JOINT BASE ELMENDORF RICHARDSON (JBER) TELECOMMUNICATION INSTALLATION STANDARDS

Supersedes JBER Telecommunications Installation Standards 10FEB2015 supplied by 673CS and all other preceding 673CS and 3CS versions:
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Chapter 1

General Information

1.1 Telecommunications installations will be driven by the most current industry and Air Force standards, as applicable to a given project. The list of installation guidelines and standards referenced during the design and installation process will include, but is not limited to the most current version of the following:

JBER Telecommunications Installation Standards
ASTM B 1
ASTM B 8
ASTN D 709
TIA/EIA-455-107A
TIA/EIA-455-204
TIA/EIA-455-46A
TIA/EIA-455-59A
TIA/EIA-455-61A
TIA/EIA-455-B
TIA/EIA-526-14A
TIA/EIA-526-7
TIA/EIA-568-C
TIA/EIA-569-A
TIA/EIA-590-A
TIA/EIA-606-A
TIA/EIA-758
TIA J-STD-607-A
IEEE C2
IEEE Std 100
ICEA S-87-640
ICEA S-98-688
ICEA S-99-689
NFPA 70 (National Electric Code)
RUS 1755
RUS Bul 1751F-815
RUS Bul 1753F-201
RUS Bul 1753F-401
RUS Bul 345-65
RUS Bul 345-72
UL 510
UL 83
AFI 33-201, V8
AFCESA ETL 02-12
AFCESA ETL 07-1
AF T.O. 31W3-10-22
AF T.O. 31-10-25
AF Base Area Network Functional Specification - 2013

1.1.1. As a general rule, the JBER Telecommunications Installation Standards will be used as the primary design and installation guideline for the unclassified (Niprnet, Voice, etc.) cable plant material and installation efforts. Although some information is included in this document as general reference information regarding various classified communication systems, it is listed here for convenience and general awareness only. There are specific standards that apply to these specialized, classified systems that shall be referenced as part of their design and installation process to ensure that those systems are fully functional and can be accredited as an operational system by the appropriate certifying agencies. In case of a discrepancy between various standards and guidelines, the most beneficial to the system being installed shall apply (greatest separation from electrical noise sources, largest bend radius, lowest pulling tension, largest communications room size, largest expansion capability, highest drop count in an area, etc) to afford the greatest protection and security to the cable installation and improved life cycle capability of the installed infrastructure. Any specific exceptions must be agreed to by the 673rd Communication Squadron Plans Shop (673CS/SCXP), in writing, on a case by case basis. To be considered as part of the deliverables for any project will be a complete equipment labeling effort and as-built documentation package relevant to the communications systems (take into account specific guidelines shared throughout this installation standards document). This will include such items as, but is not limited to, labeling of cables in duct systems, labeling of cable termination points, drawings showing as-built floor plans and rack elevations, and in general, the labeling and documentation of any work done to support the efficient maintenance and usage of the newly renovated or newly installed communications material, such as equipment racks, cables, cable routing diagrams, communications relevant floor plans, cable count break outs for splice plans, geobase survey information for outside cable plant work, etc. All labeling schemes will be routed through 673CS Project Managers for written approval, prior to implementation. The labeling scheme submitted for approval will include a floor plan showing the locations of each relevant label (i.e., the location of a comm. equipment room with room number, the location of each faceplate with its discrete label, comm. room layouts with equipment/rack labels shown per each equipment location, etc.). The labeling scheme and associated documents will be delivered for review no later than the 95% design review timeframe.

1.1.2. Information provided by 673CS will generally be provided in an Adobe Acrobat (PDF) format. Any editable drawings provided by 673CS will be in Bentley Microstation V8 (*.dgn format); editable documents will be provided in Microsoft Word or Excel format. As-built drawings provided by the contractor for telecommunications installations will be Bentley Microstation V8 format. Drawings returned from the contractor will be provided in a fully open, unlocked, exploded format with all associated reference drawings/layers so that all details contained within the drawing can be individually edited using Bentley Microstation by Air Force personnel at a later date. Any outside cable plant drawings (butterfly drawings, plant in place drawings, etc.) or site layout type drawings will be provided in an Adobe Acrobat (PDF) format.

1.1.3. The JBER Telecommunications Installation Standard is generally developed to apply to end user building installations and how to provide service to them. In the case of infrastructure/utility type projects, or where work is being performed in a communications distribution node location such as an Information Transfer Node (ITN), a Remote Switching Terminal (RST), or Dial Central Office (DCO), additional design elements will apply and more specialized standards and practices will be imposed to meet the specific requirements associated with the large scale distribution of communications services to a given geographic service area on the base. It is suggested that design efforts, especially pre-RFP (Request for Proposal) efforts for communication node locations involve additional interaction with the 673rd Communications Squadron Plans Shop to ensure that a full understanding of the requirement is developed prior to bidding the project.

1.1.4. As part of any project in which a contractor is installing government furnished material or government stored material, the contractor will take on full responsibility for the operational capability of said material once it is installed. Although not specifically required, it would be to the contractor's benefit to perform any appropriate acceptance tests (such as testing cable segments on the reel) to ensure the material is fully functional prior to installation of the material. If the installation does not pass final testing requirements, the contractor will be responsible for repairing/replacing the material and any installation practices necessary to create a fully functional installation. Any material being furnished by the contractor will be of new manufacture (less than six months old), in unused condition, and properly stored in an environment appropriate for the material (protected from UV radiation, extreme temperature swings, condensing moisture/standing water, etc.) unless specifically waivered, in writing, by 673CS/SCX Project Management. Any used/refurbished/old stock material proposed for use will be clearly identified as such as part of the proposal.

1.1.5. In cases where the project involves work with existing, operational cables (rerouting sections of cable through new paths, replacing/reinstalling distribution cables to facilities as part of renovation efforts, etc.), the installer/technician will test all the existing cable counts that are part of the project prior to any work taking place. The test results shall be submitted to the Government Point Of Contact (POC, defined specifically per each project) for analysis before the work proceeds. After the cable work is completed, the installer/technician shall retest all cable counts affected by the project and return the cable counts to at least the same operational capability and performance level that existed prior to the work taking place.

1.1.6. Any project involving the demolition of existing facilities and communications support infrastructure will require that all telecommunications cable plant (copper, fiber optic, coaxial, etc.) be demolished back to the nearest service delivery point, such as a splice case in a manhole. At this location , the distribution cable count (copper pairs, fiber strands, etc.) will be spliced back into the main trunk cable so that the pair count is once again available the full length of the backbone trunk cable. In cases where the distribution count is coming off the end of a backbone cable count, the count will be recovered and prepared for future use, such as terminating with a pluggable, modular type splice for copper counts, or dressing out fiber strands in preparation for fusion splicing, then managing and sealing the counts in an approved splice case assembly.

1.1.7. The organization performing the installation work (contractor, E&I team, etc.) is responsible for preparing the location(s) for any intermediate or final inspection/acceptance testing events. This will include, but is not limited to things like opening manhole lids, providing access ladders where needed, providing temporary lighting where needed, providing any tools necessary to open splice cases or other containers, providing any specialty protective equipment (protective slip on booties, etc.), meeting ventilation requirements, etc.

