



CAMP PENDLETON REQUIREMENTS SUPPLEMENT

MCIWEST G-6 TELECOMMUNICATION REQUIREMENTS SECTION 271300 (OSP)

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271300 TELECOMMUNICATION OUTSIDE PLANT CABLING AND PATHWAYS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced and are referenced within the text by the basic designation only.

TIA/EIA-526-7	Optical Power Loss Measurements of Installed Single-Mode Fiber Cable Plant
TIA/EIA-526-14	
OFSTP-14	Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant
TIA/EIA-568-C.1	Generic Telecommunications Cabling for Customer Premises
TIA/EIA-568-C.2	Commercial Building Telecommunications Cabling Standard
TIA/EIA-568-C.3	Optical Fiber Cabling Components Standard
TIA/EIA-568-C.2	Balanced Twisted-Pair Telecommunication Cabling and Components Standard (Formally EIA/TIA 568-B)
TIA/EIA-568-C.4	Coaxial Cabling Components
TIA/EIA-569	Commercial Building Standard for Telecommunications Pathways and Spaces
TIA/EIA-606	Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
ANSI/J-STD-607-A	Commercial Building Ground and Bonding Requirements for Telecommunications
TIA/EIA -758	Customer Owned Outside Plant
NFPA-70	National Electrical Code (NEC)
NFPA-75	Fire Protection of Information Technology Equipment
NFPA-76	Fire Protection of Telecommunication Facilities
UL 497	Safety Protector for Paired Conductor Communication Circuit
UFC-3-580-1	Telecommunications Building Cabling System Planning, Design, and Estimating
UFC-3-580-10	Navy and Marine Corps (NMCI) Standard Construction Practices
EIA/TIA-942	Telecommunications Infrastructure Standard for Data Centers
UCR 2013	DOD Unified Capabilities Requirements (supersedes UCR 2008, Change 3)
UFC 4-010-01	DoD Minimum Antiterrorism Standards for Buildings

1.2 DEFINITIONS

AREA DISTRIBUTION NODE (ADN)

Real Property categories 13110 and 13115 that serves as physical concentration or central location for terminating backbone cables to interconnect with local exchange carrier (LEC) equipment at the activity minimum point of presence. The ADN generally includes vendor specific components to support voice and data circuits, building surge protector assemblies, main cross connect blocks, equipment support frames, and fireproof wood backboard.

CORE DATA CENTER (CDC)

Real Property category 14380. Formerly ADPE Center or Data Center category 61020. Regional Data Center and service point for C2 data services and non-C2 data services.

DIGITAL CENTRAL OFFICE (DCO)

Real Property categories 13140 and 14340 that serves as the main point of service delivery of a given installation. It is the local service point for voice services, main telecomm circuit distribution, commercial demarcation point and connection to the DISN.

ENTRANCE FACILITY (EF)

An entrance facility to a building that can be used for both private and public network service cables (including antennae) including the entrance point at the building wall and continuing to the entrance room or space. Telecommunications Entrance Facility (TEF) The entrance facility is required to provide signal paths from the closest point of presence to the new facility, including free standing frames or backboards, interconnecting hardware, terminating cables, lightning and surge protection modules. The work consists of providing, testing and making operational cabling, interconnecting hardware and lightning and surge protection necessary to form a complete outside plant telecommunications system for continuous use. All entrance facilities must provide the correct interface between outside plant (cabling and infrastructure) to the structural (cabling and infrastructure).

EQUIPMENT ROOMS (ER)

An architectural centralized space for telecommunications equipment and other building automations that provide services the occupants of the building. Equipment housed therein is considered distinct from a telecommunications use because of the nature of its complexity. Electromagnetic Compatibility shall be considered when designing this space.

INSTALLATION PROCESSING NODE (IPN)

Real Property category 14340. Formerly ADPE Center or Data Center (CDC) category 61020 provides a local services point for C2 data services and non-C2 data services. It may host services and applications that are not practical to be hosted at a CDC. It can also serve all functions of the Area Distribution Node.

OUTSIDE PLANT (OSP)

Real Property categories 13510 and 13520. Outside Plant refers to all of the physical cable pathways, cabling, and supporting infrastructure including, but not limited to, in-ground duct-banks, conduits, maintenance holes, cabinets (pedestals), and any associated hardware located between a demarcation point in a switching facility and a demarcation point in another switching center or customer premise

PATHWAY

A sequence of connections that provides the connectivity within (vertically/horizontal) or leading to a building in support of telecommunications cabling.

SPECIAL PURPOSE PROCESSING NODE (SPPN)

Multiple Real Property categories. Fixed data center supporting special purpose functions that cannot be supported by CDC or IPN due to its association with mission specific infrastructure or equipment (e.g., meteorology, medical, modeling & simulation, test ranges, classrooms, etc.).

TELECOMMUNICATION MAIN GROUNDING BUSBAR (TMGB)

The busbar is placed in a convenient and accessible location, bonded by means of the conductor for telecommunications to a building service equipment (power) ground. The TMGB and TGBs are exothermically welded to the facility's ground ring via a single-point ground cabling. A TR has the same single-point ground requirement.

TELECOMMUNICATIONS ROOM (TR)

An enclosed architectural space for telecommunications equipment, cable terminations, and cross-connect wiring for horizontal cabling.

1.3 SUBMITTALS

Submit the following in accordance with Section 013300, "Submittal Procedures" within the Camp Pendleton Requirement (CPR).

SD-02 SHOP DRAWINGS

Telecommunications drawings include T0, T1, T2, T3, T4, T5 and a Telecommunications Change Sheet. A laminated copy of T1 and T2 will be placed in each Entrance Facility (EF) and in each Telecommunications Room (TR) if the facility has more than one TR.

SD-03 PRODUCT DATA

Provide manufacturer's specifications on telecommunications cabling, telecommunications outlet/connector assemblies, equipment support frame, building protector assemblies, connector blocks, building entrance terminals, and other materials used.

SD-06 TEST REPORTS

Provide telecommunications cabling inspection, verification and performance testing (by Third Party) in accordance with TIA/EIA-568 for all structural cabling, in accordance with TIA/EIA-758B for all outside plant copper cabling, and in accordance with TIA/EIA-526-7 (Methods A and B) for Single Mode Fiber Optical cabling. All Category 6 cabling will be tested utilizing a Level III tester. All Category 3 Outside Plant cabling will be tested with a DC Loop Tester and a Time-Domain Reflectometer (TDR). All Terminated Single Mode Fiber Optic cabling will be tested with a power source and light meter and for all unterminated Single Mode Fiber Optic cable an Optical Time-Domain Reflectometer (OTDR) will be utilized. Provide a complete and detailed test plan for all telecommunications cabling as described including a complete list of test equipment for the UTP, optical fiber components and accessories 30 days prior to the proposed test date.

1.3.1 TELECOMMUNICATIONS DRAWINGS

Provide Registered Communications Distribution Designer (RCDD) approved drawings complete with wiring diagrams and details required to prove that the distribution system shall properly support connectivity from the telecommunications equipment room to telecommunications work area outlets. Show the entrance facility and layout of cabling and pathway runs, distribution frame, cross connect points, single point ground system, and terminating block arrangements. Drawings shall depict final telecommunications cabling configuration, including location, and terminating blocks layout at cross connect points and patch panels after telecommunications cable installation.

