Section 271543
Communications Faceplates, Connectors and Patch Cables
Part 1 - General

1.1 - Work Included

A. Provide all labor, materials, tools and equipment required for the complete installation of work called for in the Construction Documents.

1.2 - Scope of Work

A. This document details the products and execution requirements relating to furnishing and installing faceplates and connectors.
B. The Telecommunication Equipment Room shall support a minimum of (2) 4-pair Unshielded Twisted Pair (UTP) Copper Cables to each work area outlet unless otherwise noted for specific locations. The cables shall be installed from the Work Area Outlet to the Telecommunications Room (TR) located on the same floor and routed to the appropriate rack serving that area and terminated as specified in this document. Refer to 27 1500 Section 2.2 for specific workstation cabling requirements.
C. This section includes minimum requirements for the following:
    1. Faceplates
    2. Copper patch cords and modular connectors
    3. Fiber optic patch cords and modular connectors
    4. Cross Connect Wire
D. All cables and related terminations, support and grounding hardware shall be furnished, installed, wired, tested, labeled, and documented by the telecommunications contractor as detailed in this document.
E. Product specifications, general design considerations, and installation guidelines are provided in this document. Quantities of telecommunications outlets, typical installation details, cable routing and outlet types will be provided as an attachment to this document. If the bid documents are in conflict, this specification shall take precedence. The successful vendor shall meet or exceed all requirements for the cable system described in this document.

1.3 - Regulatory References

A. All products, services, materials and documentation provided by the Installer shall meet the requirements of the following where applicable:
B. National Electrical Manufacturer's Association (NEMA)
C. American National Standards Institute (ANSI)
D. National Fire Prevention Act (NFPA)
    1. National Electric Code 2020 (NEC)
E. Relevant State Electric and Fire Codes
F. Institute of Electrical and Electronic Engineers (IEEE)
G. Underwriters Laboratories, Inc. (UL)

H. Telecommunications Industry Association / Electronic Industries Alliance (TIA/EIA)
   1. TIA-526-7A Fiber-Optical Power Loss Measurements SM
   2. TIA-526-14C Fiber Optical Power Loss Measurements MM
   3. TIA-568_0-D Generic Telco Cabling Customer Premises
   4. TIA-568_0-D1 Generic Telecom Cabling for Customer Premise Addendum
   5. TIA-568_1-D Commercial Building Telcom Infrastructure Std
   6. TIA-568_1-D1 Commercial Building Infrastructure Standard Addendum
   7. TIA-568_2D Balanced Twisted Pair Cabling and Components
   8. TIA-568_3-D Optical Fiber Cabling Components Standards
   9. TIA-569-E Telecom Pathways and Spaces
   10. TIA-598-D Optical Fiber
   11. TIA-598-D Optical Fiber Addendum
   12. TIA-598-D1 Optical Fiber Color Coding Addendum
   13. TIA-606-C Admin for Telecom Infrastructure
   14. TIA-607-D Grounding and Bonding
   15. TIA-758-B Customer Owned OSP
   16. TIA-942-B Data-Centers

I. Building Industry Consulting Service International (BICSI) publications:
   1. Telecommunications Distribution Methods Manual (TDMM), 14th ed.
   2. Outside Plant Design Reference Manual (OSPDRM), 6th ed.
   3. Information Technology Systems Installation Methods Manual (ITSIMM), 7th ed.
   4. Telecommunications Project Management Manual (TPMM), 1st edition
   5. ANSI/BICSI 006, Distributed Antenna System (DAS) Design and Implementation Best Practices
   6. ANSI/BICSI 008, Wireless Local Area Network (WLAN) Systems Design and Implementation Best Practices
   7. ANSI/BICSI 005, Electronic Safety and Security (ESS) System Design and Implementation Best Practices
   8. ANSI/BICSI 007, Information Communication Technology Design and Implementation Practices for Intelligent Buildings and Premises
   9. ANSI/BICSI 001, Information and Communication Technology Systems Design and Implementation Best Practices for Educational Institutions and Facilities

J. Manufacturer's recommendations and installation guidelines

K. All cabling shall comply with all appropriate requirements of NEC Articles 770 and 800 and shall comply with the State Fire Codes as interpreted by the State Fire Marshall's Dept.

L. All publications referred to in this document shall be the latest edition thereof together with any amendments and/or addenda.

1.4 - Quality Assurance

A. Panduit Certification Plus System Warranty shall provide a complete system warranty to guarantee end-to-end high performance cabling systems that meet application requirements. The guarantee shall include cable and connectivity components and have one point of contact for all cabling system issues. The system shall be warranted for a period of at least 25 years.
B. A factory registered Panduit PCI contractor shall complete network installation.
C. Contractor shall have completed standards-based product and installation training.
D. A copy of the PCI Contractor Registration shall be submitted in the proposal.
E. Product Guarantee: All Panduit PAN-NET non-consumable products have a 25-year guarantee. When installed per TIA or ISO/IEC standards, the Panduit PAN-NET Network Cabling System will operate the application(s) for which the system was designed to support. Installation shall support 10/100/1000/10,000 Mbps Ethernet (IEEE 802.3).
F. In order to qualify for the guarantee, the structured cabling system must be installed per the following:
    1. Meet all TIA/EIA commercial building wiring standards.
    2. Manufacturer categorized products must be used in conjunction with an equivalent or higher Category UL or ETL verified cable.
    3. Manufacturer's products must be installed per Manufacturer's instruction sheets.
G. If any Panduit PAN-NET product fails to perform as stated above, PANDUIT will provide new components at no charge.
H. This guarantee is made in lieu of and excludes all other warranties, expressed or implied. The implied warranties of merchantability and fitness for a particular use are specifically excluded. Neither seller nor manufacturer shall be liable for any other injury, loss or damage, whether direct or consequential arising out of the use of, or the inability to use, the product. Before using, user shall determine the suitability of the product for its intended use, and user assumes all risk and liability whatsoever in connection therewith. The foregoing may not be altered except by an agreement signed by officers of seller and manufacturer.