1.1.8. All labeling (cable ID tags, faceplates, patch panels, etc.) will use a standard, easily readable font such as Arial or Times New Roman in the production of the tags/tapes. Fonts that take on the appearance of a cursive script with varying line widths and/or curving lines in what would generally be a straight line segment of an alphanumeric character will not be accepted. Labeling of backbone OSP or Riser type cable segments will require labels where the cables enter/exit the main container (manhole, handhole, comm room, etc.) where they enter the termination point for that cable segment (protected entry terminal, splice cases, patch panel housings, etc.) and on each service loop. Labels will be oriented so they can be read from a practical distance and direction related to the container (standing a few feet in front of a telecommunications backboard, looking through a manhole cover, etc.) they are in and without having to uncover them from overlying cables. When new cables are installed near pre-existing cables, they will be installed in a manner that does not obscure existing labels. Label fonts will be large enough to be easily read from at least five feet away.

1.1.9. Unless specifically noted otherwise in the Scope Of Work, Performance Work Statement, or other similar document associated with a cable installation project making use of existing manhole/duct system, it is expected that the cable installation effort will be responsible for dealing with any environmental issues associated with installing the cable. This includes, but is not limited to, items such as pumping standing water out of manholes, cleaning dirty duct/innerduct, thawing frozen ducts, installing missing pull ropes, or ventilating confined entry workspaces. If it is discovered and demonstrated there is an actual catastrophic duct system failure, such as a crushed or broken duct, the base will be responsible for returning that path to serviceability. Evidence of such duct failure will take into account seasonal conditions such as below grade frost line or frozen water in servicing manhole/handhole locations, hitting an apparent obstruction at approximately the same location when duct rodding from both ends of the duct segment, ability to duct rod an adjacent duct/innerduct, or ability to move a pull rope in an adjacent duct/innerduct. If the project requires duct rodding a duct with an existing, active cable, coordination for this effort prior to the work being accomplished will be required with the 673CS Project Manager. When doing any work to proof or prepare a duct system for the cable installation, only tools specifically designed for this work will be used, such as duct rods of a minimum ½” diameter that are long enough to actually reach from one duct access point to the next access point. When installing new pull strings or pull ropes in an empty duct, the acceptable methods are to either push a duct rod through the duct, then retrieve the pull rope by properly attaching to the end of the duct rod and pulling the duct rod back, or by using a pressurized air fishing system with the proper attachments, such as a Greenlee 591 power fishing system, or equivalent. No homemade or improvised tools will be allowed unless first approved, in writing, by 673CS/SCXP Project Management. When the project calls out for removing an existing cable and replacing with a new cable, often referred to as using the old cable as a pull rope, it is acceptable to use the old cable to pull in an appropriately rated pull rope behind it as it is being removed. The new pull rope will then be used to pull in the new cable sheath.

1.1.10.

In the case of projects that are of a “turn-key” type nature in which virtually all material and labor necessary to create a fully functional communications infrastructure is to be provided by the installing entity, the project will include a cooperative engineering and project management effort with 673CS/SCXP project management section, in addition to the basic acquisition and installation of the material. This effort will provide, but is not limited to, items like an installation plan and time table for work at each location or phase of the project, as well as some specific location documentation such as rack elevation drawings or telecommunications backboard layouts showing the placement of new equipment, site plans showing proposed manhole/duct systems, etc. for approval prior to work proceeding. In addition, a proposed bill of materials will be provided for approval, prior to the acquisition of material for the project. The purpose of this approval is only for approving the type/quality of the material being proposed, not to validate quantities needed for the project.

Chapter 2

Outside Plant

2.1 Manhole duct systems

2.1.1. Manholes (MH): Manholes must be installed for all connections to the existing cable plant as required to maintain a maximum manhole spacing of 500 feet. Additional manholes may be required to provide adequate control of connection and distribution of the cable plant or to support significant direction changes in the duct path. All manholes shall be designed and constructed to meet the requirements of **T.O. 31-W-3-10-22**, and provide a clear floor spacing of 8' X 10' measured inside the manhole. An alternate size of 6' X 8' may be approved only when no primary backbone cable passes through the manhole (lateral or dead end service only). All manholes are required to provide a clear internal height of no less than 7'-0". Mandatory appurtenances include connected grounding bus bar and ground rod, related conductors and wiring, integral entry ladder or steps, cable rack supports (vertical brackets on walls, to be mounted using standoffs that will allow for approximately four inches of space between the wall and the bracket, capable of supporting the fully projected load of cables and splice cases, and step arms to support cables/splice cases. Any deviation from this will be considered on a case by case basis, such as smaller handhole installations), a 50 cubic foot sump (French Drain), pull in irons, frame, and a manhole cover cast with "Telephone" or "Signal" or "Communications" exposed to the surface. Generally the French Drain location in the manhole floor should be constructed as a "knockout" assembly in which all the grating and sump locations are cast into the floor while the bottom of the sump is still sealed with a layer of concrete that can be knocked out to allow for direct drainage into a properly prepared bedding layer under the manhole (gravel layer, etc). In cases where the water table is too high for drainage to be effective, the sealing layer can be left intact so that ground water does not readily infiltrate into the manhole. The cover shall be 36 inches in diameter. The cover will have at least one extendable ring or handle that stores in a recess, or some type of hole through the lid or full width/depth notch in the edge of the lid that allows for lifting of the lid with a standard manhole cover hook and a lip around the bottom of the lid that allows for dragging of the lid by use of a standard manhole cover hook. Conduits shall enter the manholes approximately four feet above the floor (with the overall buried depth of the duct system below grade being the primary determining factor as to entry height) and shall enter the manhole perpendicular to the wall. Conduit entries should be nearer the sidewall versus entering the middle of the end wall. This facilitates the flow of cable directly to the racking system instead of having to bend cabling sideways to the racking. See standardized drawing as an example of an acceptable manhole design and layout.

2.1.2. Handholes (HH): When specified as part of a project as an alternative to full size manholes, handholes are required to be nominally 4' X 4' X 4' inner dimensions and are provided with a grounding system, cable rack supports on each wall, sump drain, pulling irons, and handhole cover with identifying markings. The cover for this type of handhole will be a 36" round lid, similar to a manhole cover specified in 2.1.1. Basic design, construction and cable/conduit routing related to the hand hole must be the same as a manhole except on a smaller scale. Any questions should be directed to the 673 CS Project Manager. See standardized drawing as an example of an acceptable handhole design and layout.

2.1.3. Manholes/handholes shall be constructed from a pre-cast waterproof concrete and be equipped with a removable cover. If manholes/handholes are constructed in a manner that requires assembly of sections on site, assembly will require the use of an approved sealant for each joint location (joint seams in walls/lids, neck riser ring seams, etc.) such as Rub'R Nek LTM RU106, Ram-Nek RN103, or equivalent. Manhole/handholes will be constructed to meet vehicular traffic load ratings as found on JBER Alaska, even if the initial installation will not be in a traffic prone area. Manhole/hand hole size and type is required to be specified as part of any design effort for review and approval by 673rd Communications Squadron Project Manager.

