

A. SCOPE

The scope of these standards includes the requirements for materials and workmanship to install a complete communications cabling system. Building entrance cables, riser cables, telephone and data terminal backboards, raceways (conduit, wire mold, cable trays), station wiring (telephone and data), terminations, termination devices and any demolition work required are specified.

B. CLARIFICATIONS OF SPECIFICATIONS

In any case where the specifications or drawings are not clear to contractors submitting proposals, it is the responsibility of the contractor to obtain clarifications from the Pima County Information Technology, Enterprise Communications Division.

Drawings are diagrammatic and may not be complete in every detail. The contractor shall be responsible for determining how to perform indicated work under the scope of the project and shall not make any additional charges for any work or material required for a complete installation. Drawings and specifications are complementary, and what is called for on one shall be binding, as if called for by both. Construction and Architectural information is included for reference only, except where it may be included in the Cabling Contractor's scope of work.
The Pima County cabling standards are inclusive of a wide variety of applications and are the minimum standards. Only certain portions may apply to a given circumstance, such as an RFQ or RFP in which cabling is part of a complete voice or data system or for an RFQ or RFP requesting ONLY cabling . Therefore, use only what is pertinent for the specific application. This Standard is a living document. The criteria contained in this Standard are subject to revisions and updating as warranted by advances in building construction techniques and communications technology.

C. GENERAL REQUIREMENTS

1. CODES AND LICENSE COMPLIANCE: The completed installation shall be in compliance with all applicable electrical and fire codes and ordinances, the Williams-Steiger Occupational Safety. Under no circumstances is telephone or data equipment to be mounted (floor mount, wall mount, rack mount, etc.) less than 48 inches from an electrical panel, transformer, motor or similar device which may induce electromagnetic interference.

2. NEW AND LISTED MATERIALS: All materials shall be new and listed as being suitable for their intended use, as certified by ANSI TIA/EIA standards and must meet the current National Electric Code (N.E.C.) minimum, where appropriate.

3. WORKMANSHIP: All work shall be executed according to these specifications in a professional workmanlike manner and shall present a neat mechanical appearance when complete.

4. QUALITY ASSURANCE: At least one person directly employed by the prime contractor shall monitor the daily activities of workers to assure the quality of work performed.
5. ACCEPTANCE INSPECTION: All work must pass functional and workmanship inspections prior to acceptance. The contractor will make all required corrections, at no additional cost (including documentation), before the system is put into service.

6. CLEAN-UP AND REPAIR: Contractor shall be responsible for clean up and repair of job site. Damaged false ceilings, pencil or chalk marks, hand prints, gouges and tool marks, plaster dust, etc. shall be repaired, cleaned, removed, or painted as required. Proof of tile damage for which the contractor is NOT responsible rests with the contractor. Penetrated fire barriers shall be resealed in an approved manner.

7. SUBMITTAL: (2 copies required) Complete materials lists, manufacturer's literature, required drawings and other required information shall be submitted for approval no less than 10 working days before such materials are required to be ordered for the work. The Pima County Telecommunications Division must approve submittal prior to the start of installation.

8. GUARANTEE: Upon completion of the work acceptance by the Pima County Telecommunications Division, the contractor shall submit his warranty, effective for one year, guaranteeing to replace, without additional cost to Pima County, any work or material, which develops defects. MANUFACTURER'S WARRANTIES ARE IN ADDITION TO, NOT IN LIEU OF, CONTRACTOR'S WARRANTY.

9. AS-BUILT DRAWINGS AND DOCUMENTS: The contractor shall develop and maintain daily up to date specifications and drawings. Upon completion of testing, certification and labeling, the contractor will submit two complete sets of "As-built" drawings and documentation of all terminated cable with clear delineation and marking. Any item changed or deleted by addendum or change order shall be indicated on the drawings in red and referenced to the addendum or change order number. Electronic copies are acceptable if compatible software is available.

10. TESTING: Field-testing of cabling to ensure performance parameters as outlined in ANSI/TIA/EIA – 568-B.1, standards for copper cabling, is mandatory. Fiber optic testing standards are identified in Section J, here in. The term "cabling" includes all components; cable, patch cords, equipment cords and connecting hardware. Testing shall be carried out in accordance with this document. This includes testing the attenuation and polarity of the installed cable plant with an optical loss test set (OLTS) and the installed condition of the cabling system and its components with an optical time domain reflectometer (OTDR) or a power meter for short distance runs. The condition of the fiber end faces shall also be verified.

Testing shall be performed on each cabling link (connector to connector).

Testing shall be performed on each cabling channel (equipment to equipment) that is initially installed or identified by the owner and shall not include any active devices or passive devices within the link or channel other than cable, connectors, and splices, i.e., link attenuation does not include such devices as optical bypass switches, couplers, repeaters, or optical amplifiers.

All tests shall be documented including OLTS dual wavelength attenuation measurements for multimode and single mode links and channels and OTDR traces and event tables for multimode and single mode links and channels.

11. CHANGES: No changes will be made from the work as called for by these specifications and drawings, except by a written order approved by the Pima County Information Technology Enterprise Communications Division Project Coordinator.

12. SPLICING: A qualified cable Splicer must do the splicing. Submit cable Splicer's name and qualifications to Pima County Information Technology, Enterprise Communications Division for verification and approval prior to commencement of work.

13. SERVICE LOOPS (COPPER): As cable runs are being installed, additional slack (service loops) at both ends are required to accommodate future cabling system changes and re-terminations. The equipment room end shall have a 10 foot loop and the work area shall have an 36 inch loop.

14. ACCESS: Contractor may be required to submit the project employee names, social security numbers and dates of birth to the Pima County Security Department prior to start of the project.

15. WORK COMPLETION AND INVOICING: Invoices WILL NOT BE PAID until the work is inspected by the Pima County Information Technology Project Manager or appointed substitute and/or verbal or written confirmation of work completion is received by the Pima County Information Technology, Enterprise Communications Division. Adherence to numbers 1 through 11 (above) must be apparent, as determined by the Pima County Information Technology, Enterprise Communications Division Project Manager, or appointed substitute.

D. COMMUNICATIONS EQUIPMENT ROOM DESIGN GUIDE- MINIMUM REQUIREMENTS

1. SCOPE:
The Communications equipment room shall provide a safe, secure and environmentally suitable area for installing cables, premises equipment and termination equipment for voice and data systems.
Riser equipment rooms are used to provide distribution points for the riser cables on each floor of a multi-story building and in low wide buildings where the riser cables are run horizontally. There shall be one equipment room per floor. **All** communications cabling, within a building, shall terminate in the closest equipment room.

2. GENERAL REQUIREMENTS:
1. Install Vinyl Composition Tile (VCT) "no wax" flooring material, with a four inch black (or a shade matching the incumbent) rubber base, to avoid dust and electrostatic discharge. Tiles should be a minimum of 1/8" gauge thick, smooth texture and a neutral color through, such as gray or beige. Armstrong Flooring *Excellon* is preferred.
2. The minimum recommended ceiling height is eight feet, six inches.
3. When ceiling distribution systems are used, design the closets with adequate conduit or openings through beams or other obstructions into accessible ceiling space.
4. Design doorway opening with a minimum of three feet wide and six feet, eight inches high.
5. Hinge door to open outward.
6. Equipment rooms shall not have a false ceiling.
7. Locate the equipment room in areas above the threat of flooding.
8. The equipment room should not be located by, or share space with, power supply transformers, elevator or pump motors, generators or other potential sources of electromagnetic interference.
9. Provide a No. 6 AWG shielded ground conductor, in each equipment room. Terminate ground conductor to a ten inch copper bus bar, per ANSI/NFPA 70, with provisions for additional ground connections (see section D.9.l).
10. Design lighting to provide a minimum equivalent of 30 foot candles measured at floor level.
11. Equipment rooms shall be keyed to consistent with other telecommunications wiring areas so that the room is accessible only to authorized personnel.
12. Minimum room size shall be 8 feet wide by 8 feet long with a recommended ceiling height of 8 feet, 6 inches. Equipment room size will vary depending on the total work space of the structure involved. The general guideline is .75 square feet per 100 square feet of work space.

13. In new buildings or extensive re-models, line all communications equipment room walls with 3/4 inch 4 ft. X 8 ft. A-C plywood (fire-rated; plugged and sanded on one side) backboards as indicated on plans. Existing structures and minor re-models, see **Section D**, **paragraph 8c** Telephone Terminal Backboards (TTB) and data Terminal Backboards (DTB).
14. Equipment rooms shall not be used for storage or for janitorial equipment and/or supplies.
15. If possible, locate riser closet in the center of the building within 150 feet of each tenant space. Multiple riser closets may be required on each floor.
16. Equipment rooms shall be temperature controlled to a maximum of 68 degrees Fahrenheit, ambient, sustained, based on a 24 hour per day, 365 day per year heat load of 3,300 B.T.U. (minimum), 17,000 B.T.U. (maximum). Actual B.T.U. output is contingent on the number of communications devices required to serve the building tenants.

NOTE: HORIZONTAL STATION WIRING MUST BE IN COMPLIANCE WITH EIA/TIA 568-B HORIZONTAL WIRING DISTANCE SPECIFICATIONS.

The maximum horizontal cable length shall be 90 meters (295 feet). This is the cable length from the mechanical termination of the media in the telecommunications closet to the telecommunications outlet in the work area. The distance maximum includes all wiring that is part of the horizontal wiring. In establishing maximum distances, an allowance was made for three additional meters (9.8 feet 'service loop') from the telecommunications outlet to the workstation, to accommodate maintenance, repairs, minor jack moves etc. Therefore, a minimum 9.8 foot service loop shall be provided, for horizontal cabling, in each equipment room in which there are cable terminations, i.e., punch downs, patch panels or other termination methods, as appropriate. **See paragraph C.13.**
17. In a multi-floor building, the equipment rooms shall be aligned vertically. Locate the rooms so building structure beams and other trades equipment does not interfere with placing riser sleeves/conduits within six inches from the wall.
18. Provide a dedicated 120 V, ac duplex (minimum) power outlet as shown on drawing. NOTE: Equipment outlets are to be connected to building emergency power. There may be special receptacle requirements, such as voltage, wattage, amperage, frequency and input/output connection type, depending on the type of device (U.P.S., PBX switch, etc.) using an electrical input/output connection.
19. Locate riser sleeves/slots on the immediate left side if the closet. This will enhance the use of wall space from left to right.
20. Riser sleeves/slots shall be aligned vertically from floor to floor.
21. Riser sleeves/slots shall be: (4), four inch sleeves or four inch by sixteen-inch slots. Additional sleeves may be required in large buildings. All riser sleeves shall have bushings installed for cable protection and secured with sleeve collars on at least two sides, on all wall and/or floor penetrations. Multiple sleeves may be required where minimum cable bend radiuses are not practical. This will be determined on a case by case basis.
22. Provide fire stops for cable tray system and riser system as required by code. Putty type fire stop material is to be used as required for all conduits and sleeves. Pillow type fire stops are only acceptable for cable tray penetrations.
23. Equipment rooms are dedicated to telecommunications and/or data equipment and shall not be used as a passageway to other utility rooms. Fire alarm and sound system equipment shall not be located in the telecommunications wiring closet.
24. Equipment rooms are not to be used for HVAC, plumbing or electrical riser systems.
25. User equipment requiring an attendant, monitoring or frequent attendance shall not be placed in telecommunications rooms, buildings or wiring closets.
26. A cable tray/conduit to "user equipment" room or area shall be provided for installation of data riser type cable.
27. Installation of Ethernet service loops, if any, shall be confined to a three-foot square area and the P.C.I.T. Enterprise Communications Division must approve the placement.

E. DESCRIPTION OF WORK

1. CONDUIT DESIGN GUIDELINES:

A. Conduit systems shall adhere to TIA/EIA 569B standards,TIA/EIA 758 standards and shall accommodate the cabling requirements of TIA/EIA 568-B1, 568-B2 and 568 B-3 standards.
B. The Pima County I.T. design requirements are for a minimum of one-4" PVC conduit system that is innerduct ready as well as a 4" PVC with 4-1" innerduct conduit system that is cable ready. The decision as to which system is used will be made on a per-project basis.

C. The conduit system can contain PVC field bends with a minimum 36 inch sweep. Factory bends must be manufactured out of PVC or rigid steel conduit per the special provisions provided.

D. The general conduit system layout requires pull boxes or vaults to be placed a maximum of 300' apart but specific circumstances and conditions may dictate distance modifications.

E. Work covered under this section shall consist of a Complete-in-Place installation, including all material, labor and equipment, and installation of conduit, pull boxes, vaults, mule tape and tracer wires for an underground fiber optic conduit system, including excavation, backfilling, compacting, jacking, and boring in accordance with these standards.

2. CONDUIT MATERIALS:

A. Polyvinyl Chloride (PVC) Conduit: All conduit shall be listed by Underwriters Laboratory (UL) and conform to NEC standards. Unless otherwise specified, all conduits to be installed underground or installed in concrete structures shall be 4-inch diameter, rigid Polyvinyl Chloride (PVC) Non-Metallic Conduit. The PVC conduit shall be schedule 40, heavy wall, sunlight resistant, manufactured from high impact material and shall be rated for use at 90 degrees centigrade. The conduit shall meet the specifications of UL 651 and NEMA TC-2, and furnished with interface fit bell ends. Fittings shall be schedule 40 PVC, meeting the specifications of NEMA TC-3 and UL 514. PVC bends (sweeps) of 36 inches or greater shall be used. Field bends should not have a radius of less than 50 feet. Factory bends shall have a radius of not less than 12 times the nominal diameter of the conduit.
B. Electrical Metallic Tubing (EMT): Electrical metallic tubing (EMT), sometimes called thin-wall, may be used instead of galvanized rigid conduit (GRC) depending on application, as it is less costly and lighter than GRC. Generally, EMT is used in transitioning from vaults and/or pull boxes, to j-boxes, in situations where it's necessary to protect vertical cable runs, on the outside of a structure. EMT cannot be threaded. Lengths of conduit are connected to each other with clamp-type fittings. EMT used in Pima County applications shall be made of coated steel, only.
C. Conduit with Integral Innerduct: Conduit with Integral innerduct shall be of schedule 40 PVC in modular, slip fit lengths. Shall have pre-lubricated innerducts with internal spacers and which expand and contract at the same rate as the outerduct.
Conduits shall have anti-reversing gaskets and an o-ring gasket at bell base. They shall have inward tapering holes on coupling body for easy assignment, printed indication such as "Install Print Side Up" to keep system straight during installation, marked innerduct with marked hole(s) on coupling body to ensure proper innerduct alignment, allowing crews to work from opposite directions. Bends shall be flexible and engineered to be cut through resistant. Innerducts shall be Carlon Telecom Systems Multi-Gard brand or equivalent. All integral innerducts shall have a continuous non-spliced, unknotted, detectable 1250 pound test mule tape installed.
D. Solvent Cement for Polyvinyl Chloride (PVC) Conduit and Couplings: All solvent cement shall meet the requirements of ASTM D 2564. The cement shall be of medium or heavy bodied cement capable of

making watertight joints. The cement and primer shall be of a type recommended by the manufacturer of the conduit.