Part 2 - Products

2.1 - Approved Products

A. Approved faceplate manufacturer: Panduit
B. Approved surface mount box manufacturer: Panduit, Wiremold
C. Approved outlet component manufacturer: Panduit
D. Approved label component manufacturer: Panduit
E. Approved category 6A module manufacturer: Panduit
F. Approved category 6A patch cord manufacturer: Panduit
G. Approved USOC module manufacturer: Panduit
H. Approved category 6A punchdown 110 style connecting base manufacturer: Panduit
I. Approved category 6A punchdown 110 style connecting base manufacturer: Panduit

J. Approved category 5e punchdown 110 style connecting base manufacturer: Panduit
K. Approved fiber optic patch panel manufacturer: Corning
L. Approved fiber optic enclosure manufacturer: Corning
M. Approved fiber optic module/insert manufacturer: Corning
N. Approved fiber optic connector manufacturer: Panduit, Corning
O. Approved fiber optic patch cord and pigtail manufacturer: Panduit, Corning

2.2 - Products

A. Panduit shall manufacture all products, including but not limited to communications faceplates and connectors. Refer to section 270000 Part 6 regarding substitution of materials.

2.3 - Product General Requirements

A. Outlets and surface mount boxes shall support the network system by providing high-density in-wall, surface mount or modular office furniture cabling applications.
B. Outlets consist of faceplates for flush and recessed in-wall mounting as well as mounting to the modular office furniture systems.
C. Surface mount boxes can be mounted where in-wall applications are not possible or to support applications where surface mount is the best option.
D. All outlets shall utilize fully the interchangeable and individual Mini-Com connector modules that mount side by side to facilitate quick and easy moves, adds and changes.
E. All outlets shall be manufactured from high impact thermoplastic material with a U.L. flammability rating of 94 HB or better.
F. All outlets and surface mount boxes shall be available in four colors including:
    1. Off White (IW)
    2. Electrical Ivory (EI)
    3. White (WH)
    4. International Gray (IG)

2.4 - Faceplates

A. Mini-Com Executive Series Faceplates shall be one, two, four and six port vertical single gang and 10 port vertical double gang faceplates with combination head screws, screw covers, labels, label covers and a curved, designer appearance.
B. The faceplates shall mount to standard U.S. NEMA boxes and adapters with screw-to-screw dimensions of 3.28" (83.3mm).
C. The insert labels shall meet UL 969. Each faceplate shall accept Mini-Com modules that can be individually inserted and removed as required. Labeling is required.

D. Faceplate Part Numbers

Part Number	Gang	Number of
Modules		
CFPE2**Y	Single	2
CFPE4**Y	Single	4
CFPE6**Y	Single	6
CFPE10**-2GY	Double	10
** designates color.		

E. Wall Phone installation requires a Phone Plate with Module. This is the only component in the Caltech network that do not use the Panduit Mini-Com Executive Series Faceplates since a phone cannot be mounted to that style of faceplate. Contact Panduit technical support to verify mounting holes when using IP or console type telephones. All faceplates supplied with mounting screws. Wall mount faceplate kits only accept wall mountable phones with short patch cord connections to the jack module.

Part Number	Gang	Description
KWP	Single	Stainless steel phone
NK6X88M**		NetKey Category 6A Keystone Jack Module
** designates color		

F. Ultimate ID Products shall provide labeling options that comply with the TIA/EIA-606-A Standard. All products shall be clearly identified with thermal transfer printer (laser printer) technology. Products shall include faceplates, surface mount boxes, patch panels, marker ties, printers and accessories. All label heights shall be the same to allow for consistent labeling. Labeling is required.

Part Number	Description	Number of Modules
UICFFP4**	Snaps into standard knockouts on modular furniture	4
** designates color		

G. Mini-Com Modular Furniture Faceplates shall be four-port flat or angled faceplates that snap directly into TIA/EIA standard furniture openings. If required, an extender shall be used with the four-port flat faceplate to provide 12.7mm(0.5") additional depth. Each faceplate shall accept Mini-Com modules that can be individually inserted and removed as required. Cutout size requirements are 1.88" to 1.91" (47.80mm to 48.72mm) vertical by 2.98" to 3.03" (74.37mm to 76.96mm) horizontal. Labeling is required.

Part Number	Orientation	Number of Modules
CFFPL4**	Flat with Label	4
CFFPLA4**	Sloped with Label	4
** designates color		

H. Mini-Com Modular Furniture Faceplates for Four Module Space Herman Miller Ethospace Beltline Furniture Snap-On Faceplate shall be four-port flat or angled faceplates that

snap directly into TIA/EIA standard furniture openings. If required, an extender shall be used with the four port flat faceplate to provide 12.7mm(0.5") additional depth. Each faceplate shall accept Mini-Com modules that can be individually inserted and removed as required. Cutout size requirements are 2.38" (60.33mm) vertical by 3.44" (87.31mm) horizontal. Labeling is required.