> **2.1.3.1** Occasionally long remote fiber optic cable runs will require periodic pull boxes along the run to facilitate service, repair, and access to the fiber optic cable. In these locations, it may be acceptable to use a lighter duty modular type pull box such as those produced by Hubbel (Quasite) or PenCell in a size that is appropriate to properly managing a service loop in the cable as well as a Preformed Fiberlign splice case. These locations will be addressed on a case by case basis and require written approval by 673rd Communications Squadron project manager.

2.1.4. A 3/4-inch X 10 foot copper clad steel grounding rod is required to be installed through the floor of each manhole/handhole provided. Four inches of the rod shall extend above the finished floor level. The rod must not enter the manhole more than 3 inches nor less than 2 inches out from the vertical surface of the adjacent wall. The installed ground is required to have impedance of 25 ohms or less. Single piece pre-cast manholes may require the grounding rod to enter through the duct window. Multiple piece manhole assemblies may need to have the ground rod installed through the floor, before the top section is placed. Cable bonding needs to be provided by the installing contractor in accordance with (IAW) **T.O. 31W3-10-22**.

2.1.5. Once installation of the manhole/handhole is completed, all penetrations will be sealed (ground rod penetrations, duct entry points through walls, ducts themselves, etc.) to prevent infiltration of ground water into the container. Each penetration type will be sealed with a method appropriate to the long term operation of the manhole/handhole container, ie. grout around conduit penetrations, removable plugs or expanding foam sealant in the mouth of empty ducts, expanding foam sealant in the ends of occupied duct or innerduct, etc. The expanding foam sealant will be of a type that sets up firm, does not remain sticky, and can be readily cut out as access is needed in the future. In addition, the MH/HH identification number will be stencil painted inside the neck of the container, just below the removable cover with characters that are at least four inches tall.

2.2 Conduits and Duct Banks

2.2.1. Cable Locate Tracing Wire: Where a non-metallic conduit material is used for buried duct, such as PVC or HDPE, a conductive tracer wire is required to be installed. In the cases of well grouped duct bank systems, such as four ducts in a tight 2x2 configuration, the conductive tracer wire will be installed on the exterior of the duct, approximately centered on the top of the duct bank. In cases where the ducts are spread out over a width greater than four ft., then a tracer wire will be installed on the exterior on each of the extreme outer ducts to enable locators to determine the width of the duct bank corridor. This wire will be an insulated 10AWG copper wire or larger. It will be looped around the duct every 20 feet, and securely taped to the duct every 10 feet. The wire will be extended into the manhole, and routed up the wall and across the ceiling to the manhole neck, so that it is accessible just by opening the manhole lid. In the case of multiple locate wires coming into the man hole, all wires will terminate in the same location in the neck of the manhole. The wires will all be connected together with a common electrical wire nut type connection, and each wire will be labeled as to the direction it leaves the manhole, and if possible, the manhole or building that it is heading toward to allow easy identification and attachment of a tone generator to assist in future cable path location efforts. The tracer wire will be tested for continuity and functionality with a locater before acceptance. The contractor shall be responsible for all bonding to occur inside each manhole and at CER grounding frame. The tracer wire requirement applies both to structured manhole/duct systems (it is sufficient to mark a single duct run in the center of an overall bank of ducts) and to direct bury type innerduct. In cases where the innerduct is plowed in (versus being trenched in) an appropriate manner of installing the tracer wire with the duct will be determined, since taping and wrapping may not be feasible with that installation method. Any deviations from taping and wrapping will require 673rd Communications Squadron Project Manager written approval. In addition to the tracer wires and other locating methods, each duct run, manhole location, direct bury innerduct run, direct bury cable run, direct bury cable splice location, or any other significant feature related to the buried cable plant will be surveyed using a GPS/GeoBase compatible survey device, such as a Trimble Geo XH unit to collect path and feature location information. The data will be provided in a format that is compatible with the ARCGis geobase database system being used by JBER and managed by the 673/773 CES Geobase Office (POC: Shane Metcalf, 907-384-2336). This surveying will be done prior to backfilling so the actual locations can be precisely surveyed.

2.2.2. Conduit Routing/Warning tape: When a conduit/duct run cannot be run in a straight line and still enter a manhole or building perpendicular to the wall, conduits must be curved to provide gentle sweeps with a minimum radius of 25 feet to accomplish any necessary direction changes. The exterior conduit routing path will be such that short sweeps (60" type sweep) are not used to make the conduit entry point perpendicular to the wall at the very end of the run. Total amount of bends in a duct run segment will not exceed 90 degrees between manholes/buildings (to include any sweeps inside a building footprint, such as when a conduit arrives below grade and does not terminate directly into the CER, but must change direction to reach its ultimate destination in the CER). In the case were the conduit enters the comm room through the floor, the final vertical sweep up into room will be a minimum 48" radius sweep for a 4" ID conduit. Any sweeps within the building for a conduit system to support the extension of outside plant through the building will also use be a minimum of 48" radius for 4" ID conduit. All conduits are required to be sloped downward from the center of the run toward each opposing manhole at a slope of 3 inches per 100 foot of run to promote drainage of any accumulated liquids. In the case of the last segment between the building entry point and the servicing manhole, it is acceptable to maintain a continuous slope from the building down to the manhole at a grade of 3 inches per 100 feet to help prevent fluid draining into the building (still taking into account minimum bury depths for the whole length). Length of runs between building entry points and manholes, or between two manholes will not exceed 500 feet cable path distance. In instances where sharp turns in the duct path must be made, a manhole shall be installed at the corner, to facilitate safely redirecting the cable. All conduits or cables shall be buried at a minimum depth of one meter (40 inches) from top of conduit or cable to finish grade. The minimum conduit size will be 105 mm (4 inch) internal diameter, but may be larger, as needed, to meet specific requirements. Buried Cable warning tape shall be three inches wide, orange in color, and be used for direct buried cable applications, as well as conduit and direct bury innerduct installations, to mark cable pathways. Warning tape shall be installed 315 mm (12 inches) above the cable, conduit, or protective enclosure (sleeve, concrete encasement, etc.), whichever is highest. The tape will be marked with “Buried Communication Lines” or other approved marking to indicate that it applies to a communication line run, as opposed to some other type utility. In addition to these measures, all cables shall be fitted with permanent and corrosion resistant tags for identification purposes. Cable identification names will be coordinated with 673CS Project Management prior to installation of the identification tags.

2.2.3. All communications cables shall be installed in accordance with the guidelines indicated in **T.O. 31-W-3-10-12**. A copy of applicable section of this T.O. will be provided upon request of the contractor.

2.2.4. Conduit Bedding/layout: Generally conduit will be sand bedded between manholes with all appropriate bracing and installation practices being followed. In the case of the conduit path passing under a high load or high traffic area, such as under a road bed, parking lot, or aircraft taxiway or runway, the installation should be planned with some form of additional protection for the conduit, such as an overall steel sleeve or concrete encasing where it passes through the higher risk areas. In cases where more that two duct are being run, steps will be taken to ensure the conduits within the duct bank are grouped to minimize the horizontal spread across the duct bank, to ensure accurate locates may be accomplished at a later date. It may also be appropriate to run the conduit at a deeper level through these areas to help minimize loading on the conduit system. Conduit runs shall be sized to account for all project cable requirements related to the project (or overall development of the area, whichever is greater), plus a minimum of one spare conduit. The conduit banks between manholes will be installed based on an even number of conduits, laid out in a grid pattern for entry into the manhole, such as two ducts wide by two duct tall pattern if four ducts are being installed between manholes. In a case like this, if two ducts were needed to support the actual requirements, the additional duct required for a spare would bring the minimum count up to three. Since the ducts will be installed in even numbers in a grid pattern, the actual installation required would be for four ducts in a 2 x 2 pattern. Any deviation from this approach will require written approval from the 673CS Project Manager.