- a. **T0** – Campus or site plan: exterior pathways and inter building backbone cable and pathways.
- b. **T1** – Layout of complete building per floor - Building Area/Serving Zone Boundaries, Backbone Systems, Structural Cabling System and Horizontal Pathways). The drawing indicates location of building areas, serving zones, vertical backbone diagrams, telecommunications rooms, access points, pathways, grounding system and other systems that need to be viewed from the complete building perspective.
- c. **T2** – Serving Zones/Building Area Drawings - Drop Locations and Cable Identification (ID'S). Shows the building area, and the serving zone within the building. These drawings show drop locations, telecommunications rooms, access points and detail call outs for common equipment rooms and other congested areas.
- d. **T3** – Telecommunications Equipment Room (ER): plan views of telecommunications

- racks, walls, equipment and power, plumbing elevations (racks and walls).
- e. **T4** – Typical Detail Drawings - Faceplate Labeling, Fire-stopping, and Americans with Disabilities Act (ADA), Safety and the Department of Transportation (DOT). The T4 will show detailed drawings of symbols and typical such as faceplate labeling, faceplate types, faceplate population installation procedures, detail racking, and raceways.
 - f. **T5** – T5 drawings shall include schedules to show information for cut-over and cable plant management, patch panel layouts and cover plate assignments, cross-connect information and connecting terminal layout as a minimum. T5 drawings shall be provided in hard copy format on electronic media using Windows based computer cable management software, all drawings will be provided in an AutoCAD and Adobe Acrobat format. Provide the following T5 drawing documentation as a minimum.

1.4 TELECOMMUNICATIONS QUALIFICATIONS

The telecommunications contractor shall be a firm which is regularly and professionally engaged in the business of the applications, installation, and testing of the specified telecommunications systems and equipment. The telecommunications contractor shall demonstrate experience in providing successful telecommunications systems within the past 3 years. Submit documentation for a minimum of three and a maximum of five successful telecommunication system installations for the telecommunications contractor.

1.4.1 REGISTERED COMMUNICATIONS DISTRIBUTION DESIGNER (RCDD)

Telecommunications design must be performed and stamped by a Building Industry Consulting Service International (BICSI) Registered Consultant Distribution Design (RCDD) for all projects per UFC 3 580 01.

1.4.2 CABLE SPLICING AND TERMINATING

Personnel assigned to the installation of this system or any of its components shall have training in the proper techniques and have a minimum of 3 years' of recent experience in splicing and terminating the specified cables. Modular splices shall be performed by factory certified personnel or under direct supervision of factory trained personnel for products used.

1.5 RECORD DOCUMENTATION

Unless otherwise specified by MCIWEST G-6 provide electronic (AutoCAD and Adobe Acrobat formats) and a hard copy of all T-5 Telecommunication Drawings to include documentation of cables and termination hardware in accordance with ANSI/TIA/EIA -606-A. Marine Corps Base Camp Pendleton is a class 4 activity requiring all labeling schemes to be provided by MCIWEST G-6 Infrastructure Planning. T5 drawings shall include schemes to show information for cut-over and cable plant management, maintenance hole and conduit pathways (to include GIS coordinates) patch panel layouts and cover plate assignments, cross-connect information and connecting terminal layout as a minimum.

PART 2 PRODUCTS

2.1 OUTSIDE CABLE PLANT COMPONENTS

2.1.1 PATHWAYS

The Telecommunications Outside Plant (OSP) pathways will consist of an in-ground duct-bank (conduits) and maintenance holes (Note: aerial construction is no longer an acceptable pathway solution) connecting to the closest point of presence and the new

facility. Included are the free standing frames, interconnecting hardware, grounding and bonding.

2.1.2 OUTSIDE PLANT CABLING

Copper cabling shall be a minimum of 24-gauge solid core (PE-89) and the Optical fiber shall be single mode loose tube fiber (PE-90). (Note: all cable pulling tension and bend radius standards/manufacturer specifications must be followed).

2.1.2.1 FIBER OPTIC SPECIFICATIONS

The optical glass characteristics used within the fiber optic cable is critical to meet acceptable and compatible criteria currently in operation aboard Camp Pendleton (See APPENDIX A).

2.1.3 COPPER TERMINATION DEVICES

2.1.3.1 CENTRAL OFFICE PROTECTORS

Terminations within the Area Distribution Nodes require a 100 pair 4486 Dual Post Type Central Office Protectors (24AWG Input and Wire-Wrap Output) to include an UL497 (5 Pin) Protection Gas Tube Modules (3B1E Type) equipped with gold plated protector sockets that eliminate noise problems and meet primary protection standards. Mounting the Central Office Protectors from Top to Bottom will be determined by MCIWEST G6. Grounding and Bonding of the Central Office Protectors will be conducted in accordance to manufacturer and current ANSI J-STD 607 standards (See APPENDIX B).

2.1.3.2 BUILDING ENTRANCE TERMINALS

Inter-building backbone cables shall be terminated on 110 type protected UL 497 rated entrance terminals with a splice closure. Outdoor type terminals which are mounted on the outside of buildings shall not be used, all terminations and demarcations will be inside the building in the entrance facility (EF). Install self-contained 5-pin, 3 element, gas tube protector module supplied with a field cable stub factory connected to protector socket blocks to terminate and accept protector modules for a minimum of 25 pairs of outside cable. Building protector assembly shall have 710 interconnecting hardware for connection to interior cabling at full capacity (See APPENDIX C).

2.1.4 FIBER OPTIC TERMINATION

2.1.4.1 OPTICAL FIBER PANEL ADAPTER

The Fiber Panel Adapters shall accommodate 12 fiber prewired modules or cassettes using SC-Type Duplex connector. Utilizing a snap (push-pull coupling) and 2.5 mm ferrules, the panels shall be able to use field-installable connectors or in applications where pre-terminated cables are routed directly from the equipment to the interconnect hardware.

2.1.4.2 OPTICAL FIBER RACK INTERCONNECT CABINET (RIC)

The RIC houses, protects and allows the administration of fiber optic components in telecommunications local area networks (LANs), data centers, storage area networks (SANs) and other related enterprise network applications.

The fiber optic housings are designed for rack-mounted or frame-mounted applications that support conventional cross-connection and interconnection schemes as well as through-splicing applications. Fiber optic housings shall meet the design requirements of ANSI/TIA-568-C.3, and shall be RoHS compliant. Housings shall also be U.L. 1863 listed ("Communication-Circuit Accessories"), and all plastic structural components shall be UL 94 V.0 rated. Fiber optic housings include one through four unit-height housings ("1U",

"2U, "3U" and "4U"), whereby one industry standard (EIA compliant) rack unit is defined as 44.45mm in height in compliance with EIA-310-D ("Cabinets, Racks, Panels, and Associated Equipment"). The generic requirements for 1U-4U housings are listed below: The Rack Interconnect Cabinet shall support cross-connection, interconnection and/or splicing applications and routing schemes in the same housing. The housing shall accommodate direct termination via a connector panel(s) or in conjunction with slack storage cassettes that hold the connector panels (See APPENDIX D).