Part Number	Orientation	Number of Modules
CFFPL4**	Flat with Label	4
CFFPLA4**	Sloped with Label	4
** designates color		

2.5 - Surface Mount Boxes

A. Ultimate ID Products shall provide labeling options that comply with the TIA/EIA-606-B Standard. All products shall be clearly identified with thermal transfer printer (laser printer) generated labels. Products shall include faceplates, surface mount boxes, patch panels, marker ties, printers and accessories. All label heights shall be the same to allow for consistent labeling.

Part Number	Orientation	Number of Modules
UICBXA12**-A	Surface Mount	12
** designates color		

B. Mini-Com Low Profile Surface Mount Boxes shall be one, two, four, six and 12-port low profile surface mount boxes with a 28mm (1.1”) maximum height. All connections (with exception of the 12 port low profile box) shall exit one side of the box, parallel to the wall. The boxes shall be capable of mounting with screws, adhesive, and/or magnets. The two port boxes shall include a removable blank for addition of a second port. The four, six and 12 port boxes shall include breakouts for use with Pan-Way surface raceway and cable tie slots at each raceway entry point to provide strain relief on incoming cables. The four (except low profile four), six, and 12 port boxes shall include tamper resistant screws that securely fasten the cover to the base and are concealed by screw covers and labels. Each box shall accept individual Mini-Com modules that can be individually inserted and removed as required.

Part Number	Max Height	Number of Modules
CBXJ2**-A	23 mm	2
CBX2**-AY	27 mm	2
CBXC4**-A	23 mm	4
CBX4**-AY	28 mm	4
CBXD6**-AY	26 mm	6
CBX12**-AY	26 mm	12
** designates color		

C. Mini-Com Fiber/Multi-Media Surface Mount Boxes shall be six and 12- port surface mount boxes with all connections exiting one side of the box, parallel to the wall. The six and 12 port boxes shall contain a "captive" fiber spool that maintains a minimum 25.4mm (1") bend radius. The six and 12 port boxes shall store up to 24 meters of buffered optical fiber. The boxes shall be capable of mounting with screws, adhesive, and/or magnets. The boxes shall include breakouts for use with Pan-Way surface raceway on three sides and cable tie slots at each raceway entry point to provide strain relief on incoming cables. The boxes shall include tamper resistant screws that securely fasten the cover to the base and are concealed by screw covers and labels. Each box shall accept Mini-Com modules that can be individually inserted and removed as required.

Part Number	Max Height	Number of Modules
CBXF6**-AY	25 mm	6
CBXF12**-AY	46 mm	12
** designates color		

2.6 - Patch Cords and Station Cords - Copper

A. General

1. The modular connectors and patch cords will be chosen to match the horizontal cabling medium and rating. The same manufacturer shall provide the modular connectors and patch cords. The total patch cord length at the work area is not to exceed three meters (10 ft). Exception: When implementing an open office cabling system as specified under ANSI/TIA/EIA-568-C.1.
2. The Panduit Mini-Com Network Cabling System or equivalent shall be used for the Work Area subsystem, including all modular connectors. The network cabling system shall be comprised of modular connectors in support of high-speed networks and applications designed for implementation on copper cabling. All outlets shall utilize fully interchangeable and individual connector modules that mount side-by-side to facilitate quick and easy moves, adds and changes.

3. Plug meets all applicable ANSI/TIA-968-A requirements and exceeds IEC 60603-7 specifications.
4. Slender strain relief boot provides easy access in high density applications, clear in color.
5. Plug uses an integral pair manager to optimize performance and consistency by reducing untwisting of conductors within the plug.
6. Labels on patch cords provide identification of performance level, length, and quality control number.
7. Tangle free latch prevents snags and provides easy release, saving time on frequent moves, adds, and changes.
8. Category 6A cables exceed requirements of ANSI/TIA/EIA-568-C.2 Category 6A, IEEE 802.3an-2006, and ISO 11801 Class EA channel standards.

B. Patch Cords
1. Patch Cords are used to connect network electronics to patch panel ports in the wiring closet.
2. Patch Cords are to be yellow in color.
3. Each patch cord is 100% performance tested at the factory and wired T568B.
4. Construction
   a. Constructed of Category 6A, 24 AWG UTP stranded cable and TX6A Modular Plugs; plug contacts plated with 50 microinches of gold for superior performance.
   b. Constructed of Category 6A, 28 AWG UTP solid cable and TX6TM Plus 28 AWG UTP Modular Plug. Use of 28 AWG patch cables requires a de-rating of the overall cable length and can only be used when derated run still meets TIA-568.2-D Category 6A and ISO 11801 Class EA standards.

C. Station Cords
1. Station Cords are used to connect a workstation outlet to end user equipment.
2. Station Cords are to be white in color.
3. Each station cord is 100% performance tested at the factory and wired T568B.
4. Constructed of Category 6A, 24 AWG UTP solid cable and TX6A Modular Plugs; plug contacts plated with 50 microinches of gold for superior performance.
5. Category 6 cables exceed ANSI/TIA/EIA-568-C.2 Category 6 and ISO 11801 Class E standards.