E. Rigid Steel Conduit Bends: Conduit bends shall be listed by UL and conform to NEC standards. The bends shall be steel, hot dipped zinc coated, meeting the requirements of UL 6 and ANSI C80.1, and shall carry the UL label. Non-thread couplings shall not be used. Bends shall have a minimum radius of 12 times the nominal diameter of the conduit. Steel conduit bends shall have a factory applied 40 mil PVC coating or be doubled (half overlap) wrapped with a 10 mil PVC plastic tape specifically manufactured for corrosion protection of metallic conduits installed below grade. For PVC conduit bends see paragraph A, above.

F. Flexible Conduit: When specifically indicated on the plans and where approved by the Pima County Enterprise Communications Division, flexible solid wall direct bury conduit may be used. The conduit shall be manufactured of Polyvinyl Chloride (PVC). The conduit shall be specifically manufactured for direct buried communications cable raceway systems and shall be Carlon "Optic-Gard PE" conduit, or approved equal. Flexible conduit shall not be utilized for making bends in conduit system. Connection between the flexible conduit and conduits of other materials shall be made with a watertight transition coupling manufactured for the specific type of material.

G. Plastic Conduit Spacers: Spacers shall be constructed of Polyvinyl Chloride (PVC) or other non-metallic material. The spacers shall be vertical and horizontal interlocking and provide a minimum of 3-inch clearance between conduits. Base spacers shall be provided with a wide base plate to provide solid support on the bottom of the trench. The base spacers shall provide for a minimum clearance of 3 inches between the bottom of the trench and the conduit.

H. Aggregate Bedding Material: Aggregate material for bedding material shall meet the gradation indicated in the specifications and on the drawings for the subject project. The plasticity index shall also conform to the specifications under which the subject project is designed and constructed.

I. Detectable Warning Tape: On open trenching, an electronically detectable 6" Fiber Warning tape shall be installed 18" above the conduit. Tape shall be acid and alkali-resistant polyethylene film, with a minimum thickness of 0.004 inch. The tape shall have a minimum strength of 7500 PSI lengthwise and 1,500 PSI crosswise. The tape shall be manufactured with integral wires, foil backing, or other means to enable its detection by a metal detector when the tape is buried up to a depth of 3 feet deep. The tape shall be orange in color and have the following continuous inscription, "CAUTION -FIBER OPTIC CABLE BURIED BELOW". The inscription shall be 2 inch black letters.

J. Backfill Material: The backfill material shall be designed and constructed using the plans and specifications of the subject project.

K. Tracer Conductor: The cable and conductor shall be listed by UL and conform to NEC standards. The conductor shall be a continuous unspliced stranded CU 6AWG, rated for 600 volts, and shall have THW or XHHW insulation. The color of the insulation shall be green. The conductors shall be of the required length to eliminate all splices within the conduit.

L. Pull Boxes (A.D.O.T. #7T style): Communications pull boxes shall be UL listed. All pull boxes shall be reinforced concrete and be of a neutral color. Unless specified otherwise, pull box lids shall be steel checked plate material and shall be equipped with a bolt-down cover secured by a minimum of two (2) recessed penta-head bolts. The cover shall have the word "COMMUNICATIONS" in permanent raised or stamped letters. Pull boxes shall be open base unless they are placed in a high traffic area, in which case they must have a minimum 1.5 inch base slab and a full traffic-rated cover (28,000 G.V.W.R. plus rating). The pull box base shall have four (4) 4 ½" x 4 1/2" knockout channels, two at each end. Pull boxes may be extended by means of an "extension". The extension shall have four (2) 4 1/2" x 4 1/2" knockout channels, one on each end. Contractor shall provide all necessary collars, extensions, hardware, sealant, and conduit caps. All conduit entrances shall be sealed. The assigned pull box number shall be painted on the box at the time of installation. Chipped, cracked, or otherwise damaged boxes and covers will not be accepted.

Other pull box and hand-hole boxes may be substituted with approval from the Pima County Telecommunications Technical Coordinator.

M. Vaults (A.D.O.T.# 9 style): Communications vaults shall be UL listed. Vault base shall be pre-cast concrete with a minimum cover thickness of 6". Vault cover shall be fabricated steel, 36" diameter, secured by a minimum of one (1) recessed penta-head bolt. The cover lid shall have COMMUNICATIONS" written on it in permanent raised, stamped or welded lettering. The vault base and

vault cover shall be gasketed and weather proof. Vaults shall have a minimum outside dimension of 48" long by 48" wide by 50" high with a minimum thickness of 4". The base shall have one (1) 8" diameter by 4" deep sump hole knockout in the floor. The base interior shall have a minimum of one (1) 2 ½" diameter ground rod knockout in the floor, at a corner; the base interior shall have four (4) 7/8" diameter pulling irons, one centered on each side. The base exterior walls shall have four (4) 36" "C" channels precast in the sides, one on each side; the base exterior shall have four (4) 18" x 18" knockouts, one on each side; and, the base exterior shall have sixteen (16) 4 1/2" diameter knockouts for 4" conduit entrances, four on each side. The contractor shall provide all necessary collars, extensions, hardware, sealant, and conduit caps. All conduit entrances shall be sealed. The assigned box number shall be painted on the box at the time of installation. Chipped, cracked, or otherwise damaged boxes and covers will not be accepted.
Other vaults may be substituted with approval from the Pima County Telecommunications Technical Coordinator.
N. Innerduct: Innerduct shall be 1" PVC constructed of a smooth walled exterior and a longitudinally ribbed interior with a continuous unknotted 1250 lbs test mule tape installed. No corrugated innerduct will be accepted. Each innerduct, within a single conduit, shall be of a different color (orange, brown, blue and black).
O. Watertight Alibi: Watertight Alibi shall consist of a Quadraplex Duct Plug designed to seal around, organize, and support innerduct where it emerges at the top of the riser. Fasteners shall be stainless steel. Plug shall support a minimum of 400 lbs of cable, and shall be removable. Jackmoon or equivalent. No chemical seals will be accepted.
O. Blank Duct Plugs: Blank Duct Plugs shall be installed in each individual innerduct where it emerges at the top of the riser. Duct plugs shall be all plastic construction, corrosion proof, water and air tight to 30 psi. Jackmoon or equivalent.

3. CONDUIT CONSTRUCTION DETAILS:

Conduit:

A. Handling and Storage. All conduit shall be transported in modules or bundled in a straight and level position. The straps securing the conduit to the vehicle shall be a minimum of 4 inches in width and shall not deform or damage the conduit in any manner. Conduits shall be unloaded in accordance with the manufacturer's recommendations and shall not be dropped to the ground. Conduits shall be stored in a straight and level position in stacks not exceeding 8 feet in height. Materials shall be stored in an approved manner and covered to prevent ultraviolet deterioration due to the exposure to sunlight. When stored, conduit ends shall not be capped nor shall conduit be subject to temperatures in excess of 140degrees fahrenheight.
B. Cleaning. The interior of the conduit shall be kept clean and free of debris. Prior to installation, all foreign materials shall be removed from the interior of the conduit with compressed air and a swab.
C. Size. Unless otherwise indicated on the plans or special provisions, all conduits shall be 4-inch diameter.
D. Cuts and Connections. The conduit shall be cut square, de-burred, and trimmed to remove all rough edges. PVC conduit connections shall be of the solvent weld type. Wipe conduit dry and clean before joining. Apply a full coat of primer to the pipe and coupling per the manufacturer's recommendations. Apply a full and even coat of solvent cement to the entire area inserted into the fitting. Prevent excess cement from accumulating in the interior of the conduit. Allow joint to cure a minimum of 20 minutes. The complete joint shall be water tight. Where a connection is made to a steel bend, the coupling used shall be a PVC female adapter.
Expansion fittings shall not be installed in PVC conduit runs unless otherwise specified. Expansion fittings shall be installed in conduit runs where both ends are fixed in-place, such as between two foundations, and within concrete structures. Expansion fittings shall allow for a minimum linear expansion of 6 inches.
E. Bends. Bends shall be installed only when absolutely necessary. All bends shall be manufactured out of PVC, EMT or rigid steel conduit. Bend shall be factory bent or field bent. Field bends should not have a

radius of less than 50 feet. Factory bends shall have a radius of not less than 12 times the nominal diameter of the conduit. Conduit shall be bent without crimping or flattening, using the longest radius practicable. The sum of the deflection angles of all bends in any conduit run shall not exceed 270 degrees between termination and/or junction points. For the purpose of calculating the sum of the deflection angles, bends with a radius of 500 feet or greater may be excluded from these criteria.

F. Transitions from vaults and/or pull boxes, resulting in vertical conduit placement (such as from ground level to a j-box on the side of a structure) shall employ either EMT or rigid conduit, depending on the specific application.

G. End Treatment. Conduit ends shall be capped with conduit end caps at all times when work is not in progress. Rigid steel bends terminating in pull boxes shall terminate with an approved plastic bushing.

H. Placement. Conduit runs shown on the plans shall be changed only to avoid underground obstructions and only as directed by the Pima County Telecommunications Project Manager. Unless otherwise specified, conduits shall be placed with a minimum cover of 36 inches to the top of the conduit below the finished grade. Conduits shall be installed along the straightest horizontal and vertical alignment practicable, and with a uniform depth of cover. Variations in the alignment shall be accomplished with smooth transitions maximizing the radius of the bends. In cases where it is impossible to maintain the alignment of the conduit, the grade of the conduit shall be transitioned using the minimum number and the longest radius bends. Should discovered field conditions necessitate additional bends in the conduit run, the location and number of pull boxes shall be adjusted as directed by the Pima County Telecommunications Project Manager.

Conduits to be encased within concrete shall be installed on plastic conduit spacers. The spacers shall be placed at suitable locations to prevent sagging of the conduit between spacers or at 10 foot maximum centers. Prior to the placement of the concrete, the conduits shall be tied down to prevent them from floating.

Conduit penetrations into pull boxes shall be made using the knockouts or shall be cored in the structure. Conduits entering through the side wall of pull boxes shall be located 3 inches above the floor and 3 inches away from the end wall of the box. Conduit entering the bottom of pull boxes shall be located in the near side corner of the box, approximately 3 inches away from the side and end walls. The conduit shall be sloped towards the top center of the box to facilitate pulling of the cables and innerduct. Conduits terminating in pull boxes shall terminate a minimum of 3 inches inside the box wall. The void between the conduit and the box shall be completely filled with mastic to form a watertight seal. Conduits entering vaults shall enter through single duct knockouts. The location of the knockout shall be as indicated on the plans, or directed by the engineer. The joint between the knockout and the conduit shall be filled to form a watertight seal. At all locations where the conduits cross under a new curb, the letters “FO” shall be cut into the top of the curb directly over the conduit run. The letters shall be 3 inches tall and shall be clearly defined.

I. Trenching. Unless otherwise specified, all conduit runs shall be installed by trenching methods. Trenching shall include the removal of all material to the design grade no matter what type of material is encountered. The alignment of the conduit shall be staked in the field per the Pima County standard procedures. When trenching in excess of 5 feet is required, the contractor shall submit, in writing to the Pima County Telecommunications Technical Coordinator, a detailed description of their proposed trenching operations, including shoring methods, prior to the commencement of construction.

All conduit shall be covered with bedding material or concrete at the completion of each day’s work to prevent shrinkage and thermal expansion that could influence the alignment of the conduit.

Concrete encasement shall be a minimum of Class B (2,500 PSI) in accordance with Pima County/City of Tucson Standard Specifications and provide a minimum cover of 3 inches on all sides of the conduit. Otherwise, bedding and shading of the conduit shall be in accordance with the plans and specifications of the subject project. When installed adjacent to water mains, the conduit shall be encased in concrete.

J. Backfill. Upon completion of the conduit and bedding installation, the trench shall be backfilled and compacted. The backfill shall be designed and constructed using the plans and specifications of the subject project. Place the detectable warning tape in the backfill, 18 inches below finished grade and directly above the conduit.