Dimensions

The housing shall not exceed a depth requirement of 16.5 inches (42.0 cm), excluding door latches and locks. The housing shall not exceed a width requirement of 17.5 inches (44.5 cm), excluding mounting brackets, fasteners or entry grommets.

Materials and Compliance

The unit shall meet the design requirements of ANSI/TIA/EIA-568 and the plastics flammability requirements of UL 94 V-0. The connector housings shall have a labeling scheme that complies with ANSI/TIA/EIA-606. The housing shall contain the following labels that shall be affixed to the base of the front compartment of the housing: A laser radiation warning label that contains the word "DANGER" in a High-lighted color or colored background (preferably red). A product information label that contains the manufacturer's name, product part number, manufacturing location, date of manufacturer, as well as other pertinent information for manufacturing traceability and a communication circuit accessory (listing 41S4 or equivalent).

Connector Panels and Modules

They shall be held in place via interchangeable panel retention clips that snap into position independent of one another on both the top and bottom of the housing. The housing shall be capable of holding up to twelve (12) connector panels and/or modules. The housing shall accommodate pigtail splicing via interchangeable with pigtailed connector panels, while maintaining the capability to accommodate connector-pigtail modules and pigtailed connector panels outside of the splice cassettes (See APPENDIX E).

Jumper Management and Front Access

The Main Housing shall contain a removable front jumper assembly compartment accommodating 144 (2.0mm) jumpers/patch cords. Egress openings each side, four jumper management routing clips with flex fingers, two pass-through grommets on top tinted, translucent door (removable) with two slam-latches, key-lock, and accepts two label cards.

Rear Access

The rear assembly housing is a metal door with a routing and cable sub-unit slack storage bracket; lances for cable tie and/or hook-and-loop type strap installation. The door shall contain left and right slam latches with single hand operation, keyed lock (removable) with brush entry on both sides of the rear housing covering height of the housing (removable). The brush with bristles is two inches (50 mm) in length and retained by a metal spine (See APPENDIX F).

Top Access

The housing shall contain removable top cover with relief holes on its left and right sides with two pass-through grommets on its rear edge.

Cable Strain-relief

The housing shall provide means for strain-relieving fiber optic cables both interior and exterior to the rear of the housing. The internal strain-relief bracket shall strain-relieve a single cable up to 34.0mm or multiple cables of a comparable bundle diameter.

Interior Management

The rear housing assembly shall contain provisions for routing and maintaining fiber optic cable components, including cable sub-units and buffer tube, 900 µm optical fiber, and buffer tube transition kits. The floor/base of the rear assembly housing shall provide holes or slots for the installation (and removal) of fiber retention or slack management clips with fingers on the top that allow the quick removal and installation of optical fiber and cable sub-units. The fiber retention clip shall be of a segmented design with a divider that separates the clip into two sections for greater organized fiber storage capacity. The floor/base of the rear assembly housing shall provide holes or slots for the installation (and removal) of transitional strain-relief clips. The transitional strain-relief clip shall be made from flexible durable injection-molded plastic. The transitional strain-relief clip shall be capable of holding six (6) buffer tube transition kits that can each manage a single twelve-fiber buffer tube. Fiber fan-out devices are used to build 250µm fibers in buffer tubes out to 900µm for fiber protection and to allow them to be connected. The transitional strain-relief clip shall be stackable utilizing only the integral retention features to affix the clips to one another.

Mounting Provisions

The housing shall be mountable in an EIA-310 compatible 465 or 592mm rack with a 5 inch (13cm) frontal projection with the option to flush mount through removal of the front jumper assembly.

2.1.5 BACKBOARDS

Provide and install interior grade void free plywood 3/4 inch thick in 4 foot by 8 foot sheets, painted on all 6 sides, 2 coats of fire retardant paint white in color. Ref TIA/EIA-569.

2.1.6 GROUNDING AND BONDING PRODUCTS

Comply with ANSI/JSTD-607 and NFPA 70.

2.1.7 MAINTENANCE HOLES

Unless otherwise specified by MCIWEST G-6 maintenance holes shall be a minimum of 6 Feet Wide x 12 Feet Length x 7 Feet High. When required to connect directly to an ADN cable vault the maintenance hole shall be 8 Feet Wide x 12 Feet Length x 7 Feet High. Maintenance holes shall have a round 36 inch diameter H20 traffic rated cover stamped or embossed with "Telecommunications" and shall be bordered by a minimum 12-inch wide traffic-rate reinforced concrete pad, flush with the cover and the surrounding surface. A unique identification number specified by MCIWEST G-6 shall be legibly stenciled (4-inch characters) onto the inner ring surface using black water-resistant paint (black characters on a white painted background is permitted). Additional requirements include a permanent galvanized steel ladder, grounded cable rails and shoes to rack the cable(s), minimum 6 inch sump and a 3/4 inch x 10 foot grounding rod tested to 25 ohms or less (less is preferred). All unused conduits shall be sealed with expandable cable plugs. All used conduits shall be sealed using expandable foam or similar sealant. The maintenance hole floor shall be level +/-3° slope toward sump. The top section or neck can be custom formed to accommodate road or terrain slope as needed (no spalls, cracks or holes).

2.1.8 HAND HOLES

Hand-holes shall have a rectangular H20 traffic-rated cover stamped or embossed with "Telecommunications." The hand hole covers shall be bordered by a minimum 12-inch wide, traffic-rate reinforced concrete pad, flush with the cover and the surrounding surface. A unique identification number specified by MCIWEST G-6 shall be legibly stenciled (4-inch characters) onto the inner ring surface using black water-resistant paint (black characters on a white painted background is permitted). All Hand holes shall have grounded cable rails and shoes to rack the cable(s), minimum 6 inch sump, a

3/4 inch x 10 foot grounding rod tested to 25 ohms or less (less is preferred). Hand holes are typically small, pull-through points where no cable splicing within is permitted. There are three approved hand hole types; two of which cannot support splicing and one that can under certain circumstances. Sizes include:

3314 (non-splicing hand hole)

Outer dimensions: 3 Feet Wide x 5 Feet Length x 4 Feet High *

3315 (non-splicing hand hole)

Outer dimensions: 5 Feet Wide x 7 Feet 6 Inch Length x 6 Feet, 6 Inch High *

3316 (limited splicing hand hole)

Outer dimensions: 6 Feet Wide x 9 Feet 6 Inch Length x 6 Feet High *

* Depth varies with grade and is determined by riser and neck dimensions.

2.1.9 INNERDUCT

All Optic Fiber cabling shall be run through a multi-cell nylon fabric inter-duct within a 4 inch conduit (Note: corrugated inner-duct shall not be used). Each cell of the inner-duct shall contain a color coded pull-cord. At least one inner-duct per OSP duct-bank shall include a detection wire. No more than two, 4 inch 3 cell inner-ducts or three, 3 inch 3 cell inner-ducts shall be used per 4 inch diameter conduit.

2.1.10 SPLICE CLOSURES

Housing, encapsulating compound shall not be used. Closure shall be of stainless steel material supplying structural strength necessary to pass the mechanical and electrical requirements in an OSP environment. Size of closure shall be determined by MCIWEST G-6. Optical Fiber Splice Closures shall be suitable to house splice organizer in a protective housing. Closure shall be of thermoplastic, or stainless steel material supplying structural strength necessary to pressure test, and pass the mechanical and electrical requirements in an OSP environment. Size of closure shall be determined by MCIWEST G-6. Metallic Splice Closures shall be suitable to house a straight and butt splices.