D. Part Numbers – Patch Cables Cat 6A

Part Number	AWG	Function	Color	Typical Lengths
UTP28X**YL	28	TR, Network	Yellow	5, 6, 7, 10
UTP28X**	28	TR, Voice	Off White	5, 6, 7, 10, 15
UTP6AX**YL	24	TR, Network	Yellow	5, 6, 7, 10
UTP6AX**	24	TR, Voice	Off White	5, 6, 7, 10
UTP6AX**	24	Station Cable	Off White	7, 10, 15, 20
**designates length				

2.7 - Modular Connectors - Copper

A. Mini-Com Modules for copper shall include the following:
   1. 50 and 75 Ohm BNC coax coupler modules, male-male.
   2. F-Type coax coupler module, male-male threaded.
   3. RCA connector modules with black, red, yellow, and white inserts pass through and punchdown termination types.
   4. S-Video connectors modules - coupler and punchdown termination types.
   5. Blank module to reserve space for future additions.
   6. The connectors shall snap into all Mini-Com outlets and patch panels.
   7. Mini-Com TX6 Plus Jack Modules shall be Category 6A modules featuring GigaTX Technology.
      a. The eight position modules shall be used in all work areas and shall exceed the connector requirements of the TIA/EIA Category 6A standard.
      b. Termination shall be accomplished by use of a forward motion termination cap and shall not require the use of a punchdown tool.
      c. The termination cap shall provide strain relief on the cable jacket, ensure cable twists are maintained to within 1/8" (3.18mm) and include a wiring scheme label.
      d. The wiring scheme label shall be available with both T568A and T568B wiring schemes.
      e. All terminations for this project shall use the T568B wiring scheme.
      f. The modules shall terminate four-pair 24 and 22 AWG 100-ohm solid unshielded twisted pair cable.
      g. The modules shall be universal in design, including complying with the intermateability standard IEC 60603-7 for backward compatibility.
      h. Category 6A modules shall have UL and CSA approval.
      i. Modules shall have ETL verified Category 6A performance and ISO Class E performance (as defined in ISO/IEC 11801) in both the basic and channel links.
      j. Modules shall be universal in design, accepting six or eight-pair modular plugs without damage to the outer module contacts.
      k. Modules shall be able to be reterminated a minimum of 10 times and be available in 11 standard colors for color coding purposes.
      l. Module shall snap into all Mini-Com outlets and patch panels.

B. Part Numbers

Part Number	Connector Style	Medium/ Cable Type	Termination Style	Insert Color
CJ6X88TG**	RJ-45	Category 6A	Termination	
CJLR6X88TG**	RJ-45	Category 6A	Termination	
CJUD6X88TG**	RJ-45	Category 6A	Termination	
CJS6X88T**	RJ-45	Category 6A	Termination	
CJSLR6X88TGY	RJ-45	Category 6A	Termination	
CJSUD6X88TGY	RJ-45	Category 6A	Termination	

CC6X88**	RJ-45 Coupler	Category 6A	Coupler	
CMBA**	BNC 50 Ω	Coax	Coupler	
CMBA75**	BNC 75 Ω	Coax	Coupler	
CMF**	F Type 75 Ω	Coax	Coupler	
CMFSR**Y	F Type 75 Ω Self Terminating	Coax	Coupler	
CJRY**	RCA from UTP	UTP	Punchdown	Yellow
CJRR**	RCA from UTP	UTP	Punchdown	Red
CJRW**	RCA from UTP	UTP	Punchdown	White
CMRPR**	RCA from RCA	Copper	Coupler	Red
CMRPY**	RCA from RCA	Copper	Coupler	Yellow
CMRPW**	RCA from RCA	Copper	Coupler	White
CMRPB**	RCA from RCA	Copper	Coupler	Blue
CMRPG**	RCA from RCA	Copper	Coupler	Green
CMSVC**Y	S-Video	Copper	Coupler	Black
CJSV**	S-Video from UTP	Copper	Punchdown	Black
CMB**-X	Blanking Plate	N/A	N/A	
**designates color				

2.8 - Patch Cords and Modular Connectors - Fiber

A. Patch Cords
   1. General
      a. Patch cables are to be bid as an alternate-add item.
      b. Patch cables are plenum rated.
      c. Patch cables are duplex.
      d. Patch cable lengths are project specific.
      e. Pass all TIA/EIA-568-B.3 performance requirements.
      f. LC connector housing and boot colors follow TIA/EIA-568-C.3 suggested color identification scheme.
      g. Insertion loss per connection: 0.10dB typical; 0.25dB maximum.
      h. Factory terminated and 100% tested for insertion loss.
      i. Insertion loss data recorded for every patch cord.
      j. Lifetime traceability of test data to a Q.C. number on each patch cord.
      k. Highest quality flame retardant fiber optic cable with tight-buffered coating on each optical fiber.
   2. OM4 Patch Cords (Jumper)
      a. Patch cords are backward compatible for use with all 50/125µm system requirements.
      b. Patch cords support speeds up to 10 Gbps up to 550 m.
      c. Patch cords support speeds up to 40 Gbps up to 150m.
      d. Patch cords are constructed of bend-insensitive fiber.

e. Patch cords comply with IEEE 802.3ae and IEEE 802.3ba standards.