2.3 Innerduct Installation

2.3.1. Innerduct installed:

- Corrugated or ribbed innerduct shall be installed in any duct used for fiber optic cable.
- Innerduct shall not have an inside diameter less than 1 inch.
- Innerduct segments within a duct will be continuous, one piece sections. Splices will not be allowed.
- Innerduct shall be sized for each fiber optic cable and have no less than ¼ inch air gap existing between the inside perimeter of the innerducts and the outside perimeter of the cable.
- Innerduct shall be capped, plugged, or sealed and left with a pull rope tail tied off within the container if unused.
- Innerduct through each manhole or cable vault shall be labeled and tagged with the data for the fiber optic cable installed or the word vacant for unused innerducts.
- Vacant innerduct must contain a waterproof and corrosion resistant pull-rope (0.25 inch nylon or Kevlar mule tape) for future cable installations.
- Contractor shall be required to install maximum number of innerduct possible when installing in a conduit raceway system. Ex: When running fiber through a 4” (i.d.) conduit in a backbone manhole/duct system, contractor would be required to install 4 pieces of one inch innerduct versus just the one required for the specific fiber optics cable. The final 4” (i.d.) duct segment being used to support a fiber optic cable from the last manhole into the building will

have three 1.25” innerducts installed. When installed, innerduct spares shall have nylon pull rope or Kevlar mule tape installed for future use/expansion. In some cases, dealing with older or smaller type duct banks that do not lend themselves to installation of standard innerduct, it may be acceptable to install a fabric type cable management duct liner, such as those produced by MaxCell. This will be determined on a case by case basis and require 673CS Project Manager written approval.

2.3.2. Exterior duct and communications cable system to support all valid requirements shall be installed from the facility’s communications equipment room(s) to the closest service connection point. This includes entry ducts, spares, conduits, and duct & manhole systems to the closest base service connection point. Provisions for crossing the roads and other paved areas are the responsibility of the contractor. When smaller diameter cables (such as a fiber optic cable) are being run through a larger duct (such as a four inch duct), the contractor shall use corrugated innerduct to first fill the larger duct (i.e. four 1” innerducts in a 4” duct). When smaller cables, such as a fiber optic cable or small count copper cable are being installed to an end user location without the benefit of a typical duct bank, a solid wall, toneable, direct bury, smooth outer/ribbed inner wall HDPE innerduct, with pressure rated couplings between segments will be installed between the service delivery point and the end user location to support the installation of the cable. The direct bury innerduct installation will include at least one spare buried innerduct and an external tracer wire will be buried along with the innerduct (as per 2.2.1). The innerduct will be pressure tested to insure the installation can support blowing fiber for the direct bury portions of the run. The direct bury innerduct will be a minimum size of 1.5 inch inner diameter. At any location where the duct run is not continuous between break out points (ie from building to manhole or between adjacent manholes), a buried marker ring such as a 3M p/n 1250 will be placed over the top of the duct ends, in addition to the associated tone locate wire being run to the end of the duct as well. This requirement applies to any place a duct or innerduct run ends underground, such as building stubouts, on both ends of a conduit placed under a roadway/rail bed, points where concrete encasement of buried duct ends, etc. This also includes both ends of a protective sleeve placed under a roadway or other structure that then has a direct bury cable or innerduct passing through it.

2.4. Exterior Entrance Cable System

The location and use of facility shall dictate whether the facility is connected via the copper plant or the fiber optic network, or both. The 673rd Communications Squadron (673CS) Project Manager (PM) shall specify what type and size of cable to use in connecting to the base communications plant, to meet the end user’s requirements. The installation or modification of any cable plant infrastructure needs to be viewed as an integrated system, made up of many components that have to work together to allow the infrastructure to perform as needed in a reliable manner that will meet all operational criteria and be efficient to maintain and repair as needed. This infrastructure must ultimately support many mission critical activities on base as well as being a component in supporting life safety operations, such as E911 capabilities. The design and specification of individual components needs to be looked at in the larger picture of how everything will integrate together as a working cable system, and not just be viewed as an individual component being purchased to operate in a discrete manner. Fiber optic cable infrastructure systems will consist of items such as, but not limited to, fiber optic cable, protective sleeve components, ducting, splice equipment/material, termination connectors, termination panels, labeling systems and any other discrete components needed to create an overall working fiber cable infrastructure system. Likewise, copper cable infrastructure systems would consist of individual components such as copper cable, splice equipment/material, protected termination panels, surge protection plugs, house cable, termination blocks, grounding wire and connectors, protective ducting, and any other discrete components needed to create an overall functioning copper cable infrastructure system. The intent here is to not analyze and subsequently accept or reject any individual component without considering how it functions as part of an overall system.

2.4.1. Physical Building Connectivity:

2.4.1.1. Building entrance: Building entrance of communication cables for a new building, or a major renovation of an existing building, will be supported via 105 mm (4 inch) internal diameter duct from the primary communications room, extended to a minimum of 5 feet outside the building foundation. The exact number of these conduits will be determined on a case by case basis, but the minimum number will allow for at least one spare duct, above and beyond the number projected for initial use (there will always be at least two ducts installed).   For buried duct that utilize a 90 degree sweep to enter up through the floor in a slab on grad type construction, a minimum of a 48” radius sweep will be used to facilitate the direction change from horizontal to vertical to enter through the floor. These ducts will be filled with cable and/or innerduct as specified for an individual project. Any vacant duct will be appropriately capped and sealed, with ¼ inch nylon pull rope or Kevlar mule tape left installed for future use. Typically the final duct segment from the building out to the first manhole would have one of the 105mm (i.d.) ducts filled with three – 1.5 inch corrugated innerducts.

2.4.1.2. Communications support path: Connection from a new building (or major renovation of an existing building) will be accomplished to the nearest service delivery point of the cable plant (copper and/or fiber as necessary). Typically to a manhole, but may be a direct bury splice point, or even back to the nearest telephone switch building or fiber distribution building, as necessary. This path will normally be supported by multiple 105mm (i.d.) duct between the building and service delivery point. On occasion it may be sufficient, or even more feasible to support the connection using multiple direct bury, HDPE, smoothwall, toneable innerduct (minimum nominal size of 1.5 inch). There will be a minimum of one unused innerduct planned into the installation design after all feeder cables are installed. This innerduct will enter the building via the 105 mm internal diameter entry ducts provided from the foundation entry point into the primary communications room. The entry duct will be filled with the maximum possible amount of innerduct, ie, a duct will not be left with only a single innerduct installed. The unused innerduct will be plugged and sealed, with a nylon pull rope or Kevlar mule tape left installed for future use. In some cases, it will be necessary to run the 105 mm (4 inch) internal diameter duct continuously from the building entrance to the nearest manhole. This will be determined on a case by case basis. In cases where the duct must be run to the nearest manhole, no individual segment of the run will exceed 500 ft. If the overall duct run will exceed 500 ft, then additional manholes must be planned into the run to break up the lengths of each segment to be less than 500 ft. In addition, no individual segment will contain more than 90 degrees worth of bends. If a segment would require more than 90 degrees of bends, then additional manholes or handholes must be planned into the system to keep from exceeding this criteria.