2.1.11 OUTSIDE PLANT LABEL

Types and materials: Labels shall be a weather-resistance material such as a rigid plastic/vinyl tag or a flexible vinyl "stick-on" label with polyester over-laminate that is able to receive and sustain permanent identification lettering without fading or discoloration.

2.1.12 SMART COILS

770-Type Smart Coil Case solutions will be utilized to accommodate POTS, ADSL, T1, or ISDN services. Smart coils shall be installed as needed every 5000 to 6000 feet on long-haul trunks.

2.1.13 EQUIPMENT SUPPORT FRAME

Shall be steel construction and treated to resist corrosion. A 19 inch open face equipment racks shall be installed. Equipment support frames will be floor mounted unless the facility has 12 or less users in which case the frame may be wall mounted.

2.1.14 CABLE TRAY

Solid bottom, slotted bottom, or welded wire cable tray should be used to provide a centralized cable management/distribution system. Provide 1 square inch cross sectional area of the tray or wire-way for each outlet location served. Cable trays shall be designed to accommodate maximum calculated fill ratio of 50% to a maximum inside depth of 6 inches. For barracks, the designer should provide 1 square inch cross sectional area of the tray or wire-way for each barracks unit, and to exceed the 50% fill ratio. Ladder cable

tray should be avoided for horizontal distribution. Provide 12 inches of clearance above cable trays for future access. Designers must coordinate with other disciplines to insure clearances can be achieved.

PART 3 EXECUTIONS

3.1 INSTALLATION

Telecommunications cabling and pathway systems, including the associated hardware shall be installed in accordance within TIA/EIA-568, TIA/EIA -569, NFPA 70, and UL standards as applicable. Reference UFC 3-580-01 and UFC 3-580-10.

3.2 OUTSIDE PLANT PATHWAYS

Must comply with TIA/EIA-758. MCIWEST G-6 **WILL** provide the point of connection for the telecommunication pathways. The installation of a duct-bank or conduits require a minimum 24" separation from parallel runs of electrical, gas, water, flues, steam, and hot water conduits. The duct-bank requirements in addition to UFC 03-580-01 listed below:

- a. Minimum (4) 4 inch duct-bank from maintenance hole to maintenance hole and from hand hole to hand hole. Additional conduits as required.
- b. Minimum (16) 6 inch duct-bank from an ADN to its adjacent maintenance hole outside the ADN cable vault.

Conduits should be filled to acceptable capacity percentage before installing cabling into an unused conduit unless otherwise specified by MCIWEST G-6. Minimum 25% of the conduits installed must be kept unused (for spare) and must contain a pull-rope. Horizontal Directional Drilling (HDD) is permitted where necessary pending MCIWEST G-6 review and approval. HDD Bore distances must not exceed the tensile strength of the cable(s) being pulled.

3.2.1 SERVICE ENTRANCE CONDUITS, UNDERGROUND

Must comply with TIA/EIA-758. MCIWEST G-6 **WILL** provide the point of connection for the telecommunication pathways. The installation of a duct-bank or conduits require a minimum 24" separation from parallel runs of electrical, gas, water, flues, steam, and hot water conduits. The duct-bank requirements in addition to UFC 03-580-01 are listed below:

- a. Minimum of (2) 4 inch conduits shall be provided from the point of connection unless provided by MCIWEST G-6 to the building entrance for telecommunications. Both ducts shall be equipped with a ¼ inch pull rope.
- b. One duct shall be equipped with a 4 inch 3 cell nylon fabric inter-duct or an equivalent product.
- c. Unused conduits shall have duct plugs installed.

The installation of a duct-back or conduits must be parallel with or at right angles to walls or structural members when entering a building entrance facility.

3.2.2 SERVICE ENTRANCE CONDUITS, UNDERGROUND (COPPER CABLING)

Duct with ¼ inch pull rope shall be utilized for copper requirements to the building.

3.2.3 SERVICE ENTRANCE CONDUITS UNDERGROUND (FIBER OPTIC CABLING)

Duct with a 4 inch 3 cell nylon fabric inter-ducts or an equivalent product shall be utilized for fiber optic cable requirements to the building.

3.2.4 OUTSIDE PLANT INNERDUCT

4 inch, 3 cell inner-duct quantities shall be used as follows:

- a. Duct-banks with (2) 4 inch conduits, place (1) 4 inch, 3-cell inner-duct in (1) conduit.
- b. Duct-banks with (4) 4 inch conduit duct-bank, place (2) 4 inch, 3-cell inner-ducts in (1) conduit.
- c. Duct-banks with (6) 4 inch conduit duct-bank, place (4) 4 inch, 3-cell inner-ducts in (2) of the conduits (two apiece).
- d. Conduit duct-bank with (8) 4 inch conduits, place (6) 4 inch 3-cell inner-ducts in (3) of the conduits (2 apiece).

3.3 MAINTENANCE/HAND HOLES

MCIWEST G-6 will provide the point of connection for the telecommunication pathways. Unused conduits shall be fitted with expandable plugs and all used conduits shall be resealed with expansion foam. Pull-ropes shall have minimum 15ft of slack, coiled and secured to nearest cable bracket. Nylon inner-duct shall have minimum 36 inches of extra material inside the maintenance hole and secured to the nearest bracket. Connected Maintenance Hole distances in an OSP duct-bank are typically 500 feet to 550 feet with 520 feet being typical. Shorter or longer distances are subject to MCIWEST G-6 review and approval.

All new maintenance holes installed shall include ground rods and bonding ribbon. The ground rod and bonding ribbon may only be omitted when the following conditions apply:

- a. A maintenance hole has been designed and constructed with an integral ground system with all ironwork bonded together.
- b. The maintenance hole bears a visible manufacturer's label certifying that the structure contains an integral ground system.
- c. U.S. Government approval has been obtained.

Butterfly drawings and photos are required for any cable work to be performed inside a maintenance hole. Electronic format (PDF or JPG) is preferred method. All four walls must be addressed, and include an orientation reference (such as north) and including the maintenance hole identification number (See APPENDIX G).

3.4 OUTSIDE PLANT CABLE

Must comply with TIA/EIA-758. MCIWEST G-6 **WILL** provide each point(s) of connection and the fiber optic strand and copper counts for all telecommunication cabling. The minimum requirement for structures requiring telecommunications services is 25 pairs of copper cabling and 12 strands of single mode fiber optics cabling; unless specified by MCIWEST G-6. Telecommunication conduits require a minimum of 24 inches away from parallel runs of electrical, gas, water, sewer and/or steam conduits/pipes.

3.4.1 CABLE SPLICING

All splicing to be performed and materials supplied by the contractor. MCIWEST G-6 requires a **21** day notice prior to any splice being performed.

3.4.2 OPTICAL FIBER CABLE SPLICING

All Optical Fiber splicing will be performed and all materials supplied by the contractor. All Optical Fiber splices will be completed using the fusion splicing method at locations shown on the construction drawings. Optical fiber splicing shall be in accordance with manufacture's recommendation.