3. OS2 Patch Cords (Jumper)
   a. Patch cords are backward compatible for use with all OS1 and OS2 systems.
   b. Patch cords support speeds up to 1,000 Gbps.
   c. Patch cords comply with
4. Part Numbers

Manufacturer	Part Number	Description	Cable	Length (m)
Corning	040402G5Z20***M	LC-LC, Duplex, 2.0 mm	OS2, BI	3,5,7,10
Corning	020202G5Z20***M	LC-LC, Duplex, 2.0 mm	OS2, BI	3,5
Corning	E050502Q5Z20***M	LC-LC, Duplex, 2.0 mm	OM4, BI	3,5,7,10
Corning	797902QD120***M	LC-LC, Duplex, uniboot, reversible polarity	OM4, BI	3,5,7,10
Panduit	F92ERLNLNSNM***	LC-LC, Duplex, 1.6 mm	OS2	3,5,7,10
Panduit	FZ2ERLNLNONM***	LC-LC, Duplex, 1.6 mm	OM4	3,5,7,10

B. Modular Connectors - Workstation Outlets

1. Mini-Com Modules for fiber shall include the following:
   a. TIA/EIA-604 FOCIS-10 compatible adapters.
   b. Exceed TIA/EIA-568-B.3 requirements.
   c. Adapter housing colors follow TIA/EIA-568-C.3 suggested color identification scheme.
   d. Small form factor (SFF) duplex adapter design fits into single module space.
   e. Compatible with Mini-Com products for complete modularity.
   f. Accept FOCIS-10 compatible senior LC connectors at either end and FOCIS-10 junior LC connectors at the inside end for behind the wall applications.
   g. Every adapter is laser marked with Q.C. number to assure 100% traceability.
2. Part Numbers

Manufacturer	Part Number	Connector	Cable/ Medium	Feature	Color
Panduit	CMDJLCZBU	LC	OS2 (9µ)	Ceramic Sleeve	Blue
Panduit	CMDJAQLCZBL	LC	OM4 (50µ)	Ceramic Sleeve	Aqua
Panduit	CMDJAQLCBL	LC	OM4 (50µ)	Bronze Split Sleeve	Aqua

Part 3 - Part 3 - Execution

3.1 - Faceplate Configurations

A. General

1. Faceplates are to be Panduit Mini-Com Executive Series Faceplates with four positions unless a requirement for more than four positions is needed (CFPE4xx).
2. Faceplate color is to match color specified by Caltech for specific location.

3. Locations where more than four positions are needed, use the next larger capacity Panduit Mini-Com Executive Series Faceplates (refer to 271543, Section 2.4.A).
4. Blank port openings in face plates are to be covered using insert Panduit Blanks where blank color matches faceplate color.
5. Ensure that all faceplate labels and jacks are labeled and installed correctly.

B. Wall Phone Faceplate - 8 conductor.
1. Provide a wall-mounted flush modular faceplate to house a single work area jack.
2. Faceplate shall fit over a standard NEMA dual gang electrical outlet box fitted with a single gang plaster ring cover and shall be stainless steel.
3. Faceplate shall be capable of having a wall-mounted telephone fitted directly over it.
4. Furniture Faceplate.
5. Provide a flush-mounted modular faceplate to contain work area jacks, capable of housing a minimum of three jacks.
6. The faceplate shall fit into a modular furniture raceway.
7. Utilize flat faceplates unless workspace requires an angled faceplate.
8. An additional label will be required containing contact information.
9. Additional label shall be permanently affixed to the faceplate.

C. 106-Type Faceplate/Insert.
1. Provide duplex mounting strips to house four work area jacks in a standard NEMA duplex electrical mounting fitted in a raceway, poke-through unit or flush floorbox, and all animal holding area rooms.

D. Waterproof Faceplate.
1. Provide Hubbell (5205WO) aluminum cast faceplate suitable for waterproof applications.
2. Faceplate shall be installed horizontally at all outdoor, animal holding, cage wash areas and other moisture exposed areas.

E. Stainless Steel Faceplate.
1. Provide
2. decorative stainless steel faceplate covers for locations where stainless steel wall outlets are required.

F. Floorbox Faceplate.
1. Provide an internal blank bracket to house combinations of work area jacks and optional LC connectors in a flush-mounted floorbox.
2. Bracket shall be provided by the manufacturer of the flush floorbox and shall be designed to fit in the floorbox installed as a part of this project.
3. Provide cutsheets for the floor boxes to be utilized on the project so the correct faceplate insert can be sources to support Panduit Mini-Com jacks.
4. Solution that does not utilize Panduit Mini-Com jacks will not be installed and will require a different floor mount box to be used.

G. Wireless Networking.
1. Faceplates and enclosures required for supporting wireless networking will be specified on a case-by-case basis by Caltech.

2. Location of faceplates for wireless need to be as close as practical to locations specified on the drawings.
3. Locations which deviate in excess of 1 meters (3 feet) from the specified location need to be approved by Caltech.

H. Single Communications Outlet (Wall Phone) - 6 conductor.
1. Unless otherwise specified, each outlet will be configured with (1) RJ11 telephone connector terminated with the USOC wiring standard.
2. This outlet shall be capable of supporting a wall-mounted phone.
3. Provide (1) Category 6 distribution cable running from each outlet back to the patch panel in the Communications Rooms using cable tray and conduit infrastructure. Leave 12 inches of slack cable in wall behind wall mounted outlet to allow for retermination to support Voice over IP and other network services.
4. At the closet end, terminate the first three pairs of each distribution cable on a RJ48 jack using the TIA-568B wiring scheme.
5. At the termination frame end, terminate all four pairs of the cable onto the patch panel using the TIA-568B wiring scheme.