2.4.2. Site prep for future activity: In cases where it is clearly known that there will be additional development work accomplished in the near future (additional buildings as part of complex, multiple buildings as part of an overall installation plan spread out through multiple years, etc.), basic infrastructure support for the area will be sized according to the overall requirement, and accomplished as part of the initial phase of the project. An example of this would be installation of a manhole duct system sized to support several buildings, not just the initial building, or backbone cables sized to support the projected overall requirements, not just to meet the minimum initial building requirement.

2.4.3. Leaving conduit under roadways: Anytime significant grade work and road work is being performed as part of the construction effort, future use of the area shall be considered by leaving multiple capped and marked 4 inch I.D duct under potential driveway crossings or parking lot crossings. The duct location will be captured on as-built outside plant drawings as well as the installation location will be geo-surveyed along with any other outside plant work in a manner to provide data that is compatible with the ArcGis database in use by 673/773 CES Geobase office. The duct will be installed to basic buried telecom duct standards (toning wire, proper bedding, warning tape, etc.). The location of each end of these duct segments will be marked with a buried metallic marker ring, compatible with Dynatel locating equipment (such as a 3M 1250 ring). This will help prevent the need to cut up the paved surfaces at a later date to install new runs of cable through the area.

2.4.4. Running entrance conduit for alternate routing: Some buildings will be considered to be supporting critical missions. Once identified, these buildings will be required to have communications ducts run out multiple locations from the building. The exact location of these ducts will be determined on a case by case basis. This issue will be addressed as part of developing the operational requirements related to the project. This will require the organization developing the design criteria for the project to interact with 673CS Plans Office to determine the exact communications redundancy support required for the project.

2.5 Documentation of outside plant work: Any exterior work done with an associated project will be fully surveyed using approved GPS survey equipment and the information will be provided in a format compatible with the JBER GeoBase data base managed by the 673CES GeoBase Office. The surveying of the exterior work will take place prior to any backfilling (trenches, pits, etc.) to ensure the most accurate survey path of the buried infrastructure. The geospatial coordinates for each unique communication feature (manholes, duct paths, distribution pedestals, splice points, buried sleeve termination points, cable paths, building entry points, etc.) will be located to within one (1) foot of its true ground position, in the horizontal plane, with a 95% spatial accuracy confidence level as defined in FGDC-STD-007.3-1998, specified in PWS Appendix 5.6. Geospatial coordinates for the location of manholes and cable vaults shall be recorded for the center of the manhole lid. Geospatial coordinates for the location of hand holes, pull boxes, pedestals, and buried splices shall be recorded for the top center of the feature. Geospatial coordinate data for the location of utility lines shall be recorded at a minimum every 10 feet and each turn or bend in a cable installation pathway must also be recorded so that the coordinates for any point along the turn pathway will fall within the allowable accuracy. The Contractor shall use GPS equipment and technology supplemented with electronic underground cable locating equipment and land surveying operations necessary to collect required Communication Feature Location Data (CFLD) following the Federal Geographic Data Committee (FGDC)-STD-007.4-2002 specified in PWS Appendix 5.6. The Contractor shall be responsible for providing all required equipment including software, hardware, and any other tools, labor, and materials necessary to provide CFLD on electronic storage media in the specified formats. In addition, an electronic CAD type format as-built drawing set will be provided in a format compatible with Bentley Microstation Ver. 8 XM cad software. The drawing set will be provided in a format that can be edited using the Microstation software.

Chapter 3

Communications Equipment Room/Riser Closets/Cable Installation

3.1. The Communication Equipment Room (CER): The Main CER serves as the entrance facility for all communications services to the facility. Riser closets may be required to support backbone cable paths between CER locations. Satellite CERs serve to distribute those services throughout the facility. A CER may also serve as a riser closet. All facilities, regardless of size or intended use (with possible exception of guardhouses, utility control facilities, and storage bunkers) shall have a dedicated CER. Facilities with multiple floors or facilities in which communications outlets lay more than 90 meters in horizontal cable path length (not linear physical separation) from the closest CER shall have at least one satellite CER (SCER) per floor, and as many as necessary to keep the total cable length of the horizontal runs under 90 meters. Any room that actually supports the termination of any aspect of the cable plant, or houses any active electronic communications equipment will be considered a Communications Equipment Room (CER). A room will only be considered a riser closet if all the cables within the room are merely passing through the room and no cables are being terminated or spliced with in the room, as well as there being no active communications equipment housed within the room. These CER locations will be dedicated to the support of government, official communications systems and cabling. In general, all other disciplines and service providers (electrical, cable TV, etc.) will not be allowed in these rooms.

3.1.1. Location: The CER and riser closets must be located in the most central location available to keep the total maximum length of horizontal cabling under 90 meters. The main CER may be located in the basement or on the first floor in a location to provide the best service to the facility and riser closets. Riser closets on successive floors must be vertically stacked. In most cases it is desirable to have the riser closet function and satellite communications equipment room be the same room in a centrally located area of the building. Each floor with telecommunications requirements will have a CER (or satellite CER) to support requirements on that floor. The location of these CERs will be chosen with consideration for long term growth and maintenance, as well as the convenience and safety of the communications support personnel as they work on the equipment and move between the CER and end user locations. Depending on the floor layout and projected requirements, the satellite CER may take the form of an enclosed equipment cabinet located appropriately to support a specific zone. An adequate number of nominal 105mm (4-inch) diameter rigid steel conduits shall be installed between stacked riser closets to support user requirements and provide for 2 remaining spares. The CER shall never be co-located with electrical, mechanical, or HVAC facilities that have the potential to introduce electrical interference, moisture, gases, dust, or in any other way create an environment hazardous to the equipment being installed within the CER. In addition, every effort will be made to avoid having the CER and electrical service equipment (to include major circuit breaker distribution panels, transformers, electrical switch gear, etc) in adjacent rooms to prevent electromagnetic noise issues from impacting the communications equipment. In the rare case that a mechanical/utility room must be located adjacent to the CER, no electrical service equipment will be mounted on the shared wall and appropriate signage will be mounted on the wall in the mechanical/utility room to prevent the installation of this type of equipment at a later date. In no case will a CER or riser closet be used as a pass through path for any general utilities (plumbing, electrical, melt water, HVAC ducting, etc.). In addition, no utilities or other items will be installed within the floor or walls (water lines, electrical conduits, etc.) of the CER that may prevent the future installation of equipment and subsequent anchoring of the equipment to the floor or walls anywhere within the room (i.e. the installation of anchor studs, sleeves, etc. to bolt down equipment racks and other equipment to the floor, or screws into walls to support equipment cabinets, etc.). The only utilities that will have a presence within a CER or riser closet will be those necessary to support the requirements within the room itself (convenience outlets around the walls, light switches, etc.).