3.4.3 COPPER CABLE SPLICING

Multi-pair splices are insulation displacement (IDC) type splices. Provide multi-pair, fold-back, in-line, single pair, splices of a moisture resistant, two or three wire insulation displacement connector held rigidly in place to assure maximum continuity. Cables greater than 25 pairs shall be spliced using multi-pair splicing connectors, which accommodate 25 pairs of conductors at a time. Provide correct connector size to accommodate the cable gauge of the supplied cable and 710 splicing is the preferred method for MCB Camp Pendleton.

3.5 CENTRAL OFFICE PROTECTORS

MCIWEST G-6 **WILL** determined the placement of the termination block(s). Grounding and Bonding of the Central Office Protectors will be conducted in accordance to manufacturer and current ANSI J-STD 607 standards.

3.5.1 TRANSITION BACKBONE CONNECTOR BLOCKS

Connector blocks shall be 110-type IDC and wall mounted in orderly rows and columns. Adequate vertical and horizontal wire management routing areas shall be provided between groups of blocks. Install in accordance with industry standard wire routing guides in accordance with ANSI/TIA/EIA-569-A. 110 type connector blocks are used for OSP transition field only.

3.6 FIBER OPTIC ENCLOSURE RACK

Patch panels shall be rack mounted with sufficient ports to accommodate the installed of the fiber optic cable termination with a 25 % spare capability. Within the enclosure the fiber optic cable loop shall be 3 feet in length with the outer cable jacket secured to the enclosure to prevent movement utilizing clamps or brackets as recommended by the manufacturer.

The panel shall be attached with two push-pull latches to allow quick installation and removal. Blank connector panels shall be available to fill unused space within the housings. The blank connector panel shall be attached with at least two push-pull latches to allow quick installation and removal. The blank panels shall be manufactured from injection-molded polycarbonate. Panels shall be manufactured from 16 gauge cold rolled steel or injection-molded polycarbonate for structural integrity.

The Fiber Panel Adapters shall accommodate applications requiring specified labeling and connector identification. Fiber Panel Adapters shall be labeled in the RIC alphabetically A-L and oriented vertically within the RIC. The housing and/or packaging shall include a hardware accessory kit that includes the following components: 1) installation instructions, 2) fiber optics label, 3) 8 inch cable ties, 4) 4 inch cable ties, 5) #12-24 mounting screws. Housings shall be manufactured using materials and colors for structural integrity and shall be finished with a wrinkled black powder coat for durability on exterior metal. Installation fasteners shall be included and shall be black in color (See APPENDIX H).

3.7 LABELING (OUTSIDE PLANT CABLING)

Labels shall be a weather-resistance material such as a rigid plastic/vinyl tag or a flexible vinyl "stick-on" label with polyester over-laminate that is able to receive and sustain permanent identification lettering without fading or discoloration. Hand-printed labeling is not acceptable. Nomenclature must be affixed using a label making device that can present uppercase block lettering on the specified materials. Black lettering on a light background is preferred. Orange for copper and Yellow for fiber is typical utilized. MCIWEST G-6 **WILL** provide both the copper and fiber optic number sequence.

3.7.1 LABELING (COPPER CABLING)

Copper cable labeling shall have an uppercase CA prefix followed by a unique cable identifier, followed by a hyphen and an alpha-numeric suffix. Do not insert spaces between any lettering. Intra-camp (local) cable identifiers shall typically use the Encampment's Area designation number followed by an alpha-numeric suffix. Inter-camp (camp to camp) Trunk cable identifiers contain the two Encampment Area numbers with the lower Area number generally preceding the higher number. The cable's *pair* count follows the identification suffix and a comma. (See APPENDIX I).

Copper cabling examples:

Local copper cable: CA 20-1,1-600P

Inter-camp cable: CA 4151-1,1-600P

Local cable feeding a facility spliced into an inter-camp cable: CA4151-1,576-600P

Note: Within an ADN the horizontal blocks lettering must read left to right and typically appears in 100 pair bundles.

ADN, MDF PET Blocks:

1st PET Block = CA20-2,1-100P

2nd PET Block = CA20-2,101-200P

3rd PET Block = CA20-2,201-300P

4th PET Block = CA20-2,301-400P

TR and EF Blocks:

BET label = CA20-3,1-25P

3.7.2 LABELING (FIBER OPTIC)

Fiber optic cable labeling shall have an uppercase FOC prefix followed by a unique cable identifier followed by a hyphen and an alpha-numeric suffix. Do not insert spaces between any lettering. Intra-camp (local) cable identifiers typically use the encampment's Area designation number followed by an alpha-numeric suffix. Inter-camp (camp to camp) Trunk cable identifiers contain the two Encampment Area numbers with the lower number generally preceding the higher number. The cable's *strand* count follows the identification suffix and a comma. Some fiber optic cabling examples include:

Local fiber cable: FOC20-1,1-144S

Inter-camp cable: FOC4151-1,1-144S

Local cable feeding a facility spliced into an inter-camp cable: FOC4151-1,133-144S

Note: Within a TR or ADN the Fiber Optic Cabling will be installed within a Fiber Optic Patch Panel (FOPP) or Rack Interconnect Chassis (RIC) and the labeling is typically placed horizontally. Fiber strand counts are typically in groups of 12 strands. The cable number, along with strands assigned for each group of 12 shall be placed on the FOPP's panel or cover. (See APPENDIX J).

The following example lists two separate cables; where one is a 24 Strand and the other a 48 Strand:

- a. FOC20-2, 1-12
- b. FOC20-2,13-24
- c. FOC20-3,1-12
- d. FOC20-3,13-24
- e. FOC20-3,25-36
- f. FOC20-3,37-48

Note: Continue sequentially for all ports where fiber strands have been terminated. Once a cable has been assigned, the cable number along with the location served is listed in each group of 12. For example:

- a. FOC20-2, 1-12, Bldg 20123
- b. FOC20-2,13-24, Bldg 20123

3.7.3 CABLE TAG INSTALLATION

Labeling shall be securely affixed to cables and splice cases. Nylon cable ties are acceptable for securing rigid tag-type labels to cables. Labels must be affixed at sufficient enough angle so they are visible and can be read from the maintenance hole entrance as well as from standing inside the maintenance hole without disturbing other cables.

Building Entrance Terminals (BET) or Protected Entrance Terminals (PET):

On vertical mounted blocks, the label shall be affixed to the outward facing blank strip or flange adjacent to the pin block. The letters must read from top to bottom in a left to right progression like the spine of a book.

3.8 TELECOMMUNICATIONS CABLE TESTING

Provide to MCIWEST G-6 test plan that defines the test required to ensure that the system meets technical, operational and performance specifications. Time Domain Reflectometry (TDR) shall be used on outside plant copper cabling. Optical Time Domain Reflectometry (OTDR) and Power Meter/Light Source shall be used on optical fiber. Test results shall be provided in a pdf format, so that they are non-editable. (2) Electronic copies of the test reports shall be provided to the MCIWEST G-6 for database records.