I. Single Communications Outlet (Wall Phone) - 8 conductor (VoIP)
1. Provide Keystone Phone plate with module to support mounting of wall phone while conforming with Panduit TX6A cabling requirements.
2. Use Panduit TX6A Keystone Jack Module for termination instead of Mini-Comm jack due to faceplate design.
3. Provide (1) Category 6A distribution cable running from each outlet back to the patch panel in the Communications Rooms using cable tray and conduit infrastructure.
4. Installation to be certified consistent to Panduit TX6A extended warranty requirements.

J. TV Outlet
1. Unless otherwise specified, each duplex outlet will be configured with (1) F-Type coupler.
2. Provide (1) RG-6 distribution cable running from each outlet back to the RJ45 patch panel in the CATV Closet using cable tray and conduit infrastructure.
3. Terminate each RG-6 distribution cable on an F-Type jack.
4. Provide (1) coaxial cable running from each outlet back to the CATV Closet using cable tray and conduit infrastructure.
5. Terminate each coaxial distribution cable on an F-Type Connector at each end.
6. Mount F-type connectors to blank 1U jack panel in television cable wiring closet which is a location separate from the MDF and IDFs located in the facility.
7. CATV coaxial cable plant is not to be terminated in MDF or IDFs, only in CATV closet.
8. CATV coaxial cable plant is not to transit the Voice and Data networking conduits, they must run through their own conduits and duct bank.
9. Power meter and frequency sweep installed cable to certify 5MHz to 3GHz usability.
10. Provide test results in electronic form.

K. Quad Communications Outlet – Data and Voice Services

1. Unless otherwise specified, each quad outlet will be configured with three (3) RJ45 connectors and one (1) CATV connector OR up to four (4) RJ45 connectors.
2. Positions upper left and upper right are reserved for network, lower right corner is reserved for CATV (if applicable).
3. Provide Category 6A distribution cables running from each outlet back to the RJ45 patch panel in the Telecommunications Room using the cable tray and conduit infrastructure.
4. Terminate each Category 6A distribution cable at each end on a RJ45 jack using the 568B wiring scheme.
5. CATV coaxial cable shall be installed per 3.1.M specifications.

L. Quad Communications Outlet – Data Services
1. Unless otherwise specified, each quad outlet will be configured with two (2) or more RJ45 connectors and one (1) CATV connector OR up to four (4) RJ45 connectors.
2. Positions upper left and upper right are reserved for network, lower right corner is reserved for CATV (if applicable).
3. Provide Category 6A distribution cables running from each outlet back to the RJ45 patch panel in the Telecommunications Room using the cable tray and conduit infrastructure.
4. Terminate each Category 6A distribution cable at each end on a RJ45 jack using the 568B wiring scheme.
5. CATV coaxial cable shall be installed per 3.1.M specifications.

M. Sextuple Communications Outlet
1. Unless otherwise specified, each sextuple outlet will be configured with four (4) or more RJ45 connectors.
2. Positions upper left, upper middle and upper right are reserved for network, lower right corner is reserved for telephone and lower right is reserved for CATV.
3. Provide (4) Category 6A distribution cables running from each outlet back to the RJ45 patch panel in the Telecommunications Room using the cable tray and conduit infrastructure.
4. Terminate each Category 6A distribution cable at each end on a RJ45 jack using the 568B wiring scheme.
5. CATV coaxial cable shall be installed per 3.1.M specifications.

N. Furniture Mounted Outlets
1. Each desk will have one (1) four-port faceplate.
2. Unless otherwise specified, provide three (3) or more Category 6A distribution cables running from the faceplate back to the RJ45 patch panel in the Telecommunications Room using cable tray and conduit infrastructure.
3. Category 6A distribution cables shall run from each outlet back to the RJ45 patch panel in the Telecommunications Room using the cable tray and conduit infrastructure.
4. Terminate each Category 6A distribution cable at each end on a RJ45 jack using the 568B wiring scheme.

O. Raceway Outlets
   1. Each raceway data activation will have one (1) four-port outlet mounting strap (106 frame if required).
   2. Provide three (3) or more Category 6A distribution cables running from each mounting strap back to the RJ-45 patch panel in the Telecommunications Room using cable tray and conduit infrastructure.
   3. Terminate each Category 6A distribution cable at each end on a RJ45 jack using the 568B wiring scheme.

P. Floorbox Outlets
   1. Floorbox shall utilize Mini-Com insert(s) to install RJ45 terminations.
   2. Floorbox frame shall support data and voice services.
   3. Provide three (3) or more Category 6A distribution cables running from the modules back to the RJ-45 patch panel in the Telecommunications Room using cable tray and conduit infrastructure.
   4. Terminate each Category 6A distribution cable at each end on a RJ45 jack using the 568B wiring scheme.

3.2 - Horizontal Distribution Cable Installation

A. Cable shall be installed in accordance with manufacturer's recommendations and best industry practices.

B. A pull cord (nylon; 1/8" minimum) shall be co-installed with all cable installed in any conduit.

C. Cable raceways shall not be filled greater than the TIA/EIA-569-C maximum fill for the particular raceway type or 40%.

D. Cables shall be installed in continuous lengths from origin to destination (no splices) except for transition points, or consolidation points.

E. Where transition points, or consolidation points are allowed, they shall be located in accessible locations and housed in an enclosure intended and suitable for the purpose.