3.1.2. Size: The CER shall be approximately 1.1% of the total usable square footage of the facility. Riser closet size shall be approximately 1.1% of the floor space of the floor it serves. In no case shall the interior size of the main CER or riser closet be less than 10 feet by 10 feet (minimum dimension will be 10 ft and the maximum aspect ratio shall be 2:1 for room shape). These minimum dimensions will be adjusted to accommodate any structural anomalies (such as support columns, boxed out utility riser columns, etc) so as to ensure actual usable space is allocated to support the building communications requirements. This is necessary to ensure adequate area for equipment and maintenance activities within the CER or riser closet. When determining the overall size of the CER/Riser closet, consideration shall be given to the equipment slated for installation in the CER/Riser closet under the MCP (to include equipment provided by the end user and any space requirements generated by commercial providers for the facility). Additionally, adequate space for expansion shall be factored into the total size of the CER/Riser closets. Basic construction of a typical CER will be a painted, drywall type construction with the walls extending completely to a drywall type hard lid ceiling. The intent being to create a well sealed room that resists dust and other contaminants from entering the room and affecting the performance of the equipment. Drop ceilings shall not be installed in a CER. Ideally the CER ceiling should be at least one foot higher (two or more is desirable) than the drop ceiling height in the adjacent areas around the CER. This will facilitate the exit location of the cable tray or other raceway system, allowing it to be above the drop ceilings for aesthetic purposes. In no case will the clear, usable height throughout the room be less than 86 inches (meaning a 7 ft rack can easily be moved around anywhere within the room without encountering an overhead obstruction). This means that all permanently mounted fixtures suspended from the ceiling or mounted to the walls (cable trays, HVAC units, sprinkler heads/cages, lighting fixtures, etc.) will be at least 86 inches above finished floor. The actual height of the ceiling will then be calculated upwards to insure proper working clearances for all other permanently mounted equipment above rack height.

3.1.3. Security: The CER and riser closets shall have a minimum 36-inch wide, standard commercial height, outward hinging door. Unless there are special circumstances dictating otherwise (exterior entry, higher security concerns, etc.) the door will be a basic wooden solid core door with no vision panels installed, with a metal door jamb assembly and a minimum of three supporting hinges. Access to these locations shall be from inside the building. Door locks shall be Best type locksets, using an E-3B210 key core for comm. rooms located on the Elmendorf side of JBER or a 3B-210 core for comm. rooms located on the Richardson side of JBER. Other requirements for larger doors or increased security in the form of upgraded lock systems or Intrusion Detection Systems (IDS) will be addressed on a case by case basis. In the event that a CER will have to support communications equipment or circuit paths operating at a classified level of secret or higher, the physical security of the room will also have to be factored into the construction methods (door types, locks, wall construction, sound attenuation, wall penetrations, etc.). These issues will have to be worked with the appropriate physical security certification agency for type of systems being protected. In the case of Secret/Open Storage ratings to support Siprnet installations, the 673SFS Physical Security Manager will be the primary design review and approval agency. The construction of these areas will reference all appropriate standards, such as DOD 5200.1-R appendix 7, Mil-handbook 1013/10, AFI 33-332, and AFI 31-401 or their most recent versions. The design and construction of these secure rooms will include all necessary items to ensure full accreditation and the ability to come on line once the facility is released to the government, to include things like certified locks, Intrusion Detection Systems compatible with existing systems on base, sealing of all wall penetrations once all utilities are installed (electrical, comm. signal cables, etc.), etc.

3.1.4. Climate Control/Fire Suppression: The CER and riser closets shall provide climate control to maintain a temperature range between 68 – 78 degrees Fahrenheit. Climate control is required 24 hours per day, 365 days per year. Additionally, a positive pressure shall be maintained to reduce the potential for dust. Air used to ventilate the room will be run through a filtration system to minimize dust build up within the room. Projected heat loading will be addressed on a case by case basis, but should plan on a minimum of 5000 BTU per hour from the equipment. In the case of a CER sized to support four equipment racks or over 400 horizontal drops (actual wall jacks/patch panel port count, not faceplate count), the HVAC will be sized to support a minimum of 10,000 BTU/hr. Additionally, the CER locations will typically be unoccupied, but on occasion may have up to four people working in the rooms simultaneously for a period of two or three workdays. In cases where an actual HVAC unit must be installed to maintain temperature control, versus just having adequate air flow through the room, the siting of the HVAC unit will be such that it does not conflict with the cable paths that must be developed within the room (i.e., the HVAC unit will not be mounted directly above equipment racks or cable tray paths within the room), unless a minimum clearance of at least 12 inches can be maintained from the bottom of the HVAC unit to the top of the cable tray suspended below it. In no case will the HVAC unit be mounted directly above equipment rack locations or other locations that will be used to mount electronic equipment within the room and any plumbing paths needed to support the HVAC unit or fire suppression system will be developed such that a leak in a pipe will not cause fluid to drip or spray onto any equipment or cable bundles. In addition, the installation location of any equipment will also factor in a working clearances needed to service the equipment without creating a risk the installed communication equipment and cable plant. The installation of any type of HVAC system will include provisions for the continuous/automatic removal of any condensation products of the system. Systems that incorporate a catch basin or tank that must be emptied periodically by the user will not be accepted. In cases where a fire suppression system, such as water based sprinkler heads must be installed in the room, the system will be installed in such as manner as to avoid inadvertent activation due to normal work activities in the area (people up on ladders, pulling cables in cable trays, etc.). This may take the form of rigidly mounted protective cages, or any other installation technique that prevents mechanical impact from triggering the sprinkler heads to activate.

3.1.5. Lighting & Wall Finish: The CER and riser closet lighting shall be a minimum of 8.5 feet high, providing 50-foot candles @ 3 feet above the floor. Walls will be painted, or otherwise sealed, prior to any equipment or backboards being installed on the walls. Walls and backboard shall be painted white to maximize effective illumination and minimize the difficulty inherent in identifying color code discriminator markings on communications cables. Light fixtures will be positioned to avoid interference with cable routing paths, both from an electromagnetic interference standpoint, as well as a physical shading standpoint that may cause shadowed areas to occur in the work space.