3.8.1 TESTING (COPPER)

Perform the following acceptance test in accordance with latest version of TIA-EIA 758:

- DC loop resistance
- Wire map (pin to pin continuity)
- Continuity to remote end
- Short between two or more conductors
- Crossed Pairs
- Reversed Pairs
- Split Pairs
- Grounded Pairs
- Tip Ground (ohms)
- Ring Ground (ohms)
- Loop Resist (ohms)
- Footage

Provide a PDF electronic file of the tests report to MCIWEST G-6 within 10 business days of testing. Provide Copper and Fiber Optic Cable Test Reports to MCIWEST G6 in PDF format.

3.8.2 TESTING (FIBER OPTIC)

Test fiber optic cable in accordance with current standards. Two optical tests shall be performed on all optical fibers: Optical Time Domain Reflectometry (OTDR) Test, and Attenuation Test. The OTDR test shall be used to determine the adequacy of the cable

installations by showing any irregularities, such as discontinuities, micro-bending or improper splices for the cable span under test. The OTDR test shall be measured in both directions. A reference length of fiber, 1000 feet minimum, used as the delay line shall be placed before the new end connector and after the far end patch panel connectors for inspection of connector signature. Conduct OTDR test and provide calculation or interpretation of results in accordance with TIA/EIA-526-7 for single-mode fiber. The attenuation test shall be End-to-end measurements on all fibers, in both directions, using a 850 & 1300 for 62.5 multi-mode fiber and 1310 & 1550 for single mode nanometer light source at one end and the optical power meter on the other end to verify that the cable system attenuation requirements are met in accordance with (TIA/EIA-526-7 for single-mode) fiber optic cables. Cable Test Reports are to be provided to MCIWEST G-6 within 10 business days of testing. Provide Copper and Fiber Optic Cable Test Reports to MCIWEST G6 in PDF format (See APPENDIX K).

3.9 GROUNDING AND BONDING

Designer should verify the existence of grounding facilities. It is essential that all grounding facilities, new and existing, conform to ANSI-J-STD-607. The ANSI-J-STD-607-A provides telecommunications grounding practices and acceptable electrical characteristics. The following are MCIWEST G-6 preferred practices regarding Telecommunication Grounding utilizing a single-point ground system.

3.9.1 TELECOMMUNICATIONS MAIN GROUNDING BAR (TMGB)

The TMGB is the hub of the basic telecommunications grounding and bonding system providing a common point of connection for ground from outside cable to the building and equipment. Establish a TMGB where the OSP cables enter the building at 19 inches above Finish Floor (AFF) as close as possible to OSP entrance terminal. All pathways, equipment racks, and metallic components shall be connected to the TMGB (See APPENDIX L).

3.9.1.1 TELECOMMUNICATION GROUNDING PRACTICE

The Telecommunications Main Ground Bus-bar (TMGB) in a Telecommunication Room (TR) shall be connected directly to the facility's telecommunication ground ring using a single point ground cable. The ground cable is secured to the TMGB using a two hole, double crimped lug. The cable is secured to the ground ring using an exothermic weld. An inspection well at the point of the weld is required for quality assurance and periodic testing of the telecommunication grounding system.

Whenever practical, a Telecommunications Ground Bus-bar (TGB) located inside another TR in the same facility shall be either exothermically welded directly to the Telecommunication Ground Ring or routed directly back to the TMGB (whichever is closer) and connected using a single point ground cable. Do not connect the Telecommunication ground only to the facility's power panel ground or a metallic structural support.

Single Point Grounding - Class II Equipment grounding practices inside a Telecom Room (TR), Entrance Facility (EF), and Area Distribution Node (ADN) shall use single-point ground connected directly to the room's Telecommunications Ground Bus-bar (TGB). When practical, use the shortest distance between the equipment and the TGB.

For example: metallic cable tray sections shall be linked together using 6 AWG cabling terminated with dual-hole, double-crimp lugs. The tray's bare metal shall be exposed at the lug to ensure solid continuity between sections. A cable tray's endpoint closest to the TGB shall be connected to the TGB. Each equipment rack (stand alone or in a row) shall have a ground cable that can be connected to a single cable that ties directly to the TGB. 10 AWG cables with single lugs can be used to connect each PET and LEN block to the

Main Distribution Frame (MDF) chassis, whose ground cable ties directly to the TGB. All single point grounds shall connect to the TMGB or TGB. Do not connect the telecommunication ground to the Class 3 Telecom equipment power ground.

3.9.1.1 LABELING

Grounding and bonding labeling standard predominantly based on the methodologies outlined in ANSI-J-STD-607-A-2002.

PART 4 DAMAGE OF TELECOMMUNICATION INFRASTRUCTURE

4.1 CONTRACTOR DAMAGE

In the event of damage to a telecommunication pathway or cabling the contractor must **IMMEDIATELY contact the MCIWEST G-6 Help Desk at (760) 763-0173**. Restoration of services must be completed within **24 HOUR** of outage origination. Promptly repair indicated telecommunication pathways and infrastructure damaged during site preparation or construction. Damages to telecommunication pathways or infrastructure that was not indicated by as-built provided or not identified by third party locating services, which are caused by contractor operations, shall be treated as Changes under the terms of the Contract Clauses. When Contractor is advised in writing of the location of a non-indicated line or system, such notice shall provide that portion of the line or system with "indicated" status in determining liability for damages. **All repairs MUST be approved by the MCIWEST G-6**. Compounds or tape are not acceptable substitutes for heat shrinkable end caps and will not be approved.

PART 5 ACCESSES TO CONTROLLED SPACES

5.1 REFERENCES

DISA CCRI	Command Cyber Readiness Inspection Regulations
MCO 5530.14A	Marine Corps Physical Security Program
SECNAV M-5510.36	Physical Security Program
CVS HSPD-12	Homeland Security Protection Directive (Vetting of all DoD, Federal, Active and Contractors)
HSDP-7	Critical Infrastructure Protection Program

5.2 REQUESTING ACCESS TO A CONTROL MCIWEST G-6 SPACE

All contractors requiring access to Restricted Area (LEVEL II) or Secure Spaces must follow and be familiar with HSPD-12 regulations and Industrial Security Program DD-254 Regulations for access to secure spaces Ref: SECNAVISNT M-5530.36. Those contractors that meet these regulations may obtain a DOD CAC card under the CVS Program; this will eliminate the G-6 having to escort those contractors that require access to controlled spaces. Once a contractor is properly vetted he/she will receive a proper credential and receive a security brief prior to given access to MCIWEST G-6 controlled spaces. That DOD CAC also allows him/her to obtain a base DECAL for the duration of the contract. Not all contractors require a DOD CAC. There can be a few that can escort the remaining contractors that require access to controlled spaces, those security measures will be covered during the security brief. Access will be coordinated through the MCIWEST G-6 Information Technology Security Manager (ITSM) (760) 763-1975 or the Customer Service Desk (760) 763-0173.

Any questions pertaining to this document please contact MCIWEST G-6 Infrastructure Planning (760) 763-5263.