K. Boring and Jacking. Conduit runs shall be installed by boring and jacking methods when required by the plans or directed by the Pima County Telecommunications Technical Coordinator prior to the commencement of work. Where a conduit run is required by the plans to be installed by boring or jacking,

the trenching method shall not be utilized except with prior written approval of Pima County Telecommunications Technical Coordinator.
When casing is used, the casing shall be schedule 40 “standard wall” steel pipe. The casing shall not deviate more than 0.20 feet from the design grade. The joints in the casing shall be fully welded in accordance with A.S.M.E. Section 9. Concrete end seals shall be provided at each end. The intervening annular space shall be filled with sand material approved by the Pima County Telecommunications Project Manager.
Boring and jacking pits shall be located a minimum of 2 feet outside the pavement edge. The diameter of the bore shall be as close to the outside diameter of the conduit such that it will enable the conduit to be installed. At all locations where the diameter of the bore is 2 inches, or greater, than the outside diameter of the conduit, the interstitial space between the conduit and the bore stall be filled with slurry. All boring and jacking methods used shall neither damage nor deform the conduit. The installed conduit shall conform to the alignment and grade shown on the plans.
L. Concrete Structures. Conduit embedded in concrete structures shall be securely attached to the reinforcing steel at locations and intervals detailed on the plans. Expansion fittings shall be installed at all locations where the conduit crosses expansion joints in the structure. Expansion joints shall also be installed at the point where the conduit enters and exits the concrete structure. Where it is not possible to install expansion joints, the conduit shall be installed in a conduit sleeve of sufficient size to provide a minimum of 1/2-inch clearance between the outside diameter of the conduit and the inside wall of the sleeve. Sleeves shall be discontinuous across the expansion joints in the structure.
M. Pull Boxes and Vaults. Prior to setting the pull box or vault, verify that the excavation is to the design elevation and alignment. Pull boxes and vaults shall be placed such that the crushed stone does not wash away or into the conduit. Vaults and pull boxes shall NOT be placed in a location of water drainage or standing water. Set boxes and vaults true and plumb. The top plane of the cover shall be a minimum of 1 inch above finished grade and 6 inches above possible standing water level for the location. Backfill and compact around the structure avoiding damage to the structure. The backfill shall be compacted to a minimum of 95 percent of the maximum density as determined by ASTM D698. Pull boxes are to be placed on a minimum of 5 cubic feet of clean 1 inch (size 57) rock and vaults are to be placed on a minimum of 16 cubic feet of clean 1 inch (size 57) rock.
Pull boxes installed in roadways or pedestrian walkways shall be encased in a concrete ring a minimum 10 inches wide and a minimum of 12 inches deep on compacted soil. Each pull box/vault shall be provided with a 5/8 inch by 8 foot ground rod and acorn, driven vertically in the corner with 6 inches of rod exposed above the top of the drainage rock.
Install the pre-cast sections in accordance with ASTM C891. Joints between the pre-cast sections shall be sealed with a flexible butyl sealant meeting the requirements of AASHTO M-198. Install pre-cast adjustment rings and the frame and cover to finished grade.
Cables passing through pull boxes require a minimum 50 feet service loop where attainable without exceeding manufacturer’s minimum bend radius. Cables pulled through vaults require not less than 150 feet before exiting.
N. Innerducts. All 4 inch conduits shall have a minimum of four 1 inch smooth wall exterior, longitudinally ribbed interior innerducts with 1250 lbs test rated pull strength mule tape installed.
O. Tracer Wire, Mule Tape. A continuous, separate #6 AWG THW/XHHW CU insulated tracer wire shall be installed in each conduit run, external to the innerducts. All lubricants used in the pulling of the tracer wire shall be water soluble. No splicing of the tracer wire shall be permitted in the conduit runs. The ends of the wire shall extend into each pull box, or vault, a minimum of 5 feet, coiled and secured. Connect the ends of all tracer wires within a pull box, or vault, together to a common lug.
All unoccupied or capped O.S.P. conduits shall have a continuous mule tape which is un-spliced, unknotted, 1250 pound (minimum) test rated pull strength, with sequential footage markings, installed and secured at each end and shall be labeled with location of opposite end.
P. Testing and Cleaning. The completed conduit runs shall be cleaned and tested prior to final acceptance. Cleaning shall consist of pulling a swab through the conduit and removing all foreign material from within the conduit. If water is allowed to enter the conduit during construction, it shall be blown out or removed by other satisfactory means prior to the acceptance of the system. Vaults and pull boxes shall be cleaned of all debris. Upon completion of the cleaning operations, the ends of the conduit shall be capped. RGS sweeps terminating in pull boxes shall be plugged. All conduit runs shall be clearance

tested after the completion of all backfilling and sub-grade preparation operations. This test shall consist of pulling a mandrel through the conduit run. The mandrel shall be segmented with an outer diameter of 1/4 inch less than the inside diameter of the conduit, and shall be 10 inches in length. The test shall be considered acceptable when the mandrel can be passed through the entire conduit run with a pulling force of 300 lbs or less. Each conduit run shall be verified for continuity along its entire length, as noted on the plans, and by means of an underground line locator. The installed conduit system shall be marked on the ground using standard blue stake color code and markings procedures.
All testing of the system shall be scheduled with, and conducted in the presence of the P.C.I.T. Enterprise Communications Division Project Manager. All portions of the system that do not pass the specified testing shall be repaired by the contractor, and retested, at no additional cost.

4. BUILDING ENTRY CABLE:

Supply, install, splice and terminate the required multi pair building entrance cable and/or fiber optic cable as shown and specified on the drawings. Supply and install station protectors and grounding as required. Far end splice locations to be determined by the Pima County Enterprise Communications Division for each individual project.

5. BUILDING TELEPHONE RISER CABLE:

a. Supply, install and terminate building riser cables as shown on drawings with a separate cable to each IDF. Size riser cable to 125% of telephone "A" jack outlet count (increase cable pair count to next higher 100 pair count as required).

b. Vertical cable runs are to be supported at a maximum of five-foot centers. Horizontal cable runs are to be supported at a maximum of three-foot centers.

c. All copper backbone cables will terminate at a central hub/distribution point and be bonded and grounded at both termination ends. Copper backbone cable shall be CAT 3 ARMM. ARMM cable **IS NOT** plenum rated, so the appropriately sized E.M.T. conduit, in which to install ARMM cable, is required. Pair counts shall be specified by the Pima County Telecommunications Project Manager.

d. Copper and fiber labeling will be structured so that each item down to the port or cable pair/strand level is equipped with a unique I.D. as follows:

1) The far end from hub single or double alpha character building identifier. (H for Health & Welfare, PW for Public Works etc.)
2) Single alpha character cable type designation. (F for fiber, C for copper)
3) Single alpha character backbone/riser designation. (B for backbone, R for riser)
4) Two digit feed number (01 through 99)

Example: SFB03 is a fiber backbone cable, which terminates at the main distribution point and is the 3rd cable of its type in the Superior Court Building.

All riser cables will terminate at a central hub/distribution point.
Labeling will be structured as follows:

1) The single or double alpha character building identifier. (H for Health & Welfare, PW for Public Works, etc.).
2) Single alpha character cable type designation. (F for fiber, C for copper)
3) Single alpha character backbone/riser designation. (B for backbone, R for riser, H for Horizontal)
4) Two digit feed number (01 through 99)

Example: ACR06 is a copper riser cable, which terminates at the main distribution point in the Administration Building and is the 6th cable of its type. We can also use the cable number to designate the floor number in most buildings.

A = Administration
AB=Abrams Health Center
H = Health & Welfare
L = LSB
O = Old Courts
S = Superior Courts
C = City
PW = Public Works
PB = Pioneer Building
CP=Central Plant

6. BUILDING DATA RISER CABLES:

a. Supply, install and terminate building riser cables as shown on drawings with separate cable to each IDF. Size riser cable to 125% of data "B" jack outlet pair count (increase cable pair count to next higher 100 pair count as required).

b. Supply, install and terminate Fiber Optic cables as shown on drawings.

c. Vertical cable runs are to be supported at a maximum of five-foot centers and be bonded and grounded at both termination ends. Horizontal cable runs are to be supported at a maximum of three-foot centers.
NOTE: Building additions and remodel projects may require additional telephone and data riser cable.
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PIMA COUNTY IS IMPLEMENTING VOICE OVER INTERNET PROTOCOL (VoIP) FOR WHICH WE INTEND TO INSTALL CAT 6A UTP CABLE. SPECIFICS ARE NOTED IN THE APPROPRIATE SECTIONS OF THIS CABLING STANDARD. INSTALLATIONS REQUIRING CAT 6A UTP WILL BE IDENTIFIED BY THE PIMA COUNTY INFORMATION TECHNOLOGY, ENTERPRISE COMMUNICATIONS DIVISION.

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7. HORIZONTAL (INTRA-FLOOR) COPPER CABLING:

a. The cable labeling for copper cable, i.e., CAT 5E, is to be as follows:
1. Each cable label is to begin with the letter “D” for data or “V” for voice (as appropriate for the cable’s function), followed by a dash.
2. There is to be a four-digit designator for the cable. The first digit is the floor number and the other three digits make up the cable number.

CAT 6A UTP: Use the same labeling scheme.

Example: **D-7001**
1. “D” is for data
2. The “7” designates the seventh floor
3. The “001” designates that this cable is number one in the series

8. INTRA-FLOOR FIBER CABLING:

a. The cable labeling for fiber cable is to be as follows:

1. Each cable will begin with the letter “I” to designate this as an intra-floor cable, followed by an “F” for fiber and a fiber type indicator of “S” for single mode, “M” for multi-mode or “SM” for Composite cables, followed by a dash.
2. The first alpha-numeric will be the floor.
3. The next number will be the three digit cable identifier.

Example: **IFSM-7001**

“I” is for intra-floor
“F” designates fiber
“SM” designates a composite cable
“7” designates the seventh floor
“001” designates that this cable is number 1 in the series

9. TELEPHONE TERMINAL BACKBOARDS (TTB) AND DATA TERMINAL BACKBOARDS (DTB):

a. Supply and install 4' X 8' X 3/4" A-C (fire-rated **or** treated on all sides with fire resistant paint; plugged and sanded on one side) plywood backboards in communications equipment rooms as indicated on drawings. New buildings and major structure re-models, see **Section D, Common Equipment Room Design Guide-Minimum Requirements**.

b. Multi-pair cable shall terminate on Avaya or equivalent 110 type wiring blocks.
CAT 6A UTP: Rack mounted patch panel terminations may be required. The Pima County Enterprise Communications Division Technical Staff will specify when these are to be used.

c. Backboards and equipment shall be installed, centered above and below an imaginary "working height level line" 54 inches above the finished floor level. The backboard (may be more than one) attitude may be long-side horizontal or vertical, depending on available wall space.

d. Terminal blocks shall be permanently marked with pair count numbers for entry cable terminations and riser cable terminations. Riser cable terminations shall be marked with the final destination room identification. The Pima County Enterprise Communications Division Technical Staff will assist in determining entry cable and riser cable pair counts. Entry and riser cables are to be terminated starting with lowest pair count, left to right, top to bottom. Horizontal station cables are to be terminated starting with the lowest room number, left to right, top to bottom.

e. Each group of entrance, riser and horizontal (station and data) wiring blocks shall be configured to include spare (not wired) terminations for 100 pair for future additions.

f. Metal closed loop D-rings (2,4 and 6 inch as required) shall be installed in quantities sufficient to produce an orderly quality cable and wire installation. Distributing posts are not acceptable.

g. Cables shall be routed in such a way as to minimize interference with cross connect wiring and future termination block additions. D-rings shall be used to route cable away from the top and bottom of the terminal blocks. Entrance and riser cables shall be routed to and terminated to the bottom group of termination blocks. Horizontal distribution cables shall also be routed to and terminated to the bottom group of termination blocks.

h. D-rings shall be installed to maintain an orderly appearance for cable or wires running between backboards or to common equipment.

i. Entry and riser cables shall be arranged in such a manner as to occupy as little space on the TTB/DTB as possible. Transition splice cases and riser cable splice cases are not considered part of a TTB, and shall be located so as not to interfere with backboards and common equipment.

j. Telephone riser and horizontal backboards should occupy the left most TTB position, followed left-to-right by data riser and horizontal backboards, fiber optic terminations, data common equipment, telephone common equipment and broadband equipment.

k. All equipment shall be securely fastened to the TTB/DTB. Suspension by connection to other equipment is not acceptable.

l. Complete TTB and DTB backboard (BET & IDF) layout drawings shall be included as part of the project submittal documentation. Building additions and remodeling projects may require relocation of existing backboard-mounted equipment.

m. Ethernet riser cable shall be routed in such a way as to minimize interference with telephone, data, fiber optic and broadband wiring and equipment expansion of these services.

n. Installation of Ethernet service tap loops shall be confined to a three-foot square area. Minimum cable bend radius is twenty-one inches. Routing and termination of cable in equipment rooms and riser closets shall be coordinated with and approved by the Pima County Telecommunications Division.

o. Connectors requiring build up material on cable to match connector size will not be accepted.

p. Connectors are not to be re-used. In the event that a connector is removed as a result of cable relocation, patch panel upgrade or any similar circumstance, new connectors are required.

q. Terminate both ends of Ethernet riser cable using a connector, in-line connector and terminator. Ground near end (lowest impedance point) of the cable. Connect ground clamp to the in-line connector. Use #6 AWG insulated copper ground wire from the ground clamp to an approved ground.

r. Intra-building copper cable splicing is allowed only in backbone cable----never for horizontal cable, which extends between the telecommunications room and the work area.

s. All fiber optic connectors shall be "SC" epoxy cured, ceramic tip type, unless specified otherwise.

t. **All** fiber optic cable splicing shall be done using the fusion splice method.

10. STATION WIRING AND PATHWAYS

a. Supply and install one 4 - pair cable (CAT 5E, white teflon covered) from the TTB to each outlet "A" jack for telephone service and two 4 - pair (CAT 5E, blue teflon covered) from DTB to each outlet "B" jack for data service. As a general rule, each data jack location is to be furnished with a voice jack; each voice jack location with two data jacks. Multiples of one or the other jack types will be identified.
CAT 6A: One 4-pair (CAT 6A, gray Teflon covered) from patch panel to each outlet for VoIP and one 4-pair (CAT 6A, YELLOW Teflon covered from patch panel to each outlet for data. Standard station end insert configuration shall be blue (VoIP) in the upper left and orange (data) in the upper right of the four-port faceplate. Multiples of one or the other jack types will be identified.

Station wiring must be in compliance with **ANSI/EIA/TIA 568-B-1** horizontal wiring distance specifications.

b. Wireless access point (Wap) locations shall be connected using CAT 5E, orange teflon covered, plenum rated cable, terminating in orange jacks (Leviton Insert # 5G108-R05). The Wap end shall terminate in an orange insert housed a "biscuit" device.
CAT 6A: orange teflon covered, plenum rated cable, terminating in orange jacks (Leviton Insert # 6A10G-RO6), The Wap end shall terminate in an orange insert housed a "biscuit" device.

c. Outlet jack shall be an eight position modular jack meeting the specifications of FCC Regulations Part 68.500.

d. Station jacks intended for wall telephone use only, will use a six-position modular wall jack with stainless steel plate. The unused brown/white pair shall remain at trim length, insulated and stored.

e. Jacks shall be clearly marked as to their intended function. In some cases, colored jacks (brown, blue, red, etc.) may be specified for uncommon applications. This does not eliminate the need for them to be clearly marked as to their intended function.

f. Cables shall be permanently marked at both ends with the appropriate floor and cable number or room number (or other identification), sub-identifier if required and function per Client requirement.

g. Telephone and data station cable must not be spliced. Cable runs are to be direct home runs to the IDF and shall not pass through any other outlet box. There shall be no bridge or taps.

h. New Construction or Major Remodels: Install cables in 1" (minimum) E.M.T. (**no flex conduit**) conduit terminating in outlet boxes (as specified in paragraph i, below), raceways and cable trays, as specified, supplied and installed by the construction or electrical contractor. Larger E.M.T. conduit must be used if the bulk of cables being installed exceeds the recommended conduit fill ratio.
CAT 6A: Install cables in a 1 " (minimum) E.M.T. (**no flex conduit**) conduit terminating in outlet boxes (as specified in paragraph h, below), raceways and cable trays, as specified, supplied and installed by the construction or electrical contractor. A one inch (or larger, if appropriate) E.M.T. conduit must be used if the bulk of cables being installed exceeds the recommended conduit fill ratio.