3.1.6. Electrical Support: The CER and riser closets shall have a minimum of two dedicated, isolated 120 VAC, 20-amp quad outlets (separate power, neutral, and ground conductors) located in 673rd Communication Squadron Project Management (673CS/SCXP) approved locations. Typically these would be located on the base of the equipment racks, facing to the rear of the rack, but may be located on a sidewall as determined on a case by case basis, with 673CS/SCXP approval. The location of the outlets will be such that they minimize any potential trip hazards once equipment is plugged in, and that they are not placed in a location that will be difficult to access once final jumper cables, patch cables, or support equipment is installed. In the case of a CER installation that requires multiple equipment racks, the minimum power requirement will be for two dedicated, isolated (separate power, neutral, ground conductors) 120 VAC, 20A circuits, each terminated in a quad outlet assembly, facing toward the rear of the rack, per equipment rack. For CER locations that are projected to support more than 100 network devices, four dedicated/isolated 120VAC, 20A circuits, each terminated in a standard 5-20R duplex outlet, as well as two dedicated/isolated 208/240 VAC, 30 A circuits, each terminated with an L6-30R socket will be required to support the primary equipment rack. Standard duplex convenience outlets on a separate circuit shall be placed on all walls at approximately 2.5 meter intervals. The installation of the convenience outlets will be designed with an eye to the functional use of the telephone termination boards (TTB). To run surface mounted conduit around the perimeter of the room in a manner that breaks up the ability to run cables vertically on the TTB is not an acceptable approach. Typically, the convenience outlets should be approximately 18 inches above the finished floor. Every effort shall be made to run electrical conduit that supports power in an equipment rack, in a manner to create the maximum separation from the data cable paths and to ensure maximum utilization of the rack space, as well as allowing for the expansion of the equipment rack system at a later date. Typically this might mean routing the conduit down the wall on the back side of a rack, on the opposite side from the signal cable path, for example, then crossing over to the base of the equipment rack for distribution. Typically power being distributed among the equipment racks should be done by running conduit horizontally along the base of the equipment rack to maintain good separation between power conductors and signal conductors. Contractor shall submit a conduit routing plan for all power within the CER to 673CS Project Management for approval prior to installation. Additional dedicated, isolated circuits may be required to support installation of third party support equipment upon MCP completion. The 673 CS project manager will assist in identifying additional power requirements in the CER/Riser closet but should not be considered the only source of information in developing the power requirements for the room. Individual users should also be queried as to their specific requirements (673SFS for alarm systems, commercial entities for any equipment they may need to install, PA system/Mass Notification system providers, etc.). The path used to install the electrical power circuits will be deconflicted with the signal cable paths to minimize the possibility of electromagnetic interference affecting the performance capability of the signal cables. Electrical power paths will require 673CS/SCXP approval prior to implementation. The conduit path used to bring power into the room from the circuit breaker panel, as well as the conduit path to the equipment racks, will be sized such that additional power circuits can be easily installed at a later date. The path shall be sized to handle at least double the amount of circuits as initially installed.

3.1.7. Grounding: Provide a single-point ground for all equipment in the Telecommunications Rooms. All equipment racks/cabinets will be properly grounded. Ground wires shall not be run in the same bundle or cable path as signal cables (same conduits, inside the same cable tray, laying in the same J-hooks, etc.). Provide a copper ground plate (bus bar with minimum 6 inches high by 12 inches long) installed approximately one foot above the floor on a wall within the Telecommunications Rooms, typically in the general vicinity of the outside cable plant entry point or riser cable termination point. The ground riser from the ground plate to the single main electrical service entrance ground shall be a No. 1 AWG or larger copper conductor directly connected to the ground plate with no taps. The resistance of the ground path shall be 5 ohms or less measured from the main building ground point to any ground plate in any of the telecommunications rooms or riser closets. All connections of wire-to-wire and/or wire-to-ground rod shall be thermo-welded. Connection of main ground bus cables to ground bus bars will either be thermo-welded or connected using a two bolt type ring lug termination. Extend no. 1 AWG or larger copper ground wires from the main Telecommunications Room ground plate to each riser closet and satellite telecommunications rooms. All equipment racks will be suitably grounded (minimum 6AWG copper wire), with a small, horizontally mounted grounding distribution bar in the top of the rack, on the back side of the equipment mounting rail. All ground plates and ground bars will have additional, unused ¼-20 tapped holes to allow for the addition of ground wires to support future equipment installations. Any piece of equipment that requires grounding will be grounded with a minimum 6AWG copper conductor back to the appropriate ground bus bar.

3.1.8. Telephone Termination Backboards: All walls in any CER or riser closet will be covered with 8-foot by 4-foot sheets 3/4- inch A/C grade or better plywood with the A side out. Additional backboard requirements will be identified by the 673CS construction manager as needed for each project. Backboards shall be finished with white, fire-retardant paint. Backboards shall be installed in such a manner that they cover the usable wall sections from the floor to at least eight feet high. The backboards will be installed such that there is no bowing of the backboards and anchored well enough that load bearing of typically mounted equipment (cable service loops, protected entry panels, cable TV distribution cabinets, IDS alarm cabinets, etc.) will not cause the backboard to come loose from the primary wall structure. In specific cases, more coverage may be required (such as specialty areas outside of the defined CER locations) and will be addressed on a case by case basis.

3.1.9. Connecting Hardware: Connecting hardware installed in the CER and riser closets shall be rated for operation under ambient conditions of 0 to 60 degrees C (32 to 140 degrees F) and in the range of 0 to 95 percent non-condensing, relative humidity.

3.1.10. Terminal Blocks and Surge Arrestors: In most cases, horizontal copper cable termination and distribution shall occur on 48 port, RJ-45 type patch panels of an appropriate category performance rating. Copper outside plant entrance cables up to 600 pair that feed end user buildings will be terminated on a surge suppression panel(s), similar to AVAYA 489BCB1-100, populated with appropriate plug in modules. These cables will be extended from the surge suppression panels to 66 blocks mounted on the telephone backboard. Copper riser cables will be terminated on separate 66 blocks mounted on the telephone backboards in each CER to push voice grade connectivity out to each satellite comm. room. Short house cables will be terminated on 66 blocks near the entrance/riser backbone cable 66 blocks and shall extend to 48 port, RJ-45 style patch panels located in the equipment racks to a facilitate cross connecting telephone or other dedicated circuits onto the horizontal cable plant for delivery to an end user location. All four pair of each port on a patch panel designated as a telephone/voice support panel will be wired back to 66 blocks on the telephone backboard. Each 24 port row of RJ-45 ports will be wired back to a distinct set of 66 blocks that can be associated with that row of ports using a distinct 100 pair cable. The violet/slate pair at the end of each 25 pair binder group will be spared out so that each binder group is supporting 6 fully wired ports. The next binder group will then start a new group of 6 ports (allowing for the four binder groups in a 100 pair cable to fully support a 24 port row in an RJ-45 patch panel assembly). The next 24 port row of patch panel jacks will then be wired with a discreet 100 pair cable, in a similar manner as the first, back to another distinct set of split 50, 66 blocks, appropriately labeled to distinguish which ports are being supported, and so on until all ports on all designated voice panels are wired out to the telephone back board. In the case of cables larger than 600 pair terminating in an end user building, or any cables that are terminating in a communications distribution node building (ITN, RST, DCO, etc.), provision for terminating the cable on a distribution frame using breakout cables, wire wrap termination blocks with integrated surge suppression, etc. will be designed into the project. Reference the standardized facility drawing for a typical layout of telephone backboards and equipment racks.