APPENDIX A OPTICAL GLASS CHARACTERISTICS

Provide Single-Mode Fiber Optic cabling meeting the following minimum optical glass and cladding characteristics:

Be ITU-T G.652.D compliant and fully backward compatible with legacy standard single-mode fibers with Optical Specifications having Maximum Attenuation for Wavelength 1310 (nm) maximum value of 0.03 to 0.35 (dB/Km), 1383+/- 3 (nm) maximum value of 0.31 to 0.35 (dB/Km), 1490 (nm) maximum value of 0.21 to 0.24 (dB/Km), 1550 (nm) maximum value of 0.19 to 0.20 (dB/Km), and 1625 (nm) maximum value of 0.20 to 0.23 (dB/Km). The Cable Cutoff Wavelength shall be 1310 (nm) 9.2 +/- 0.4 (um) and 1550 (nm) 104 +/- 0.5 (um). The Attenuation versus Wavelength ratios shall be 1285 to 1330 (nm) Reference Lambda 1310 (nm) with Maximum Alpha Difference of 0.03 (dB/Km) and 1528 to 1575 (nm) Reference Lambda 1550 (nm) with Maximum Alpha Difference of 0.02 (dB/Km).

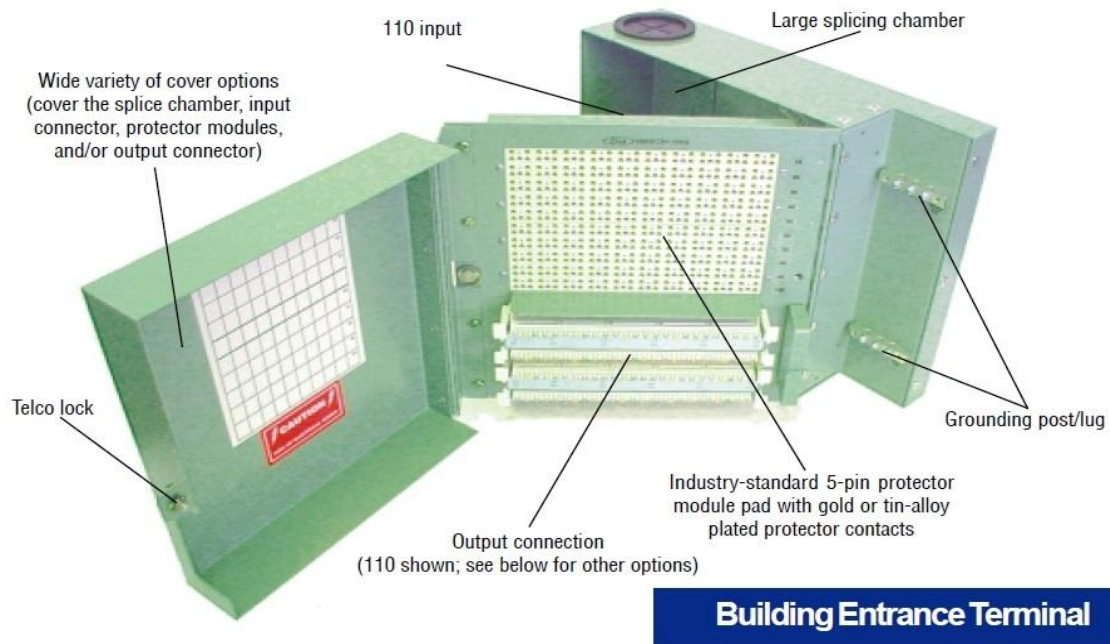
The Dispersion Value/s for the product shall be 1550 (nm) less than or equal to 18.0 (ps/nm per Km) and Communication Information Systems Ops Complex WO 1113900 1625 (nm) less than or equal to 22.0 (ps/nm per Km). The products Macrobend Loss shall be rated 32 mm Mandrel Diameter with one (1) turn at 1550 (nm), 50 mm Mandrel Diameter with one hundred (100) turns at 1310 (nm), 50 mm Mandrel Diameter with one hundred (100) turns at 1550 (nm), 60 mm Mandrel Diameter with one hundred (100) turns at 1625 (nm) all having an induced Attenuation of less than or equal to 0.03 (dB). The Polarization Mode Dispersion (PMD) values shall be equal to or less than 0.06 (ps/square root of Km) per IEC 60794-3:2001, section 5 for the PMD Link Design Value and equal to or less than 0.1 (ps/ square root of Km) for the Maximum Individual Fiber PMD.

The product's Point Discontinuity shall be less than or equal to 0.05 (dB) for 1310 (nm) and 1550 (nm). Dimensional Specifications for The Glass Geometry of the product are greater than or equal to 4.0 m radius of curvature for the Fiber Curl, a Cladding Diameter of 125.0 +/- 0.7 um, a Core Cladding Concentricity of less than or equal to 0.5 um and a Cladding Non-Circularity of less than or equal to 0.7 percent. The Glass Geometry shall be 242 +/- 5 (um) for the coating diameter and a Coating - Cladding Concentricity of less than 12 (um).

APPENDIX B AREA DISTRIBUTION NODE (ADN) RELAY FRAME



APPENDIX C BUILDING ENTRANCE TERMINAL/LABELING



APPENDIX D OPTICAL FIBER RACK INTERCONNECT CABINET (RIC)