All conduits shall be fire-stopped in accordance with fire codes. All conduits shall have a plastic or nylon pull string, with a minimum test rating of 200 pounds, placed inside the conduit with a 24-inch lead, on each end of the conduit. All conduit and sleeves shall have insulated bushings installed to protect wire and cables from damage.

Routine Installations or Remodels: Re-use existing pathways or create pathways by "fishing" interior walls with stiff wire or fish tape, as necessary. Provide wall cut-outs, outlet boxes, plaster rings and other appropriate attachment methods for wall mounted outlets.
Flex conduit, to be placed by others, may be used when necessary (example: fire blocked walls, walls with granular, batt or roll insulation, etc.), provided that it is routed in such a manner as to allow non-binding conductor pulling capability. If flex conduit is used, provide a minimum 1 inch where three cables are to be pulled, 1" where four to six cables are to be pulled and a minimum 2" for seven or more cables. Plastic or nylon pull string, with a minimum test rating of 200 pounds, is to be placed inside the conduit with a 24-inch lead, on each end of the conduit, all conduit installations. NEC conduit fill tables shall be used as the standard. All conduits and sleeves shall have insulated bushings installed to protect wire and cables from damage.

i. Telecommunications outlet boxes shall be installed in drywall, plaster, or concrete block wall and are to be U.L. listed, single-gang, wall type with 1 inch conduit knockouts (2 3/8 inches wide by 4 inches high by 3 1/2 inches deep) fabricated from pressed steel and either hot-dipped galvanized, electroplated-plate galvanized or prime coated with a final coat of manufacturer's standard enamel or lacquer finish. Larger boxes may be required depending on the total cable count in a given application. When possible, offset box locations so as to not compromise the effectiveness of the wall as a sound barrier.
CAT 6A: Telecommunications outlet boxes shall be installed in drywall, plaster, or concrete block wall and are to be U.L. listed, single-gang, wall type with 1 inch conduit knockouts (2 3/8 inches wide by 4 inches high by 3 1/2 inches deep) fabricated from pressed steel and either hot-dipped galvanized, electroplated-plate galvanized or prime coated with a final coat of manufacturer's standard enamel or lacquer finish

j. Station cable and wiring shall comply with **ANSI/EIA/TIA-568-B.1** standards.

k. Buildings with multiple floor IDFs - All Tele/Data outlets in any one room must terminate in the same IDF.

l. Install and terminate fiber optic cable as shown on drawings.

m. Tele/Data outlets shown on drawings (DEMOLITION) to be removed or relocated shall be removed completely, including outlet and wiring to originating IDF termination point. IDF termination identification labels shall be corrected to reflect removal.

n. Copper cable must be designed for continuous length from the distribution enclosure to distribution enclosure.

o. Systems (modular) furniture to be cabled for communications can be fed with wire whips from abutting walls, power poles, concrete floor penetrations or surface mounted raceway systems. Minimum cable bend radii, conduit capacity and approved termination methods shall be maintained.

p. Conduit runs must be designed and installed to:

1. Follow the most direct route possible with no more than two 90 degree bends between pull boxes.
2. Keep conduit at least 6 inches away from parallel runs of flues and steam or hot water pipes or other heat sources operating at temperatures above 100 degrees Fahrenheit. Install horizontal conduit runs above water piping.
3 Contain no continuous sections longer than 100 feet. Pull boxes shall be used for runs that exceed 100 feet in length.
4. Be grounded and bonded on one or both ends.
5. The radius of a conduit bend must be a minimum of 6 to 10 times the internal diameter of the conduit being used.
6. Use ANSI/EIA/TIA-569 guidelines on cable capacity for horizontal conduits that have no more than two 90 degree bends.

11. WIRING PRACTICES:

a. Telephone riser cable shall terminate on the TTB (Telephone Terminal Board) 110 wiring block groups.

b. Data riser cable and horizontal station cable shall terminate on patch panel as designated by Communications Dept.

c. All horizontal copper and fiber cables installed in or through plenum ceiling or raised floor spaces are to be plenum rated. Fiber optic cables shall be housed in plenum rated inner duct, if the cable is installed in a plenum space.

d. Cross connect wires shall pass through 88A retainers, and D-rings as required. Wiring horizontally between termination block groups shall be run horizontally through D-rings or 188B1 backboards mounted at the same elevation.

e. AC power cords shall not be routed through or attached to D-rings, which contain or are intended to contain signal wiring.

f. Cable and wire above the ceiling shall be run parallel or perpendicular to the walls. Diagonal runs will not be accepted. Riser cables shall be run parallel to riser system. Do not install cables in close proximity to fixtures or equipment that may cause RFI or EMI. Avoiding potential sources of interference (e.g. motors, transformers, copiers, etc.) must be a primary consideration when designing horizontal pathways. To avoid electromagnetic interference, all pathways should provide clearances of at least:

> 1.2m (4 ft) from large motors or transformers.

> 0.3m (1 ft) from conduit and cables used for electrical power distribution.

> 12cm (5 in) from florescent lighting. Pathways should cross perpendicular to florescent lighting and electrical power cables or conduits. Clearance requirements are specified in ANSI/EIA-569 and ANSI/NFPA70.

g. Cables and wire shall not be attached to conduit, pipes, ceiling grid, light fixture hangers or HVAC ductwork, etc.

h. Cable and wire above ceiling shall be suspended from approved hangers as required and be routed, as close to upper ceiling as practical. Supports shall be installed at a maximum of three-foot centers. Metal D-rings and bridal rings are approved hangers.

i. Cable shall be permanently identified at both ends.

j. Entrance cable shield should be grounded to an approved provable ground as close to the entrance as possible.

k. Riser cable shields (Telecom and Data) shall be bonded to the entrance cable shield at the BET. Maintain shield continuity over the entire cable length. Riser cable shields (Tele and Data) shall also be bonded together at the IDF and properly grounded.

l. All telephone boards, racks, trays and cabinets must have a No. 6 AWG insulated copper conductor bonded to a ten inch (10”L x 4”W x 1/4 H) wall mounted, main grounding, copper bus bar, Chatsworth Products number 10622-010, in each equipment room. Chatsworth part numbers 10622-012 and 10622-020 are to be used where additional lug capacity is required. Shielded cable shall be grounded according to the manufacturer’s, EIA/TIA and IEEE specifications.

The building primary ground connection shall be a minimum No. 6 AWG insulated copper conductor, bonded to the same ten inch (or larger, as required) main grounding, copper bus bar(s), mentioned above. All grounding connections shall be fully bonded per NEC and ANSI/TIA/EIA 607 standards

m. End to end testing of all copper pairs and fiber optic strands shall be done after completion of splicing and termination. These must be approved by the PCIT Enterprise Communications Division. Test documentation will be provided for each fiber optic strand.

n. Install 110C connecting blocks for all pairs terminated. Each row of 25 cable pairs requires (left to right) (5) 110C-4 and (1) 110C-5 connecting blocks. Supply 110C blocks (not installed) for all unused positions.
NOTE: When terminating cables in increments of 25, 50, 100, etc, use 110C-5 connecting blocks and C-5 connectors. Use ONLY a 5-pair termination tool for punch downs.

o. Feed cables are to route from the bottom, up, to allow for additional 110 blocks to be stacked vertically, if needed, for growth.

p. Station cables are to route from the bottom, up, to allow for additional 110 blocks to be stacked vertically, if needed, for growth.
CAT 6A: Patch panel mounted, only.

q. Each 110AW1-100 wiring block shall have a minimum of 4 each 88A retainers (2 on each side). Each 110AW1-300 wiring block shall have a minimum of 12 each 88A retainers (6 on each side).

r. Conduit fill: 1-cable = 53% fill, 2-cables = 51% fill and 3 or more cables = 50% fill.

s. All conduits and sleeves must have UL approved insulated end bushings installed prior to installation of cables or station wiring. All riser sleeves/conduits and firewall penetrations shall be fire stopped using approved methods and materials.

t. All fiber optic cables shall be installed in compliance with manufacturers pull tension and bend radius specifications.

u. Telephone/Data outlet. Install Leviton 6 port plate, part # 41080-6IP for all locations with blanks (Leviton part #110-41084-BIB) inserted in unused ports.
CAT 6A: Install Leviton 4 port plate, part # 41080-4AP for all locations with blanks Leviton part #41084-BIB) inserted in unused ports.

v. Appropriate wire management, using the specific wire managers identified herein, is required. Generally, one horizontal wire manager would be located immediately above and one immediately below each patch panel. Vertical wire manager requirements will be identified, by job. All cables are to be appropriately dressed and secured, including those installed **inside** equipment cabinets, such as the Great Lakes or Hoffman cabinets identified in this document.

w. A minimum of **48 inches** separation between floor mounted or wall mounted equipment cabinets and/or racks and any source of electromagnetic interference, such as power panels, transformers, motors, generators, radio transmitters, elevators, etc. shall e maintained at all times.

x. In situations where a transition is required from a cable pathway such as surface mount wire channel (raceway) or floor box to a modular furniture panel or similar mounting point, product name *"Liquid Tite-Flex"* PVC conduit (in the appropriate diameter for cable fill and using proper elbow radii for each connecting point) is to be used as a conduit from the raceway. Liquid-Tite Flex is available in diameters from ¾" to 2". **DO NOT USE SPIRAL WIRE WRAP.**

y. In the event that concrete floor penetrations are required, a cored hole is to be provided and the appropriate Hubbell SystemOne floor penetration device is to be used.

A list of Hubbell SystemOne floor penetration devices, sub plates and fittings can be found in paragraph 11, ACCEPTABLE MATERIALS LIST, sub-category yy on page 22.

In the event of a non-standard application, the Pima County Enterprise Communications Division will assist in identifying the acceptable method and device to be used.

12. FIRE STOPPING:

a. Current and future floor penetrations that have fiber inner-duct and / or tube cable are to be sealed using the U.L. system C-AJ-8131 or approved equivalent.

b. Current and future floor penetrations that have copper cable (up to 400 pair) are to be sealed using the U.L. system C-AJ-3133 or approved equivalent.

c. Current and future wall penetrations for horizontal cable are to be sealed using the U.L. system W-L-3218, W-L-3219, or approved equivalent.

13. ACCEPTABLE MATERIALS LIST:

Substitutes MUST be approved via submittal. All items not specifically covered in these specifications must have the approval of the Pima County Telecommunications Division before placement or implementation. The submittal process consists of the Vendor providing a worksheet, showing product nomenclature, model or part number and a brief description supporting your recommendation for the substitution.

The "or equivalent" notation requires you to submit a worksheet with supporting product specifications and/or a product sample with product specifications, for review by the Telecommunications Division prior to installation.

a. Building entry cable. 22 or 24 AWG solid, REA color code number of pairs as required. Avaya specification "AFAW" or AFMW" underground cable. Transition splice to non-filled cable is required prior to BET termination. Appropriate lightning protection shall be provided (see rr and ss, below).

b. Riser cable. Voice cable shall be 24 AWG CAT 3 ARMM solid, RUS color code. ARMM cable **IS NOT** plenum rated, so the appropriately sized E.M.T. conduit, in which to install ARMM cable, is required. Pair counts shall be specified by the Pima County Enterprise Communications Division Project Manager.
Data cable shall be CAT 5E, U.L. rated and listed as type "CMR" with FEP insulation UTP in a riser environment and "CMP" in a horizontal environment.
VoIP cable shall be CAT 6A UTP, U.L. rated, shielded, 23 AWG, flame Retardant PVC jacket.

c. Station wire. (4 pair), 24 AWG CAT 5E solid, RUS color code, plenum rated: U.L. listed type "CMP" with FEP insulation UTP. Mohawk, BerkTek, Tyco/Amp, Superior Essex, Belden, General Cable. **No substitute.**
CAT 6A: (4 pair), 23 AWG, gray color for VoIP; yellow color for data, UTP plenum rated. Mohawk, BerkTek, Tyco/Amp, Superior Essex, Belden, General Cable. **No substitute.**

d. Cable hangers. Caddy or equivalent.

e. Splice cases. As required and approved via submittal.

f. Termination block. Avaya 110AW1-100 for 100 pair and 110AW1-300 or equivalent.

g. Cross connect wire. One pair, 24 AWG, solid, copper, REA color code, polyethylene with PVC insulation.

h. Connecting block. Avaya 110C-4 (4 pair station cable), 110C-5 (5 pair riser cable) or equivalent.

i. Designation strip. Avaya 188BG1-100 Green (entrance & riser), 188BB1-100 Blue (tele/station) and 188BY1-100 Yellow (data station or equivalent).

j. "F" Clip terminal insulator. One pair protector Avaya AT-8660 or equivalent.

k. Telephone/Data outlet. Install Leviton 6 port plate, part # 42080-6IP for all locations with blanks (Leviton part #110-41084-BIB) inserted in unused ports.
VoIP: Install Leviton 4 port plate, part # 41080-4AP for all locations with blanks (Leviton part # 41084-BIB).

l. Insert # 5G108-R05 (data). Leviton.
CAT 6A: #6A10G-RO6 (Orange-data). Leviton.

m. Insert # 5G108-RI5 (voice). Leviton.
CAT 6A: #6A10G-RL6 (Blue-VoIP). Leviton.

n. Jack faceplate # 41080-6IP. Leviton.
CAT 6A : #41080-4AP. Leviton.

o. Blank faceplate # 110-41084-BIB. Leviton

p. 110 block, 300 pr. # S110AB2-300FT. Siemens.

q. 110 block, 100pr. # S110AB2-100FT. Siemens.

r. Patch panel # 49255-H48 non-populated. Leviton. **No substitute**.
CAT 6A: #4W256-H48 recessed and angled non-populated with #4W006-AMB angled wire management bar (rear—one per patch panel). Leviton. **No substitute.**

s. Caddy MPLS, low voltage plates. Caddy.

t. Cable CAT 5E Plenum White (for voice), per specification.
CAT 6A: Plenum Gray (for VoIP), per specification.

u. Cable CAT 5E Plenum Blue (for data), per specification.
CAT 6A: Plenum Yellow (for data), per specification.

v. Fiber optic cable shall be Draka Communications C1181 or C1182 series (primary) or Corning (secondary), 6 pair (12 strands) minimum for inside or outside cabling applications.