F. The cable's minimum bend radius and maximum pulling tension shall not be exceeded.

G. If a J-hook or trapeze system is used to support cable bundles all horizontal cables shall be supported at a maximum of 48 to 60 inch (1.2 to 1.5 meter) intervals. At no point shall cable(s) rest on acoustic ceiling grids or panels.

H. Horizontal distribution cables shall be bundled in groups of no more than 50 cables. Cable bundle quantities in excess of 50 cables may cause deformation of the bottom cables within the bundle and degrade cable performance.

I. Cable shall be installed above fire-sprinkler systems and shall not be attached to the system or any ancillary equipment or hardware. The cable system and support hardware shall be installed so that it does not obscure any valves, fire alarm conduit, boxes, or other control devices.

J. Cables shall not be attached to ceiling grid or lighting fixture wires. Where support for horizontal cable is required, the contractor shall install appropriate carriers to support the cabling.

K. Any cable damaged or exceeding recommended installation parameters during installation shall be replaced by the contractor prior to final acceptance at no cost to the Owner.

L. Cables shall be identified by a self-adhesive label in accordance with the System Documentation Section of this specification and ANSI/TIA/EIA-606. The cable label shall be applied to the cable behind the faceplate on a section of cable that can be accessed by removing the cover plate.

M. Twisted pair cable shall be installed so that there are no bends smaller than four times the cable outside diameter at any point in the run and at the termination field.

N. Pulling tension on 4-pair UTP cables shall not exceed 25-lbf for a four-pair UTP cable.

3.3 - Horizontal Cross Connect Installation

A. Cables shall be dressed and terminated in accordance with the
   1. TIA-568_0-D Generic Telco Cabling Customer Premises
   2. TIA-568_0-D1 Generic Telecom Cabling for Customer Premise Addendum
   3. TIA-568_1-D Commercial Building Telcom Infrastructure Std
   4. TIA-568_1-D1 Commercial Building Infrastructure Standard Addendum

B. TIA-568_2D Balanced Twisted Pair Cabling and Components

C. Panduit Certification Plus System Warranty requirements and best industry practice.

D. Pair untwist at the termination shall not exceed 3.18 mm (0.125 inch).

E. Bend radius of the cable in the termination area shall not exceed 4 times the outside diameter of the cable.

F. Cables shall be neatly bundled and dressed to their respective panels or blocks.

G. Each panel or block shall be fed by an individual bundle separated and dressed back to the point of cable entrance into the rack or frame.

H. The cable jacket shall be maintained as close as possible to the termination point.

I. Each cable shall be clearly labeled on the cable jacket behind the patch panel at a location that can be viewed without removing the bundle support ties.

J. Cables labeled within the bundle, where the label is obscured from view shall not be acceptable.

3.4 - Optical Fiber Termination Hardware

A. Fiber slack shall be neatly coiled within the fiber splice tray or enclosure. No slack loops shall be allowed external to the fiber panel.

B. Fiber optic service loop of no less than 10 meters is to be properly dressed and secured above the rack(s) for fiber optic interconnects (not applicable to fiber to the desktop installations).

C. Each cable shall be individually attached to the respective fiber enclosure by mechanical means. The cables strength member shall be securely attached the cable strain relief bracket in the enclosure.

D. Each fiber bundle shall be stripped upon entering the splice tray and the individual fibers routed in the splice tray.

E. Each cable shall be clearly labeled at the entrance to the splice enclosure. Cables labeled within the bundle shall not be acceptable.
F. A maximum of 24 strands of fiber shall be spliced in each tray.
G. If spare strands are pulled, all spare strands shall be installed into spare splice trays.
H. All pulled fiber is to be terminated and tested.

3.5 - Copper Termination Hardware

A. Cables shall be dressed and terminated in accordance with the
   1. TIA-568_0-D Generic Telco Cabling Customer Premises
   2. TIA-568_0-D1 Generic Telecom Cabling for Customer Premise Addendum
   3. TIA-568_1-D Commercial Building Telcom Infrastructure Std
   4. TIA-568_1-D1 Commercial Building Infrastructure Standard Addendum
   5. TIA-568_2D Balanced Twisted Pair Cabling and Components
   6. Panduit Certification Plus System Warranty requirements and best industry practice.
B. Pair untwist at the termination shall not exceed 3.18mm (0.125 inch).
C. Bend radius of the cable in the termination area shall not exceed 4 times the outside diameter of the cable.
D. Cables shall be neatly bundled and dressed to their respective panels or blocks.
E. Each panel or block shall be fed by an individual bundle separated and dressed back to the point of cable entrance into the rack or frame.
F. The cable jacket shall be maintained to within 25 mm (one inch) of the termination point.
G. Each cable shall be clearly labeled on the cable jacket behind the patch panel at a location that can be viewed without removing the bundle support ties.
H. Cables labeled within the bundle, where the label is obscured from view shall not be acceptable.