APPENDIX E PIGTAILED SPLICE CASSETTE

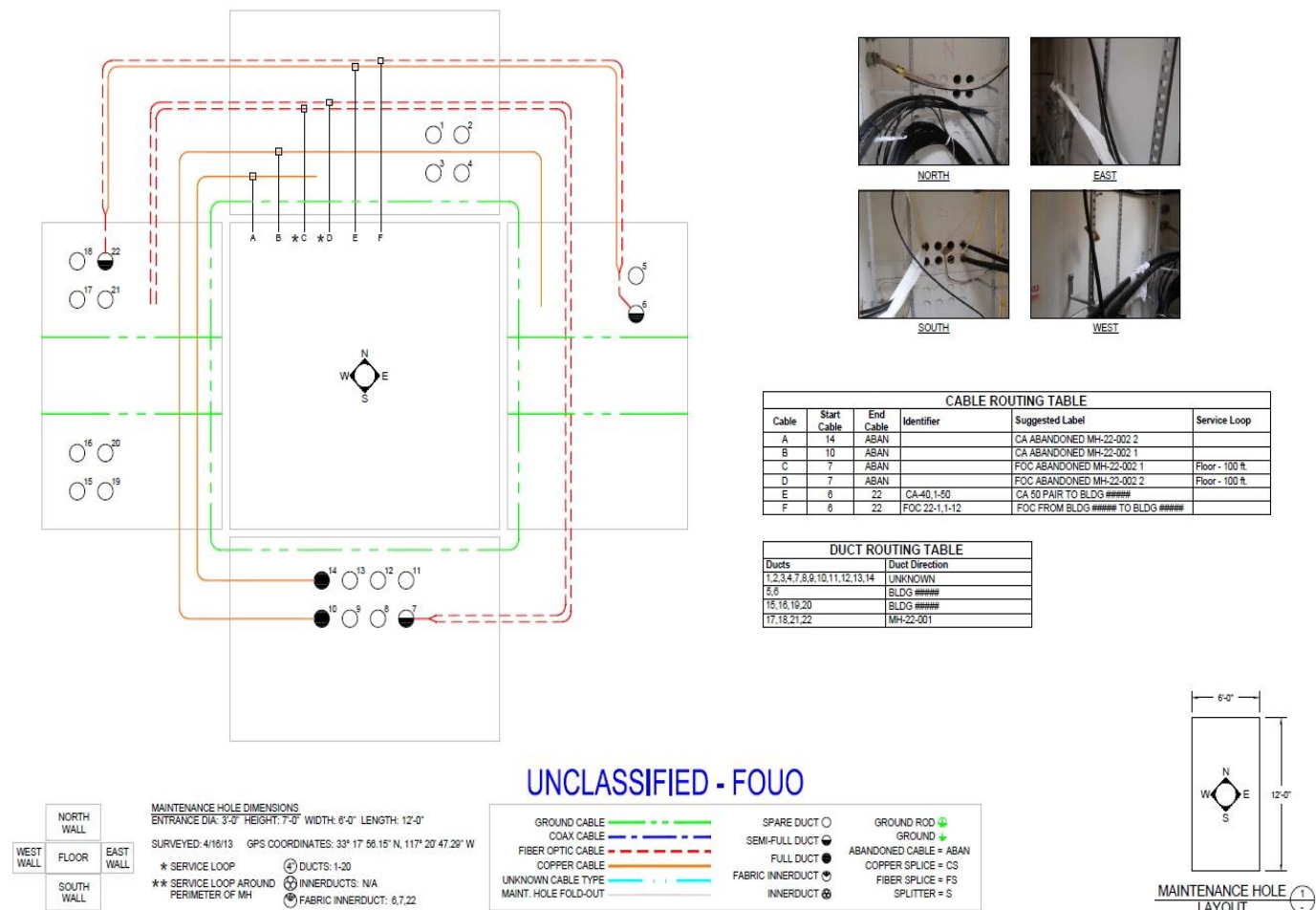


APPENDIX F RIC W/PIGTAILED SPLICE CASSETTES (REAR VIEW)



APPENDIX G MAINTENANCE/HAND-HOLE BUTTERFLY FORMAT

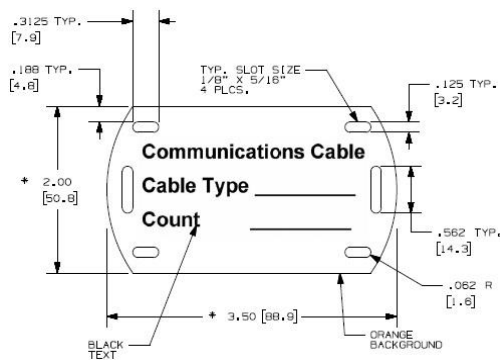
UNCLASSIFIED - FOUO



APPENDIX H FIBER OPTIC ENCLOSURE/LABELING



APPENDIX I COPPER CABLING LABEL



APPENDIX J FIBER OPTIC CABLE LABEL



APPENDIX K TEST REPORT EXAMPLES

Figure 1 Sample Fiber Optic Cable PM Test Report – 1

Cable ID	Summary	Test Limit	Length	Headroom	Date / Time
TR1134-2 3A3-SM-01	PASS	TIA-568-C Singlemode ISP	419 ft	1.30 dB (Loss Margin)	06/07/2013 03:25 PM
TR1134-2 3A3-SM-02	PASS	TIA-568-C Singlemode ISP	419 ft	1.00 dB (Loss Margin)	06/07/2013 03:25 PM
TR1134-2 3A3-SM-03	PASS	TIA-568-C Singlemode ISP	419 ft	1.00 dB (Loss Margin)	06/07/2013 03:26 PM
TR1134-2 3A3-SM-04	PASS	TIA-568-C Singlemode ISP	419 ft	1.07 dB (Loss Margin)	06/07/2013 03:26 PM
TR1134-2 3A3-SM-05	PASS	TIA-568-C Singlemode ISP	419 ft	1.10 dB (Loss Margin)	06/07/2013 03:27 PM
TR1134-2 3A3-SM-06	PASS	TIA-568-C Singlemode ISP	419 ft	0.73 dB (Loss Margin)	06/07/2013 03:27 PM
TR1134-2 3A3-SM-07	PASS	TIA-568-C Singlemode ISP	419 ft	0.91 dB (Loss Margin)	06/07/2013 03:28 PM
TR1134-2 3A3-SM-08	PASS	TIA-568-C Singlemode ISP	419 ft	1.12 dB (Loss Margin)	06/07/2013 03:28 PM
TR1134-2 3A3-SM-09	PASS	TIA-568-C Singlemode ISP	419 ft	1.26 dB (Loss Margin)	06/07/2013 03:28 PM
TR1134-2 3A3-SM-10	PASS	TIA-568-C Singlemode ISP	419 ft	1.24 dB (Loss Margin)	06/07/2013 03:28 PM
TR1134-2 3A3-SM-11	PASS	TIA-568-C Singlemode ISP	419 ft	0.17 dB (Loss Margin)	06/08/2013 07:18 AM
TR1134-2 3A3-SM-12	PASS	TIA-568-C Singlemode ISP	419 ft	0.56 dB (Loss Margin)	06/08/2013 07:18 AM

Figure 2 Sample Fiber Optic Cable PM Test Report – 2

Total Length:	20110 ft
Number of Reports:	48
Number of Passing Reports:	48
Number of Failing Reports:	0
Number of Warning Reports:	0
Documentation Only:	0

Figure 3 Sample Fiber Optic Cable PM Test Report – 3

Cable ID: TR1134-2 3A3-SM-01

Date / Time: 06/07/2013 03:25:15 PM

Cable Type: OS2 Singlemode

Test Summary: PASS

n = 1.4660 (1310 nm)

n = 1.4670 (1550 nm)

Loss (R->M)

PASS

Date / Time: 06/07/2013 03:25:15 PM

Test Limit: TIA-568-C Singlemode ISP

Limits Version: 1.9300

Operator: AARON T.

DTX-1800 (9065019 v2.7400)

Module: DTX-SFM2(1048016)

Calibration Date: 01/04/2013

DTX-1800R (9065020 v2.7400)

Module: DTX-SFM2(1048027)

Calibration Date: 01/04/2013

Propagation Delay (ns)	624	
Length ft	419	PASS
Limit 16404		
	1310 nm	1550 nm
Result	PASS	PASS
Loss (dB)	0.23	0.00
Limit (dB)	1.63	1.63
Margin (dB)	1.40	1.63
Reference (dBm)	-6.41	-6.57

Number of Adapters: 2

Number of Splices: 0

Patch Type: OS2 Singlemode

Patch Length1 (ft): 3

Patch Length2 (ft): 3

Reference Date: 06/07/2013 07:04:44 AM

1 Jumper

Loss (M->R)

PASS

	1310 nm	1550 nm
Result	PASS	PASS
Loss (dB)	0.33	0.14
Limit (dB)	1.63	1.63
Margin (dB)	1.30	1.49
Reference (dBm)	-7.01	-6.93

Compliant Network Standards:

100GBASE-LX

10GBASE-E

10GBASE-LX4

Fibre Channel 100-SM-LC-L

Fibre Channel 400-SM-LC-L

100GBASE-ER4

10GBASE-L

40GBASE-FR

Fibre Channel 1200-SM-LC-L

General Fiber Optic

100GBASE-LR4

10GBASE-LRM

40GBASE-LR4

Fibre Channel 200-SM-LC-L

APPENDIX L TELECOMMUNICATION MAIN GROUNDING BUSBAR (TMGB)