w. Cable ties. Plenum type as required. Panduit PLT1M-C702 (4 inch) or PLT2S-C702 (7.5 inch). Soft cable and “Category” cable to be secured with hook and loop (Velcro type) fastener. **DO NOT** use zip ties.

x. Four pair (station cable) connecting block # S110C-4.Siemens.

y. Junction Box # JBP1IIW. Panduit.

z. Surface jack/ 4 wire # AT468-4. Allen-Tel.

aa. Surface jack/ 8 wire # AT468-8. Allen-Tel.

bb. Fiber enclosure units: Leviton OPT-X 1000 series, rack mount enclosures, appropriately sized to accommodate a minimum of 25% growth potential, equipped with a suitable number (per specification) of SC couplers and adapter plates. Leviton OPT-X 1000 series, wall mount enclosures are to be used when wall mount applications are specified. Leviton. **No substitute**.

cc. Fiber optic connector: SC type with ceramic tip.

dd. Fiber optic entrance cable (conventional). Draka (primary) or Corning (secondary) 6 pair (12 strand) minimum count single-mode, tight buffer, loose tube, filled, ASP sheathing. **No substitute**.

ee. Fiber optic riser cable (conventional). Draka C1181 (primary) or Corning (secondary) 6 pair (12 strand) minimum count single-mode, tight buffer, loose tube, OFNR or OFNP type specified. **No substitute**.

ff. Swing-out equipment wall rack, 18 X 36 Hoffman # E19SWM20U20.
gg. Cable Cat support system # CAT32. Caddy.

hh. 2 A Adjustable beam clamp # BC. Caddy.

ii. Chatsworth rack (7 foot) # 46353-503. Chatsworth. **No substitute**.

jj. Chatsworth four-post rack (7 foot) # 50120-703 with vertical wire managers (# 11729-503). Ten inch deep equipment shelves (# 12291-701) and wire manager covers (# 12664-701) are optional and will be requested on an as-needed basis. Chatsworth. **No substitute.**

kk. Hoffman 4ru side-mount cabinet # E19SM4U. Hoffman. **No substitute.**

ll. Hubbell horizontal manager # HC219CE3N. "Transition spools" (#HCSPL310) to be used with horizontal manager, as necessary. Hubbell. **No substitute**.
CAT 6A: Leviton horizontal manager #4W254-LPM (Recessed, angled 1 r.u.--- for front of rack or cabinet). **No substitute**.

mm. Panduit bend radius control unit # CMSRC2, to be used with wire manager as specified. Panduit.**No substitute**.

nn. Chatsworth vertical manager (84 inch) # 11729-503. Chatsworth. **No substitute**.

oo. Chatsworth vertical manager cover (84 inch) # 12664-701. Chatsworth. **No substitute**.

pp Leviton vertical manager (36 inch) # 49260-MR3 where required.

qq. Wall telephone outlet, Leviton 40226-S wall plate (with mounting lugs). **No substitute.**

rr. Protector terminal block (per specification). Circa

ss. Plug in protectors. 4B1E-W for line side (M.D.F.), 3B1E-W for station/subscriber side (I.D.F.) Circa

tt. Bonding & Ground cable/wire. As required and approved by submittal.

uu. Chatsworth Products number 10622-010 grounding bus bar kit. Chatsworth part numbers 10622-012 and 10622-020 are to be used where additional lug capacity is required. **No substitute.**

vv. Splice case filling compound. Re-enterable type 3M 4442.

ww. Equipment enclosure, caster or adjustable levelers, per specification. Great Lakes. **No substitute.**

xx. Air blown fiber optic cable, per specification. Sumitomo. **No substitute.**

yy. Floor penetration/"poke-through" devices: **Hubbell SystemOne FRPT floor penetration system**. This system incorporates a floor penetration device with interchangeable sub plates that are pre-wired with 20A power receptacles. Fittings are available for use with CAT 5E, fiber, coax, and audio/video applications. It installs in a 4" diameter core drilled hole through concrete **No Substitute.**

FRPTs

Floor penetration device product numbers:

S1P4X4FIT has two ¾" EMT for communications and one ¾" EMT for power.

S1PTFIT has two 1" EMT for communications or power

S1PTAVFIT has one 1½" EMT for communications and one ¾" EMT for power.

NOTE: Where under-floor access is limited or unavailable, use the **Hubbell Round Multi-Service PVC Floor Box**, **S1PFB**, (round non-metallic concrete floor box)—see the information below to select an appropriate sub-plate. This unit feeds power and communication wiring from the side and requires a 3.0" to 5.0" floor box depth, depending on the application sub-plate.

Floor Boxes

Appropriate pathways and access methods (core drills, in floor conduits, etc.) MUST be provided when either the Hubbell SystemOne or Multi-Service PVC floor units are specified.

Sub plates to be used with Hubbell floor penetration devices:

S1SP4X4 pre-wired with four 20A, 125V receptacles and four openings for voice/data and audio/video connectors.

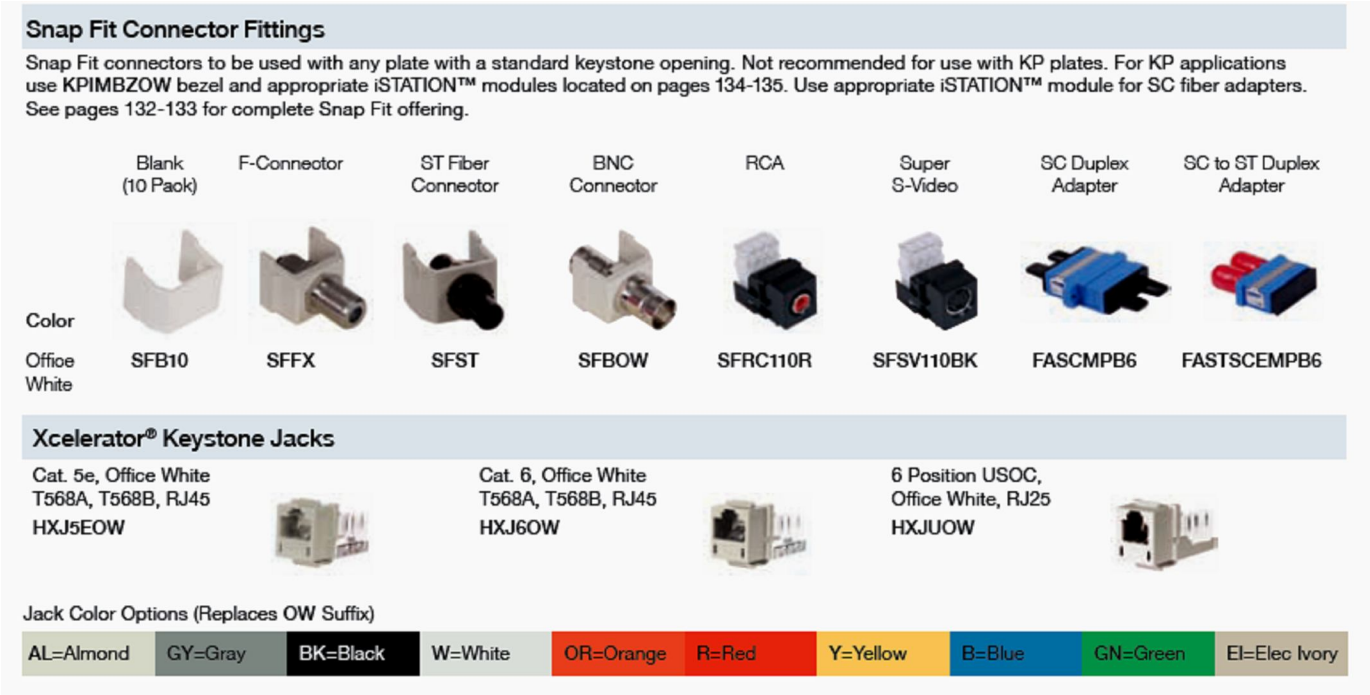
S1SP3IM pre-wired with one 20A, 125V. Accommodates voice/data and audio/video including VGA, RCA, S-video modules.

S1SP features two rectangular openings to allow two data outlet frames for up to 12 ports of connectivity.

S1SP4IM features a recessed single-gang, combination 3 unit and 1 unit opening for up to eight voice/data, fiber and audio/video connectors.

S1SPTL features one standard opening for a Hubbell 20/30A twist lock device and two openings for voice/data or audio/video connectors.

Snap Fittings to be used with Hubbell floor penetration devices and sub plates are shown below. Leviton inserts are to be used in lieu of Keystone jacks. See sections 13.L and 13.M on prior pages.



Snap Fit Connector Fittings

Snap Fit connectors to be used with any plate with a standard keystone opening. Not recommended for use with KP plates. For KP applications use KPIMBZOW bezel and appropriate iSTATION™ modules located on pages 134-135. Use appropriate iSTATION™ module for SC fiber adapters. See pages 132-133 for complete Snap Fit offering.

Color	Blank (10 Pack)	F-Connector	ST Fiber Connector	BNC Connector	RCA	Super S-Video	SC Duplex Adapter	SC to ST Duplex Adapter
Offioe White	SFB10	SFFX	SFST	SFBOW	SFRC110R	SFSV110BK	FASCMPB6	FASTSCEMPB6

Xcelerator® Keystone Jacks

Cat. 5e, Office White T568A, T568B, RJ45	Cat. 6, Office White T568A, T568B, RJ45	6 Position USOC, Office White, RJ25
HXJ5EOW	HXJ6OW	HXJUOW

Jack Color Options (Replaces OW Suffix)

AL=Almond	GY=Gray	BK=Black	W=White	OR=Orange	R=Red	Y=Yellow	B=Blue	GN=Green	EI=Elec Ivory

14. CABINET (for large applications) SPECIFICATIONS**:**

84 inch free standing (Hoffman PROLINE PDCP2078BFP): 84.00”h x 27.87”w x 33.31”d, black low gloss polyester powder paint with two sets of adjustable L-shaped rack angles. Accommodates 19” rack mount accessories in both front and rear of cabinet. Load rated at 1500lbs. Includes fan and filter package, window front door with locking swing handle, solid rear door. Order Hoffman part number DP1N622415 for vertical mount power distribution units (NEMA 5-15R receptacle style).

NOTE: Use Hoffman PROLINE cabinet number PSC20610BFP for applications where extra depth is required. Dimensions are: 82.10"h x 23.94"w x 41.18d. This cabinet REQUIRES four PRA1920TPL1 rack angles to function as a voice/data equipment cabinet.
Use screw package AS1032 (twenty 10-32 screws per package).

48 inch free standing (Hoffman NC 1268): 49.00"h x24.00"w x 33.99"d, black low gloss polyester paint with two sets of adjustable L-shaped rack angles. Accommodates 19" and 23" rack mount accessories. To include fan ready top and 6" fan, solid front door with locking swing handle and louvered rear door, removable side panels with ¼ turn key locking latch, two cable entry ports with caps and grommets. Adjustable levelers (NLK) should be ordered for all installations. Hoffman offers an 8 position rack mount power strip with circuit breaker and 15 foot cord which can be used if required. Hoffman also offers a set of 4 casters (caster kit NCK) for use where appropriate and in lieu of the levelers mentioned above.
Use screw package AS1032 (20 10-32 screws per package).

36 inch wall mounted (Hoffman EWMW36225): 37.25"h x 22.00"w x 25"d, black, wall-mount, double-hinged. Load rated 125lbs. To include a Plexiglas door and vented sides, front access to center body hinging and back section latches. Knockouts on top and bottom for 4" cooling fan. Standard 4" cooling fan (A4AXFNPQ). Knockouts on top and bottom for cable entry. Front and rear sections are to lock independently. Hoffman offers a 6 position rack mount power strip with circuit breaker which can be used if required. Mounting foot kit may be required if this cabinet is used as a floor mounted unit. Equip with top mounted cooling fan only. Fan to be installed in all cases.
Use screw package AS1032 (20 10-32 screws per package).

F. OUTLET LOCATION GUIDE - MINIMUM REQUIREMENTS

1. Typical room dimensions and number of outlets required:
   8 ft. X 12 ft. = two outlets.
   10 ft. X 12 ft. = three outlets.
   12 ft. X 12 ft. = four outlets.
   10 ft. X 20 ft. = six outlets.
   Conference Rooms = one outlet unless the room design and size dictate otherwise.

2. Standard outlets are a minimum of one voice, two data (top is voice, bottom is data) modular type mounted on a single gang wall plate. Single telephone outlets (except for wall phones) shall not be used.

3. Wall boxes shall be flush mounted, standard metal 4 inch square, deep type with a single gang plaster ring. Conduit (3/4 inch minimum, metal) from wall box shall be concealed and stubbed out above accessible ceiling, to riser closet or to telecommunications cable tray. Conduit end shall be fitted with a UL approved insulated bushing.

4. Any additional service requirements that will not operate over the standard Pima County building telephone/data wiring shall use completely separate wall outlet and conduit system.

5. Cable tray system shall originate at the floor of the telecommunications riser closet and be routed through all hallways. Design shall allow compliance with the EIA/TIA 568 maximum station wire length and fill ratio requirements.

6. Each outlet shall have a separate conduit. Outlets shall not be installed back to back or in a daisy chain configuration.

G. FIBER OPTIC CABLE SYSTEM

GENERAL REQUIREMENTS: The successful respondent is responsible for determining and supplying sufficient fiber optic cable, inner duct. Terminations and documentation to meet the requirements as specified by ANSI/TIA/EIA, BICSI and Telcordia GR-326, Generic Requirements for Single-Mode Optical Connectors and Jumper Assemblies, providing generic requirements for Physical Contact (PC) connectors that are used to join cables containing one single-mode optical fiber where a connect/disconnect capability is required. A single-mode (or multi-mode) connector assembly consists of two connector plugs and one adapter. Each connector plug, in turn, contains alignment elements that consist of ferrules with optical fibers. Radius of curvature, apex offset, fiber undercut/protrusion, connector type and end face geometry must meet these standards.

The fiber optic cable must be dielectric and designed for continuous length from the distribution enclosure to distribution enclosure. The system shall be engineered with adequate excess fiber optic cable lengths to facilitate future splicing. At a minimum, this will consist of ten feet (10') at each distribution point and a loop in each pull box. All cable shall be adequately secured and protected from accidental damage.

FIBER REQUIREMENTS: 100% of the fiber strands shall be within specifications. All cable shall meet or exceed the requirements of this section for fiber dimensions, attenuation, bandwidth, numerical aperture, fiber proof test, cable bending, tensile load, impact, resistance, crush resistance, and attenuation versus temperature, when measured in accordance with EIA Standard RS-455.