3.6 - Labeling and Identification

A. Labeling of all components shall conform to 270553 Identification for Communication Systems.

3.7 - Testing and Acceptance

A. General
   1. All cable dressing, labeling and final installation shall be completed prior to testing.
   2. All cables and termination hardware shall be 100% tested for defects in installation and to verify cabling system performance under installed conditions according to the requirements of
      a. TIA-568_0-D Generic Telco Cabling Customer Premises
      b. TIA-568_0-D1 Generic Telecom Cabling for Customer Premise Addendum
      c. TIA-568_1-D Commercial Building Telcom Infrastructure Std
      d. TIA-568_1-D1 Commercial Building Infrastructure Standard Addendum
      e. TIA-568_2D Balanced Twisted Pair Cabling and Components

3. All pairs of each installed cable shall be verified prior to system acceptance. Any defect in the cabling system installation including but not limited to cable, connectors, feed through couplers, patch panels, and connector blocks shall be repaired or replaced in order to ensure 100% useable conductors in all cables installed.
4. All cables shall be tested in accordance with this document, the ANSI/TIA/EIA standards, the Panduit Certification Plus System Warranty guidelines and best industry practice. If any of these are in conflict, the Contractor shall bring any discrepancies to the attention of the project team for clarification and resolution.

B. Copper Channel Testing
1. Certification Tester
   a. Certification
      i) The field-test instrument shall be within a 12-month calibration period.
   b. Accuracy
      i) Level IIIe accuracy in accordance with ANSI/TIA-1152
      ii) Independent verification of accuracy shall be provided.
      iii) RJ45 plug must meet the requirements for NEXT, FEXT and Return Loss in accordance with ANSI/TIA-568-C.2 Annex C
      iv) Twisted pair Category 5e, 6, 6A, 7 or 7A cords are not permitted as their performance degrades with use and can cause false Return Loss failures
   c. Measurement Capabilities
      i) Wire Map
      ii) Length
      iii) Propagation Delay
      iv) Delay Skew
      v) DC Loop Resistance
      vi) DC Resistance Unbalance within a pair
      vii) DC Resistance Unbalance between pairs
      viii) Insertion Loss
      ix) NEXT (Near-End Crosstalk)
      x) PS NEXT (Power Sum Near-End Crosstalk)
      xi) ACR-N (Attenuation to Crosstalk Ratio Near-End)
      xii) PS ACR-N (Power Sum Attenuation to Crosstalk Ratio Near-End)
      xiii) ACR-F (Attenuation to Crosstalk Ratio Far-End)
      xiv) PS ACR-F (Power Sum Attenuation to Crosstalk Ratio Far-End)
      xv) Return Loss
      xvi) TCL (Transverse Conversion Loss)
      xvii) ELTCTL (Equal Level Transverse Conversion Transfer Loss)
      xviii) Time Domain Reflectometer
      xix) Time Domain Xtalk Analyzer
      xx) PS ANEXT (Power Sum Alien Near-End Crosstalk)
      xxi) Average PS ANEXT (Average Power Sum Alien Near-End Crosstalk)

xxii) PS AACR-F (Power Sum Alien Attenuation to Crosstalk Ratio Far-End)
xxiii) Average PS AACR-F (Average Power Sum Alien Attenuation to Crosstalk Ratio Far-End)

C. Fiber Testing
1. Section 27 1323 are the authoritative documents regarding Fiber Termination and Testing.

3.8 - System Documentation

A. Upon completion of the installation, the telecommunications contractor shall provide three (3) full documentation sets to the Engineer for approval. Documentation shall include the items detailed in the sub-sections below.

B. Documentation shall be submitted within ten (10) working days of the completion of each testing phase. This is inclusive of all test results and draft as-built drawings. Draft drawings may include annotations done by hand. Machine generated (final) copies of all drawings shall be submitted within 30 working days of the completion of each testing phase. At the request of the Engineer, the telecommunications contractor shall provide copies of the original test results.

C. The Engineer may request that a 10% random field re-test be conducted on the cable system, at no additional cost, to verify documented findings. Tests shall be a repeat of those defined above. If findings contradict the documentation submitted by the telecommunications contractor, additional testing can be requested to the extent determined necessary by the Engineer, including a 100% re-test. This re-test shall be at no additional cost to the Owner.

D. Test results documentation shall be provided in digital form within three weeks after the completion of the project. The files shall be clearly marked with the words “Project Test Documentation”, the project name, and the date of completion (month and year). The results shall include a record of test frequencies, cable type, conductor pair and cable (or outlet) I.D., measurement direction, reference setup, and crew member name(s). The test equipment name, manufacturer, model number, serial number, software version and last calibration date will also be provided at the end of the document. Unless the manufacturer specifies a more frequent calibration cycle, an annual calibration cycle is anticipated on all test equipment used for this installation. The test document shall detail the test method used and the specific settings of the equipment during the test as well as the software version being used in the field test equipment.

E. Printouts generated for each cable by the wire (or fiber) test instrument shall be submitted as part of the documentation package. Alternately, the telecommunications contractor may furnish this information in electronic form using a file format agreed to by the Owner.

F. When repairs and re-tests are performed, the problem found and corrective action taken shall be noted, and both the failed and passed test data shall be documented.

G. The As-Built drawings are to include cable routes and outlet locations. Their sequential number as defined elsewhere in this document shall identify outlet locations.

Numbering, icons, and drawing conventions used shall be consistent throughout all documentation provided. The Owner will provide floor plans in paper and electronic (DWG, AutoCAD) formats on which as-built construction information can be added. These documents will be modified accordingly by the telecommunications contractor to denote as-built information as defined above and returned to the Owner. Numbering, icons, pathways and other drawing conventions are to be assigned their own individual AutoCAD layer.

H. The Contractor shall annotate the base drawings and return a hard copy (same plot size as originals) and electronic (AutoCAD or as agreed to by Caltech) form.

End Section