QUALIFICATION OF FABRICATION: Products shall be produced by manufactures regularly engaged in the manufacture of similar items and with a history or successful production acceptance to the Pima County.

CERTIFIED TEST DATA: Certified test data shall be delivered with the fiber optic cabling. This certified test data shall indicate the test results when cabling is subjected to the following EIA RS-455 defined tests; Fiber dimensions, Bandwidth, Bending Radius, Impact resistance, Attenuation versus Temperature, Numerical aperture, Tensile loading and Crush resistance. Testing shall be carried out in accordance with this document. This includes testing the attenuation and polarity of the installed cable plant with an optical loss test set (OLTS) and the installed condition of the cabling system and its components with an optical time domain reflectometer (OTDR) or “Fluke” tester for short distance fiber runs. The condition of the fiber end faces shall also be verified.

Testing shall be performed on each cabling link (connector to connector).

Testing shall be performed on each cabling channel (equipment to equipment) that is initially installed or identified by the owner and shall not include any active devices or passive devices within the link or channel other than cable, connectors, and splices, i.e., link attenuation does not include such devices as optical bypass switches, couplers, repeaters, or optical amplifiers.

All tests shall be documented including OLTS dual wavelength attenuation measurements for multimode and single mode links and channels and OTDR traces and event tables for multimode and single mode links and channels. OTDR testing will be accomplished using an EXFO model FTB-100B tester.

Test results shall include a record of wavelength, fiber type, fiber and bundle number (for air-blown), test equipment and model number, date reference and operator crew members.

CONNECTOR LOSS: Data loss of no more than .5dB per mated pair for both single mode and multimode fiber is required.

FIBER CHARACTERISTICS: All fibers in the cable must be usable fibers and meet required specifications.

A. Cable design

The successful respondent shall provide the necessary engineering and formulate installation procedures to accomplish the following:

1. All fiber optic cable shall be placed in 1.125 inch, industry standard inner duct, unless specified otherwise, by the Pima County Communications Engineer.
2. As new or previously unused conduit is used, the maximum number of inner ducts shall be placed in that conduit. All inner ducts not required to transport fiber optic cable shall contain pull strings. Excess inner ducts shall be reflected on as-built drawings.
3. All new fiber optic cable installations in underground non-metallic conduit shall contain a marker wire that will allow for detection of the cable by construction, utility and Blue Stake personnel. All conduit and marker locations shall be reflected on as-built drawings.
4. All node-to-node fiber systems are required to have an average fusion splice loss no greater than .35 db for multi-mode cable or .2 db for single mode. No individual splice shall have a loss greater than .4 db for multi-mode or .2 db for single mode. All splices shall be secured in a splicing cradle, free from stress, and housed in metal enclosures.
5. Overall attenuation for any given fiber link shall not exceed the total allowable cable loss and connector loss as measured between its patch panel terminations.
6. All fiber optic cable installations shall include a 20 foot service loop, contiguous to the line interface units on which the fiber terminates in equipment rooms. Additionally, 10 foot service loops shall be provided in pull boxes, hand-holes and j-boxes; utility vaults shall have a 20 foot service loop. Fiber splice points shall incorporate a minimum 20 foot service loop.

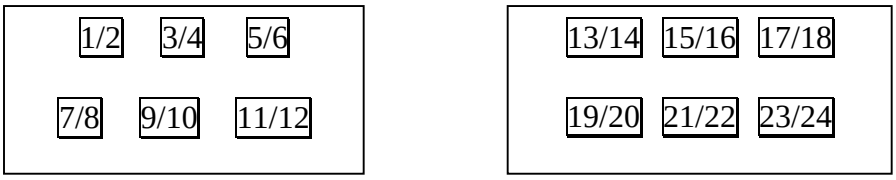
Connectors. In accordance with these specifications, the successful respondent must determine which fibers need connectors of fusion splice(s). This shall only be performed at the distribution enclosure locations. **No mechanical fiber splicing will be accepted**. All non-terminated (dark) fibers must be coiled in a large secured loop, free from stress, inside the enclosure. Adequate excess fiber must exist on the non-terminated strands to permit installation of connector(s) or fusion splice assembly. All non-terminated fiber optic cables shall be equipped with industry standard heat-shrink caps on the cable ends in place of permanent connector terminations. All connectors shall be male "SC", epoxy cured, ceramic tip type. Pull strength between the connector and attached fiber shall be fifty (50) pounds minimum. The mated pair loss (without rotational optimization) shall not exceed 1.5-db maximum, as measured at the distribution enclosure patch panel. No one from outside of Pima County I.T. is to install or de-install fiber patch cables.

Acceptable Fiber Termination Methods.
Multimode fiber may be terminated using field-installed connectors. Connectors shall be SC type as per connector specification. The fiber cable shall be furcated using breakout assemblies approved for use by the manufacture of the fiber cable. The furcation assemblies must be securely fastened in the fiber distribution enclosure. **No mechanical fiber splicing will be accepted**.
Single Mode fiber must be terminated by fusion splicing of pre-terminated factory manufactured single mode assemblies. The assembly must be terminated with an epoxy cured ceramic tip SC connector, be 1 meter in length and the termination polish must be UPC with a factory certified back reflection of –65dB or better. The fusion-spliced assemblies must be placed in a metal splice tray specifically designed for and manufactured by the fiber distribution enclosure manufacture. The splice must be protected by use of a heat-shrink protection sleeve. The incoming fiber cable strands must not be split between splice trays. **No mechanical fiber splicing will be accepted**.

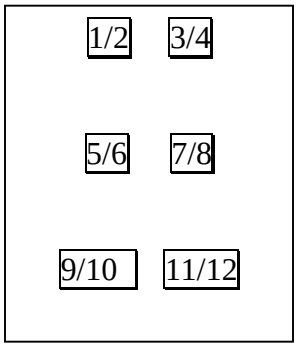
Patch panels. The successful respondent shall provide modular 19" EIA rack mounted distribution enclosure/patch panels at all cable ends. The patch panel shall provide an integrated connector panel capable of accepting all major connector types (ST, SC, LC, SMA & FSD), provide for twenty feet (20') of fiber optic cable storage, accept fusion splice splicing cables, use NEC power and signal grounding means and be suitable for termination, interconnecting, splicing and testing. The patch panel(s) must be able to accommodate full termination of all fiber optic cable(s) and, in the event that the panel is not fully populated with fiber connections, it must be completely equipped with bulkhead panels and couplers for future expansion. The illustrations below indicate the preferred connector arrangement for fiber optic cable connections in the Line Interface Unit (L.I.U.) per bulkhead panel. Deviations from these patterns must be approved by the Pima County Telecommunications Coordinator.

RACK MOUNT

(ADDITIONAL BULKHEADS SHOULD FOLLOW SAME PATTERN)



WALL MOUNT - SINGLE BULKHEAD



B. Fiber Optic Cable Specifications

Temperature Range:

A. Non-Plenum Applications. The storage temperature range for the cable on the original shipping reel shall be -40℃ to +70℃. The installation/operating temperature range for riser cables shall be -20℃ to +70℃. Testing shall be in accordance with FOTP-3.

B. Plenum Applications. The storage temperature range for the cable on the original shipping reel shall be -40℃ to +70℃. The installation/operating temperature range for plenum cables shall be 0℃ to +70°
C. Testing shall be in accordance with FOTP-3.

Crush Resistance:

The cable shall withstand a minimum compressive load of 89 N/cm (50 lbf/in) applied uniformly over the length of the compression plate. The cable shall be tested in accordance with FOTP-41, "Compressive Loading Resistance of Fiber Optic Cables." While under compressive load, the fibers shall not experience an attenuation change greater than 0.4 dB at 1550 nm (single-mode) or greater than 0.6 dB at 1300 nm (multimode). After the compressive load is removed, the fibers shall not experience an attenuation change greater than 0.2 dB at 1550 nm (single-mode) or greater than 0.4 dB at 1300 nm (multimode).

Impact Resistance:

The cable shall withstand a minimum of 20 impact cycles. The cable shall be tested in accordance with FOTP-25, "Repeated Impact Testing of Fiber Optic Cables and Cable Assemblies." The fibers shall not experience an attenuation change greater than 0.2 dB at 1550 nm (single-mode) or greater than 0.4 dB at 1300 nm (multimode).

Cyclic Flexing:

The cable shall withstand 25 mechanical flexing cycles at a rate of 30 ± 1 cycles per minute. The cable shall be tested in accordance with FOTP-104, "Fiber Optic Cable Cyclic Flexing Test." The fibers shall not experience an attenuation change greater than 0.2 dB at 1550 nm (single-mode) or greater than 0.4 dB at 1300 nm (multimode).

Flammability:

All cables shall comply with the requirements of the NEC, Article 770. Riser cables (OFNR) shall pass UL-1666. Plenum cables (OFNP) shall pass UL-910.

C. Fiber Optic Cable Construction

Riser Cables

A. In cables with more than one fiber, the fibers shall be stranded around a dielectric central member and surrounded by layered aramid yarns. The aramid yarns shall serve as the tensile strength member of the cable. A ripcord may be applied between the aramid yarns and the outer jacket to facilitate jacket removal. The outer jacket shall be extruded over the aramid yarns for physical and environmental protection.

B. Riser Cables with Multiple Subunits: The buffered fibers shall be grouped in fiber subunits. In each subunit, the individual fibers shall be stranded around a dielectric central member and surrounded by layered aramid yarns. A ripcord shall be incorporated in the subunit design to facilitate access to the individual fibers. The subunit jacket shall be extruded over the aramid yarns for additional physical and environmental protection. The subunits shall be stranded around a dielectric central member. A ripcord shall be inserted beneath the outer jacket to facilitate jacket removal. The outer jacket shall be extruded around the units for physical and environmental protection.

Plenum Cables:

A. The fibers may be stranded around a dielectric central member and surrounded by layered aramid yarns. The aramid yarns shall serve as the tensile strength member of the cable. A ripcord shall be applied between the aramid yarns and the outer jacket to facilitate jacket removal. The outer jacket shall be extruded over the aramid yarns for physical and environmental protection.

B. Plenum Cables with Multiple Subunits: The buffered fibers shall be grouped in either six or twelve fiber subunits. In each subunit, the individual fibers shall be stranded around a dielectric central member and surrounded by layered aramid yarns. A ripcord shall be incorporated in the subunit design to facilitate access to the individual fibers. The subunit jacket shall be extruded over the aramid yarns for additional physical and environmental protection. The subunits shall be stranded around a dielectric central member. A ripcord shall be inserted beneath the outer jacket to facilitate jacket removal. The outer jacket shall be extruded around the units for physical and environmental protection.

C. Strength Members: The strength member shall be a high modulus aramid yarn. The aramid yarns shall be helically stranded around the buffered fibers. A non-toxic, non-irritant talc shall be applied to the yarn to allow the yarns to be easily separated from the fibers and the jacket.

D. Cable Jacket: The jacket shall be continuous, free from pinholes, splits, blisters, or other imperfections. The jacket shall have a consistent, uniform thickness; jackets extruded under high pressure are not acceptable. The jacket shall be smooth, as is consistent with the best commercial practice. The jacket shall provide the cable with a tough, flexible, protective coating, able to withstand the stresses expected in normal installation and service.

E. The cable and subunit jacket color shall be orange for cables containing multimode fibers. The cable and subunit jacket color shall be yellow for cables containing single-mode fibers.

F. For cables with more than two fibers, the cable jacket shall be designed for easy removal without damage to the optical fibers by incorporating a ripcord under each cable jacket. A non-toxic, non-irritant talc shall be applied to the aramid yarns to allow the yarns to be easily separated from the fibers and the jacket.

G. The nominal thickness of the cable outer jacket shall be sufficient to provide adequate cable protection while meeting the mechanical, flammability, and environmental test requirements of this document over the life of the cable.

H. All cable shall be dielectric.

D. Identification

A. The individual fibers shall be color coded for identification. The optical fiber color coding shall be in accordance with EIA/TIA-598, "Color Coding of Fiber Optic Cables." The coloring material shall be stable over the temperature range of the cable, shall not be susceptible to migration, and shall not affect the transmission characteristics of the optical fibers. Color coded buffered fibers shall not adhere to one another. When fibers are grouped into individual units, each unit shall be numbered on the unit jacket for identification. The number shall be repeated at regular intervals.

B. Jacket Printing:
The outer cable jacket shall be marked with the manufacturer's name or UL file number, date of manufacture, fiber type, flame rating, UL symbol, and sequential length markings every two feet (e.g. "COMPANY - 01/94 - 62.5/125 MICRON - Type OFNR - (UL) 00001 FEET"). The print color shall be black. The printing shall be permanent and legible for the life of the cable.

E. Packing and Shipping

A. The cable shall be packaged in cartons and/or wound on spools or reels. Each package shall contain only one continuous length of cable. The packaging shall be constructed so as to prevent damage to the cable during shipping and handling.

B. When the length of an order requires a large wooden reel, one of two methods may be used to protect the cable during shipping and handling. The first method is to cover the cable with a thermal wrap and lag the reel with wooden staves. The second method is cover the cable with a three layer laminated protective material. The outer end of the cable shall be securely fastened to the reel head so as to prevent the cable from becoming loose in transit. The inner end of the cable shall project into a slot in the side of the reel or into a housing on the inner slot of the drum, in such a manner and with sufficient length to make it available for testing.
Wooden reels shall be plainly marked to indicate the direction in which it should be rolled to prevent loosening of the cable on the reel.
C. All products shall be delivered to the job site in their original, unopened containers, with all labels legible.

F. Sumitomo Air-Blown Fiber Optic Cable (No substitute)

Pima County has installed Sumitomo air-blown fiber in several facilities throughout the County and will continue to specify this product, in lieu of conventional fiber, as necessary.
The authorized/certified Sumitomo Air-blown fiber Contractor shall supply equipment, materials, labor and services to install air-blown fiber distribution systems including, but not limited to, the following:

1. Optical fiber backbone and optical fiber riser cable and terminations. Fiber counts shall be identified by the Pima County Telecommunications Project Manager.
2. Indoor tube cables and Tube Distribution Units (T.D.U.s). Tube counts shall be identified by the Pima County Telecommunications Project Manager.
3. Outdoor tube cables, splice cases and outdoor Tube Distribution Units (T.D.U.s). Tube counts shall be identified by the Pima County Telecommunications Project Manager.
4. Tube Distribution Unit (T.D.U.). A NEMA type enclosure, suitable for the site environmental conditions (i.e., NEMA 1 for indoor use) shall be provided for the tube distribution, routing and termination, with sizing based on the number of tubes entering the unit, per Sumitomo Recommended Procedure SP F-04-005. A TDU will be placed adjacent to each 84” freestanding equipment cabinet. All tube cables routed to the TC, IDF or MDF served by the 84” cabinet will be placed between the TDU and the 84” cabinet. Routing and placement will be as directed by the Pima County Telecommunications Project Manager. Tube cables entering and exiting the TDU will be arranged to allow for proper routing and coupling within the TDU and securely affixed to the TDU by use of a male lock nut compression fitting, sized appropriately for the tube cable. All tube cable will be trimmed to allow for maintenance of the correct minimum bend radius and coupling. All unused tubes will be plugged as called for in manufacturer acceptable procedures.
5. Labeling of all tube cabling, optical fiber bundles, terminations, splices and line interface units shall be provided.
6. Testing (including pressure testing of fiber tubes), certification and test documentation of all tube cable, optical fiber bundles and connections shall be provided.
7. As-built documentation showing tube cable routing, distances, T.D.U. locations, fiber splice points and any custom-built information shall be provided.

H. FIBER OPTIC INSTALLATION (Non Air-blown)

RACKING: Slack for racking shall be pulled by hand. Care will be exercised with regard to observing the minimum bending-radius limits. Cables shall be secured to proper rack position with plastic cable ties.

Excess cable in splicing cable boxes shall be neatly coiled for storage. Identification / warning tags shall be securely attached to the cables in a minimum of two (2) locations in each cable box.

IDENTIFICATION: All removable connectors shall have correspondent labeling on both parts. Backbone cables will terminate at a central hub/distribution point.
Labeling will be structured as follows:

1. The far end from hub single alpha building identifier. (H for Health & Welfare, PW for Public Works, etc.)
2. Single alpha cable type designation. (F for fiber, C for copper)
3. Single alpha backbone/riser designation. (B for backbone, R for riser)
4. Two-digit feed number (01 through 99)

Example: SFB03 is a fiber backbone cable, which terminates at the main distribution point and is the 3rd cable of its type.

All riser cables will terminate at a central hub/distribution point
Labeling will be structured as follows:

1. The single alpha building identifier. (H for Health & Welfare, PW for Public Works, etc.)
2. Single alpha cable type designation. (F for fiber, C for copper)
3. Single alpha backbone/riser designation. (B for backbone, R for riser)
4. Two-digit feed number (01 through 99)

Example: ACR06 is a copper riser cable, which terminates at the main distribution point in the Administration building and is the 6th cable of its type.
We can also use the cable number to designate the floor number in most buildings.

A = Administration
H = Health & Welfare
L = LSB
O = Old Courts
S = Superior Courts
C = City
PW = Public Works
PB = Pioneer building
KS=Kino Service Center

GENERAL:
1. All work required for this project shall be performed in direct accordance with all Occupational Safety and Health Administration (OSHA) regulations and local code requirements.
2. Cable installation personnel shall be familiar with safety procedures, equipment operation, and the cable manufacturer's installation requirements.
3. Cable shall be of continuous length throughout the entire cable run except for pre designated splice points.
4. Cable shall be pulled with a tool of the pulling-eye type, as recommended by the cable manufacturer.
5. Inner ducts shall be restrained in the appropriate pulling configuration with light duty ties. Longitudinal restraints shall be provided in both directions to prevent migration of the inner ducts.
6. Pull-throughs with severe offsets shall be rigged with two (2) sheaves.
7. When power equipment is used to install the cable, low speeds shall be used - not to exceed 30 meters per minute, with gradual, hand assisted starting. It is desirable to pull entire lengths non-stop.
8. The manufacturers minimum bending radius and pulling tension limitations shall not be exceeded under any circumstances.

SPLICING REQUIREMENTS: The following describes the minimum requirements for splicing fiber optic cable using the fusion method:
1. Compliance with this section and approved splicing procedures shall in no way relieve the successful respondent of the responsibility of providing splices, which meet the specified splice loss parameters.
2. Safety measures for the protection of splices shall be in accordance with all local, state federal and other governing regulations, utility requirements and OSHA.
3. All equipment shall be in good working order, properly calibrated and meet all safety regulations.
4. All splicing machines shall be the fusion-arc type with location monitoring capabilities. Any exception shall require a written pre-approval from Pima County Information Technology, Telecommunications Division.
5. All fiber optic connectors shall be "SC" epoxy cured, ceramic tip type, unless specified otherwise.

TECHNICAL PROPOSAL: The following, as a minimum, shall be submitted with any technical proposal:
(1) Complete description and product data for the fiber optic cabling including:

Fiber diameter
Cladding diameter
Mode (single or multiple)
Wavelength of operation
Bandwidth and attenuation at 850 nm
Bandwidth and attenuation at 1300 nm
Nominal numerical aperture
Impact resistance
Crush resistance

(2) Warranty. The manufacturer, for a minimum of five (5) years, shall warrant all cable.

(3) Listing of users of similar cabling from the same manufacture.

PROTECTION: Manufacturer shall use adequate means to protect the product from damage during delivery to the jobsite.

REPLACEMENTS: In the event of shipping damage, all effected products shall be replaced at no charge to Pima County.

DELIVERY: All products shall be delivered to the job-site in their original unopened containers with all labels legible. Prior to delivery of cable at the job site: The following will be submitted 3 weeks prior to the delivery of fiber optic cabling:

(1) Manufacturer's quality assurance testing procedures.
(2) Outline drawings including; Assembly type, Strength member, Fiber quantities, Fiber assembly, Fiber material, Buffer-tube material and construction, Cladding material and Jacketing material.
(3) Technical data including, recommended pulling compound, Static & dynamic coefficients of friction for the jacket material, Minimum bend radius, Graph of attenuation changes vs. temperature, Graph of % transmission vs. tensile loading and a Graph of % elongation vs. tensile loading.
(4) Certified test data. Every fiber optic cabling link shall be tested in accordance with ISO/IEC 11801 or the most demanding network application standards.

FIBER OPTIC CABLE: Shall consist of, but not be limited to, glass-fiber sub-cables, dielectric fillers, strength-member, and protective outer sheathing. All tube fiber optic cable, not installed between buildings or in an outdoor environment, is to be plenum rated. Inter-building, pathway and shaft installations shall be riser rated.

LOOSE TUBE DESIGN: All fiber optic cables placed in an outdoor environment shall be of the loose tube construction type.

TIGHT-BUFFERED DESIGN: Most of the fiber optic cables placed in an indoor environment, i.e., intra building backbone, horizontal distribution, patch cord and equipment cable applications, shall be of the tight-buffered design. The Pima County Telecommunications Division's Project Coordinator will evaluate exceptions on an individual case basis.

CORE DESIGN: Core design shall be the loose tube type, with no more than twelve (12) fibers per tube for up to 14 tubes (tight buffers). When more than 14 loose tubes are required to meet the fiber count, there shall be no more than 12 fibers per tube.

SUB CABLES: Single fiber optic sub-cables shall consist of tight-buffered optical fiber(s) surrounded by a synthetic yarn strength member and a color-coded jacket. Each fiber shall have a uniquely colored jacket.

TENSILE STRENGTH NUMBER: Fiber optic cables with more than four sub-cables shall be assembled by:
(1) Stranding sub-cables and any fillers around a central, non-blocking strength member, or
(2) Steel support strands surrounding the optical fibers. Any given sub-cable shall contain 62.5/125 multimode fibers.

OUTER JACKET: Fiber optic cable outer jacket shall be smooth and free from holes, splits, blisters and other surface imperfections. Outer jacket shall be flame retardant.

SURFACE MARKINGS: Fiber optic surface markings shall be as required by the NEC for type of cable and shall include the cable manufacturer name. Markings shall be repeated on 18" +/- intervals throughout the length of the cable.

I. INDOOR FIBER OPTIC CABLE SPECIFICATIONS (Non Air-blown)

50.0/125 mm OM3 MULTIMODE: The multimode fiber utilized in the cable specified herein shall meet EIA/TIA "Detail Specification for 50.0 mm Core Diameter/125 mm Cladding Diameter Class Ia Multimode, Graded Index Optical Waveguide Fibers." 50.0/125 mm MULTIMODE fiber shall be used for all new installations requiring multimode fiber.

a. Core diameter: 50.0 ± 3.0 mm.

b. Cladding diameter: 125.0 ± 2.0 mm.

c. Core-to-Cladding Offset: £ 3.0 mm.

d. Cladding non-circularity: £ 2.0 %. Defined as: [1-(min. cladding diameter ¸ max. cladding diameter)] X 100

e. Core non-circularity: £ 6.0 %. Defined as: [1-(min. core diameter ¸ max. core diameter)] X 100

f. Coating Diameter: 245 ± 10 mm.

g. Colored Fiber Diameter: nominal 250 m.

h. Attenuation Uniformity: No point discontinuity greater than 0.20 dB at either 850 nm or 1300 nm.

i. Refractive Index Profile: Graded index.

<u>62.5/125 mm MULTIMODE</u>: Inclusion of 62.5/125 mm MULTIMODE fiber in these standards is for reference purposes <u>only</u>, as this fiber has been 'grandfathered' for new installations in Pima County and shall not to be newly installed. The multimode fiber utilized in the cable specified herein shall meet EIA/TIA "Detail Specification for 62.5 mm Core Diameter/125 mm Cladding Diameter Class Ia Multimode, Graded Index Optical Waveguide Fibers."

a. Core diameter: 62.5 ± 3.0 mm.

b. Cladding diameter: 125.0 ± 2.0 mm.

c. Core-to-Cladding Offset: £ 3.0 mm.

d. Cladding non-circularity: £ 2.0 %. Defined as: [1-(min. cladding dia. ¸ max. cladding dia.)] X 100

e. Core non-circularity: £ 6.0 %. Defined as: [1-(min. core diameter ¸ max. core diameter)] X 100

f. Coating Diameter: 245 ± 10 mm.

g. Colored Fiber Diameter: nominal 250 m.

h. Attenuation Uniformity: No point discontinuity greater than 0.20 dB at either 850 nm or 1300 nm.

i. Refractive Index Profile: Graded index.

<u>SINGLE-MODE</u>: The dispersion un-shifted single-mode fiber utilized in the cable specified herein shall conform to the following specifications:

a. Typical Core Diameter: 8.3 mm.

b. Cladding Diameter: 125.0 ± 1.0 mm.

c. Core-to-Cladding Offset: £ 0.8 mm.

d. Cladding Non-Circularity: £ 1.0%. Defined as: [1-(min. cladding dia. ¸ max. cladding dia.)] X 100

e. Coating Diameter: 245 ± 10 mm.

f. Colored Fiber Diameter: nominal 250 mm.

g. Attenuation Uniformity- No point discontinuity greater than 0.10 dB at either 1310 nm or 1550 nm.

h. Attenuation at the Water Peak- The attenuation at 1383 ± 3 nm shall not exceed 2.1 dB/km.

i. Cutoff Wavelength- The cabled fiber cutoff wavelength shall be £ 1260 nm.

j. Mode-Field Diameter (Petermann II): 9.30 ± 0.50 mm at 1310 nm 10.50 ± 1.00 mm at 1550 nm

k. Zero Dispersion Wavelength (l_O)- 1301.5 nm £ l_O £ 1321.5 nm.

l. Zero Dispersion Slope (S_O)- £ 0.092 ps/(nm^2·km).

m. Fiber Polarization Mode Dispersion £ 0.5 ps/sq.rt. km

n. The coating shall be a dual layered, UV cured acrylate applied by the fiber manufacturer.

o. The coating shall be mechanically strippable without damaging the fiber.

p. Fiber Specification Parameters

q. All fibers in the cable shall meet the requirements of this specification.

r. When tested in accordance with FOTP-3, "Procedure to Measure Temperature Cycling Effects on Optical Fiber, Optical Cable, and Other Passive Fiber Optic Components," (Single-mode only) The average change in attenuation at extreme operational temperatures (-40℃ to +70℃) shall not exceed 0.05 dB/km at 1550 nm. The magnitude of the maximum attenuation change of each individual fiber shall not be greater than 0.15 dB/km at 1550 nm. (Multimode only) The average change in attenuation shall be not exceed 0.50 dB/km with 80% of the measured fibers not exceeding 0.25 dB/km.

s. Required Fiber Grade – Maximum Individual Fiber Attenuation.

t. (Multimode only 50.0/125 mm). The minimum bandwidth of multimode optical fibers shall be ³ 500 MHzŸkm at 850 nm and ³ 1000 MHzŸkm at 1300 nm.

u. (Multimode only 62.5/125 mm). The minimum bandwidth of multimode optical fibers shall be ³ 160 MHzŸkm at 850 nm and ³ 500 MHzŸkm at 1300 nm.

v.(Single-mode only) The maximum dispersion shall be £ 3.3 ps/(nmŸkm) for 1285 nm through 1330 nm and shall be £ 18 ps/(nmŸkm) at 1550 nm.

w. All optical fibers shall be proof tested by the fiber manufacturer at a minimum load of 100 kpsi.

x. (Single mode) 6 pair (12 strand) minimum count single mode, tight buffer, loose tube

J. <u>OUTSIDE FIBER OPTIC CABLE SPECIFICATIONS</u> (Non Air-blown)

Outside fiber optic cable shall be suitable for outside use between buildings in a campus environment. It shall be suitable for runs in buried conduits and aerial runs.

a. Optical fibers shall be placed inside a loose buffer tube

b. Each buffer tube shall contain a minimum 6 pair (12 strand) count single mode, tight buffer, loose tube.

c. The fibers shall not adhere to the inside of the buffer tube.

d. Each fiber shall be distinguishable from others by means of color coding in accordance with TIA/EIA-598-A, "Optical Fiber Cable Color Coding."

e. The fiber shall be colored with ultraviolet (UV) curable inks.

f. Buffer tubes containing fibers shall also be color-coded with distinct and recognizable colors in accordance with TIA/EIA-598-A, "Optical Fiber Cable Color Coding."

g. Buffer tube colored stripes shall be inlaid in the tube by means of co-extrusion when required. The nominal stripe width shall be 1 mm.

h. Buffer tubes containing multiple fibers, the colors shall be stable during temperature cycling and not subject to fading or smearing onto each other or into the gel filling material. Colors shall not cause fibers to stick together

i. For dual-layer buffer tube construction cables, standard colors are used for the tubes 1 through 12 and stripes are used to donate tubes 13 through 24. The color sequence applies to tubes containing fiber only, and shall begin with the first tube. If fillers are required, they shall be placed in the inner layer of the cable. The color sequence shall start from the inside layer and progress outward.

j. In buffer tubes containing multiple fibers, the colors shall be stable across the specified storage and operating temperature range and not subject to fading or smearing onto each other or into the gel filling material. Colors shall not cause fibers to stick together.

k. Fillers may be included in the cable core to lend symmetry to the cable cross-section where needed. Fillers shall be placed so they do not interrupt the consecutive positioning of the buffer tubes.

l. The central anti-buckling member shall consist of a glass reinforced plastic (GRP) rod. The purpose of the central member is to prevent buckling of the cable.

m. Each buffer tube shall be filled with a non-hygroscopic, non-nutritive to fungus, electrically non-conductive, homogenous gel. The gel shall be free from dirt and foreign matter. The gel shall be readily removable with conventional nontoxic solvents.

n. For all cables, a water blocking tape shall be applied longitudinally around the outside of the stranded buffer tubes/fillers. The tape shall be held in place by a binder yarn. The water blocking tape shall be non-nutritive to fungus, electrically non-conductive, homogenous. It shall also be free from dirt and foreign matter.

o. The cable shall contain at least one ripcord under the sheath for easy sheath removal of all-dielectric cable. The cable shall contain at least one ripcord under the inner sheath and under the steel armor for armored cable.

p. Tensile strength shall be provided by dielectric yarns.

q. All-dielectric cables (with no armoring) shall be sheathed with medium density polyethylene (MDPE). Jacketing material shall be applied directly over the tensile strength members and water blocking tape. The polyethylene shall contain carbon black to provide ultraviolet light protection and shall not promote the growth of fungus.

r. Armored cables shall have an inner sheath of MDPE. The inner jacket shall be applied directly over the tensile strength members and water blocking tape. The armor shall be a corrugated steel tape, plastic-coated on both sides for corrosion resistance, and shall be applied around the outside of the water blocking tape with an overlapping seam with the corrugations in register. The outer jacket shall be applied over the corrugated steel tape armor. The polyethylene shall contain carbon black to provide ultraviolet light protection and shall not promote the growth of fungus. Cable outer jacket shall be suitable for long-term exposure to sunlight and weather with a life expectancy of greater than 20 years.

s. The MDPE jacket material shall be defined by ASTM D1248,Type II, Class C and Grades J4, E7 and E8.

t. The jacket or sheath shall be free of holes, splits, and blisters.

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

v. The maximum pulling tension shall be 2700 N (608 lb foot) during installation (short term) and 890 N (200 lb foot) long term installed.

w. The shipping, storage, and operating temperature range of the cable shall be -40℃ to +70℃. The installation temperature range of the cable shall be -30℃ to +70℃.

x. WARRANTY: the manufacturer for a minimum of five (5) years shall warrant all cable.

K. CABLE TRAY SYSTEM DESIGN GUIDE - MINIMUM REQUIREMENTS

1. Cable trays are for the containment of telecommunications cables and shall be installed in accordance with the applicable electrical codes. Cable tray shall be bonded to the ground and all insulated ground conductors are to be secured on the OUTSIDE of the cable tray.

2. System shall be designed and installed to provide maximum accessibility for adds, moves and changes.

3. Cable tray shall be a minimum of 2 inches deep and 4 inches wide. Larger sizes MUST BE USED to accommodate the total cable fill (the quantity of cable equal to 50% fill of the cross-sectional area based on .220" O.D. CAT 5E cable x cable count). Plan for a minimum of 25% growth, based on cable count at initial building occupancy.

4. A standard prefabricated ladder type cable tray consisting of two side rails connected by individual transverse members shall be used. Chatsworth Products FastTrac cable tray is preferred. Substitutes shall be presented to the Pima County Communications Technical Coordinator for evaluation.

5. System shall use standard prefabricated elbows, reducers, crossover bars, tees and elevation change tray sections.

6. Trays may be supported by cantilever brackets, trapeze or individual rod suspension. Supports shall be installed on five-foot centers maximum. A support shall be placed within two feet on each side of any connection to a fitting.

7. The inside of the cable tray shall be free of burrs; sharp edges and projections that can damage cable insulation.

8. A minimum of 12-inch access headroom (18 inches where sprinkler heads are present) shall be provided and maintained above the entire cable tray system. Care shall be taken to ensure that other building components do not restrict access to the cable trays.

9. Install above ceiling at same height AFF throughout system. Cable tray shall be level and have supports if required to prevent horizontal movement.

10. System shall be designed and installed to allow compliance with EIA/TIA 568 horizontal wiring distance standards.

11. Fire wall penetrations must be sealed with an approved design tested fire stopping system, installed in accordance with manufacturer's instructions. Use of "pillow" type fire stop material is acceptable ONLY for cable tray penetrations.

L. ENVIRONMENTAL REQUIREMENTS (APPLICABLE FOR WORK IN ACM AREAS ONLY)

All outside service contractors who in the course of performing their services may disturb ACM will be notified and required to sign a written statement acknowledging that they have been informed of the presence, type, and location of ACM in Pima County Buildings. In addition, they will receive notice of the Pima County's O&M Program and the conditions they must honor regarding this Program.

Utility companies and plumbing, electrical, mechanical, roofing, cleaning, and other service contractors are included in this provision of the O&M Program. A copy of the written statement to be signed by outside contractors is shown as Exhibit 1.0.

If the County chooses to negotiate contracts with on-call companies, these contracts will include and require the following elements:

Copies of the company's respiratory protection program (29 CFR 1926.1 1 01 (h)), medical surveillance program (29 CFR 1926.1 1 0 1 (in)), and AHERA training documentation (40 CFR 763.92(a)(2) & 29 CFR 1926.1 101(k)(9)).

A resume for each company's crew chief (the "competent person" in the language of the OSHA asbestos rule [29 CFR 1926.1 1 01 (b]).

These elements do not have to be evaluated. Their inclusion in contracts with Pima County will be evidence that the contractor is (1) familiar with OSHA requirements for controlling asbestos exposure, (2) has experience working around ACM, and (3) has the necessary accreditation to perform work in County buildings.

EXHIBIT 1.0

OUTSIDE CONTRACTOR STATEMENT

I, _____representing_____
(name) (company)

have been informed by the Operations and Maintenance (O&M) Program Coordinator of the Pima County of the presence of asbestos-containing materials (ACM) in the building(s) for which we provide contract services. I have reviewed the attached documentation showing the type and location of ACM found in the affected buildings) on the(se) site(s).

I have been informed that to ensure safe conditions in the buildings which our company services the County has instituted an O&M Program. The purpose of the O&M Program is to minimize the release and distribution of asbestos fibers by controlling activities that might disturb the ACM. Our company and its employees will assist by observing the following conditions:

- Preventing inadvertent or intentional ACM disturbance,
- Reporting any accidental disturbance of ACM immediately to the Pima County's O&M Program Coordinator (named below),
- Reporting any observed change in the condition of ACM to the O&M Program Coordinator, and
- Where disturbance of ACM is possible or cannot be avoided, employing work practices as specified in the O&M Program, (applicable sections are attached).

The Pima County O&M Program Coordinator is _____

I am aware of the potential health risks associated with exposure to asbestos fibers. The company I represent has informed our employees regarding the potential hazards and the location of ACM in the buildings which they service. Our employees are aware of their obligation to comply with the above conditions.

As a representative of _____I am authorized to provide the above the above assurances to the County and obligate the company to the above conditions. In addition, I provide assurance that our company is aware of and in compliance with all applicable Federal and State regulations governing ACM and worker safety.

Authorized Company Representative

Pima County, O&M Program Coordinator

I have received a copy of this document and referenced attachments. Initial_____

All Other Work

Most work above ceilings does not depend on the HVAC system remaining operational. This includes cable installation and electrical, plumbing and some HVAC repair work. The following procedures should be used for these types of projects.

Equipment for work above a suspended or Fixed ceiling

Warning Signs, Respirator, Disposable Clothing, HEPA air Filtration Unit, HEPA Vacuum, Mop, 6-mil Plastic Sheets, Repair or Installation Equipment/Materials, Ladder, Flashlight, Spray Bottle, Detergent, Putty knife, Disposable Cloths/Toweling, ACM Disposable bags, Wet Wipes, Duct Tape, Request and Check-list forms

1. A Request and Approval Form will be submitted by the Shop Supervisor to the O&M Program Coordinator for approval. If the work request is approved the Form will be returned to the Shop Supervisor and the Supervisor will schedule a Response Team to conduct the work. If the work request is denied, the Coordinator will return a copy of the Form to the Shop Supervisor with an explanation for the denial, and retain the original for the County permanent file.

2. Work will be scheduled when the building is not in use. Otherwise, persons will be evacuated from that part of the building where the work is to be performed. An official notice will be sent to personnel in the area announcing the scheduled work and requesting cooperation.

3. The assigned Response Team will obtain all the necessary Equipment for Work Above A equipment for the task from the Suspended or Fixed Ceiling central supply (see box). A set of procedures will also be issued to the Response Team to accompany them on the job.

4. The work area will be secured by locking doors or by setting up a temporary barrier. Do not block access to any emergency exits and post a warning sign: **Caution. Construction Work Area. Do Not Enter.**

5. The air-handling system in the area where the work is to be performed will be shut off.

6. Trained Response Team members and any outside contractors will wear their assigned respirator. In addition, full-body disposable suits (including hoods) are to be worn; booties are not recommended for climbing ladders.

7. The HEPA air filtration device will be positioned just below the opening to the space above the ceiling, and will be run in the re-circulation mode for the duration of the project. Do not allow the discharge air stream to blow directly on ACM or ACM dust and debris.

8. Existing dust or debris will be cleaned from the floor, furniture, equipment, and other surfaces in the immediate location of the work. A HEPA vacuum and/or wet cleaning techniques will be used for this task.

9. Furniture and equipment will then be moved from the immediate area where the work is to be performed.

10. Items unable to be moved from the immediate work area will be draped with 6-mil plastic (polyethylene) sheets.

11. If the floor is covered with carpet, a 6-mil plastic sheet will be placed underneath the work site and will extend approximately six feet beyond.

    If the floor has an irregular surface, such as wood or tile, a 6-mil plastic sheet will be placed underneath the work site and will extend approximately six feet beyond.

12. All equipment and materials will be assembled, including that needed for the repair, maintenance or installation activities.

13. When entering the space above a suspended (dropped) ceiling system, the following procedures will be observed:

    Move ceiling tiles slowly and carefully to gain access to the space.

    Move the first tile far enough to permit a fine mist of amended water -- a solution of 50 parts water and one part detergent -- to be sprayed through the opening in the air space above.

    When the first tile has been moved far enough to allow room for a vacuum hose, clean the edge of the tile and the ceiling grid (track) with a HEPA vacuum cleaner and gently move the tile over a neighboring tile.

    HEPA vacuum the top of the tile and any other tiles that may be disturbed during the course of the work.

    HEPA vacuum visible debris on ceiling splines, HVAC mixing, boxes, light fixtures or elsewhere in the vicinity of the work.

    Mist the general area above the ceiling with amended water.

    If the ceiling is fixed (hard) rather than suspended, entry will be made through a trap door or access panel. Misting and vacuuming should be conducted as described for suspended ceilings. Be sure to vacuum parts of the ceiling over which crawling or walking will be necessary.

14. Care must be exercised to minimize contact with the ACM during the work. If possible, cables will be pulled with poles to which the cable is attached, rather than by throwing the cable across the ceiling. If this is not possible due to limited space or obstructions, then care will be exercised to minimize direct contact with fireproofing or plaster/texture and ACM debris.

15. Electrical, HVAC and plumbing repairs will be performed with minimal vibration to system components.

16. Small amounts of ACM which must be contacted to conduct the repair or install new equipment should first be removed. This includes the installation of new utility hangers. (Existing utility hangers will be used for short runs of new, pipe, conduit, etc. where possible (suspended ceiling hangers should not be used for this purpose). Limited ACM removal will be conducted only by Pima County employees with asbestos abatement worker certification or Pima County's designated asbestos abatement contractor as follows:

    Attach an intake tube to the HEPA air filtration unit and place the open end of the tube close to the area of ACM removal.

    . Lightly but repeatedly mist with amended water the area of and immediately surrounding the ACM to be removed and any other ACM which is likely to be disturbed.

    . Remove the ACM with a putty knife and catch removed material in a handheld can or paint tray. If ACM falls to the ceiling or floor, clean it up immediately with a HEPA vacuum cleaner.

17. Any ACM dislodged in the process of conducting work will be cleaned up with a HEPA vacuum cleaner.

18. After completing the project, the work area will be cleaned with a HEPA vacuum and the tile carefully replaced.

    . Vacuum the bottom side of each tile moved for access.

    . Vacuum the floor if a plastic sheet was not used.

    . Wipe all tools and equipment including ladders with damp cloths and pass them to a worker off the plastic sheet (if used). The cloths/toweling are to be left on the sheet.

    . If plastic sheeting was used to drape unmovable objects, mist the plastic with amended water and carefully remove folding the exposed surface to the inside. Place in an ACM disposal bag.

    . Workers will mist each other down and then remove their suits turning them inside out while doing so. Persons on the sheet step off as each leg of the suit is removed leaving their suit on the plastic. Dispose of the suits in an ACM disposal bag if a plastic sheet is not used.

19. The plastic sheet will be misted with amended water and folded over its contents toward the center. The folded sheet will be placed in an ACM disposal bag.

20. Workers will thoroughly clean their respirators and face/head with wet wipes. Place wipes in ACM disposal bag.

21. The disposal bag will be twisted shut, and the twisted neck bent over and sealed with duct tape by wrapping the tape around bag neck several times.

22. Workers will now remove their respirators.

23. Labeled disposal bags will be removed from the site by the Response Team and transported to the temporary storage site. Eventually the accumulated bagged waste materials will be transported to an approved disposal site in conformance with applicable regulations. At the time of disposal, the Response Team will provide the County with documentation of disposal including, but not limited to, waste manifests.

24. An O&M Worker Checklist will be completed by the Response Team. This form is to be reviewed and signed by the Shop Supervisor who will retain a copy for his files. The original will be sent to the O&M Program Coordinator to be placed in the County's permanent file.

NOTE: These procedures apply only to activities as defined in Section 4 of the O&M Program. If major disturbance to ACM cannot be avoided, the Response Team will suspend work, contact the O&M Program Coordinator and evaluate the need for ACM removal before proceeding.