3.1.11. Equipment Racks: A minimum of two 19-inch x 84-inch equipment racks (similar to a Chatsworth 46353-503) shall be installed in the main CER and each satellite CER. Configuration of equipment racks for all CERs is essentially the same and shall conform to the typical JBER rack elevation drawing. Equipment racks shall be placed side-by-side perpendicular to and against one of the CER's side walls. Rack fronts shall face the CER door. In a 10-foot by 10-foot CER, the distance from the rear wall to the back of the racks shall be a minimum of five (5) feet. Distance from the front wall to front of racks shall be 4 feet minimum. Space shall be allowed for the addition of an extra rack in line with the racks being installed as part of the project. The racks shall be anchored on the top and bottom in accordance with seismic anchoring requirements. In addition, the room layout will be such that proper working clearances can be maintained around all equipment (in the absence of any other safety guidelines, a minimum of 36" clearance will be maintained around the working foot prints of any equipment, to include the projected mounting depths of equipment planned for two post equipment racks). Any cable management, such as cable trays, that is installed overhead to provide cable paths to the racks needs to be installed to support cable routing to additional equipment locations that may be utilized at a later date (such as cable trays around the perimeter of the room, cable trays reaching completely across areas projected for future rack installations, etc.). This would include locations on telephone backboards, locations where additional equipment racks may be installed, etc. The overhead cable tray systems will be self supporting and will not rely on the equipment racks for support. The cable tray system will be installed a few inches above the top of the equipment racks to allow for the possibility of cabinet replacement with different types of cabinets throughout the lifecycle of the building, as well as the proper installation of cable bend radius management accessories (waterfalls, etc.). Equipment rack configuration will depend on the type of cabling servicing the facility, and is covered in further detail in section 3 of this publication. Vertical wire management will be accessible from the front of the rack unit to facilitate the routing and management of patch cords, as well as from the rear of the rack to facilitate the installation of additional horizontal cabling. A Chatsworth part number 11729-503 is an example of an acceptable type of vertical wire management to be installed between each rack assembly, as well as on the outside ends of the overall string of equipment racks. Since these vertical wire managers are an integral part of the horizontal cable path, they must meet the same capacity growth requirements as any other part of the horizontal cable plants, therefore it may be necessary to put in larger/wider vertical cable managers in the case of large cable plant installation (large office building with hundreds of cables returning to the cable termination racks, for example). Generally, the rack closest to the wall will be defined to support telecommunications equipment and voice transition panel terminations, while the second rack out from the wall will be designated to support the horizontal patch panels. In addition to the basic vertical wire management layout, provision will also be given to the rack layout plan to support the necessary horizontal management of patch cords in the case of multiple horizontal termination racks being required to ensure an orderly routing system for the patch cords that will reach back to the telecommunications/voice transition panel rack. An example of an acceptable horizontal cable manager would be a Siemon WM-143-5.

3.2 Cable Routing and Management

3.2.1. Backbone/Horizontal cable path: Generally, any cable path will be designed as a complete support structure and will not make use of a support structure set up for other functions, such as electrical service paths, drop ceiling suspension systems, or plumbing support systems. Where feasible (and driven by overall cable count), the preferred method shall be an open, welded wire, basket type cable tray system. An acceptable alternative would be a J-hook type support system, especially for smaller bundles branching off from a main back bone path, provided that projections for future growth are accounted for in the capacity of the cable support path as initially installed. Any system will be installed to meet both the manufacturers recommended installation practices, as well as meeting any installation criteria set down by various installation standards applicable to the various types of cables being installed, or expected to be in use in the system (Cat 5e, Cat 6, Cat 6a, fiber MIC cable, fiber house cables, coax/CATV/CCTV, etc.). This includes, but is not limited to such issues as distance between supports, maximum loaded cable support weight limits, cable bend radius (installation of waterfall accessories on cable trays, transition directions between conduits and open cable support paths, etc.), cable fill rates, electrical shielding, environmental protection of the cabling, etc. When a cable bundle must branch off from a main backbone support, such as a cable tray system run down a hallway, it shall be properly supported as it leaves the backbone path. An example of this would be if a cable tray system is run down a hallway and the branch cable bundle must cross the hallway to service rooms on the opposite side, there will be some sort of fixed, protective cable support system put in place to extend the path to a suitable breakout point. This may take the form of a branch in the cable tray system, fixed conduit with appropriate end bushing and bend radius protection to protect the cabling, suspended j-hooks, or any other practical raceway type cable path to support and protect the cable path that meets installation standards. Cable paths below grade for support of horizontal cable installations to faceplate locations will not be accepted (i.e. conduit embedded in a slab on grade type installation, etc.) except in very rare cases in which a single location must be supported across a large, industrial type area. Even when a below grade installation is required and deemed acceptable, in writing, by 673CS/SCX Project Manager, the conduit should not home run back to the CER, but rather should be kept as short as possible to reach the closest reasonable location to which a standard, overhead cable distribution system such as a cable tray or J-hook system can be extended from the CER. When multiple drop locations must be supported in an area, then an overhead distribution system must be developed capable of supporting ongoing modification and growth of the cable plant throughout the life of a building. Only direct bury rated cable will be run below grade. Bundles of horizontal cables will not be passed between floors (they will go back to a CER on the same floor). In the case where it is not feasible to develop an overhead cable distribution system, a properly designed subfloor distribution system may be considered (raised computer type floor, continuous run conduit systems, etc.) as long as the system is not below grade (i.e., embedded in a slab that is directly on top of dirt, etc.). When a conduit system is used to carry cable plants, the conduits will not be run all the way to equipment racks. The conduits will end a few inches within the CER and be properly grounded (in the case of metallic conduits). The ends of these conduits will be properly protected to prevent chafing and cutting of the cable jackets passing through them and the conduit stubs will be swept into the room in such a manner as to prevent bend radius violations as the cable transitions into the cable tray system within the CER. From this point, the cable bundles will be collected into the cable tray system within the rooms for routing to the appropriate equipment racks or telephone backboard locations.

3.2.2. All cable paths will be sized to allow for a minimum 100 per cent growth after the initial installation, without violating accepted fill rates for the individual cable support system The exception to this will be the final riser conduits extending from the wall boxes to above the ceiling. This may be sized to accommodate four cables for a single gang faceplate (minimum 1 inch conduit) or eight cables for a double gang faceplate box. Wall boxes used for datacomm cabling will be a minimum of 4 11/16 inch square boxes with the appropriate mud ring to support the correct size faceplate (single gang or double gang as requirements dictate). In addition, as part of the installation of a cable support path such as cable trays or large conduits, the support path will be mounted in such a manner as to safely support the weight of a completely filled cable path, not just to support the weight of the projected cable plant being initially installed. For open cable tray, this would typically involve the installation of an appropriate number of threaded rod support hangars. At a minimum, supports will be no more than 5’ apart. In addition, supports will be no more than 2’ away from any discontinuity in the straight section of cable tray. Examples of discontinuities include, but are not limited to, places such as section joints, changes in elevation, changes in direction, T or X type intersections of segments, etc. These hangers should generally be installed as a supporting pair with one mounted to each outer edge on opposite sides of the cable tray, or with some type of trapeze support running under the cable tray between hangers. In the rare case in which it is more practical to or more desirable to support the cable tray with a center hung support system, the threaded support hangar rod will be covered with a non abrasive sleeve from below the level of the cable tray to at least six inches above the highest sidewall of the cable tray assembly. The sleeve will be installed in such a manner as to prevent it from sliding up the support rod and exposing any sharp or abrasive surfaces. In the typical case of a piece of conduit being cut off and installed over the threaded rod, this installation shall take the form of installing a large enough washer and nut assembly above the conduit sleeve and tightening them down to restrain the conduit sleeve from any movement. When planning the layout of the cable support path to account for the transition from a backbone cable path, such as an open cable tray system, to a smaller cable path, such as j-hooks or final riser conduits from a wall box, the path shall be designed such that the cables enter/exit the cable tray from above the cable tray, with proper attention given to controlling the bend radius of the cable. The cable path will not be designed so that the horizontal cable enters through the side of the basket tray, nor shall it be designed such that the cables lay on the top wire of the elevated sides of the cable tray system, nor will the cable paths generally be designed such that the cable path exits/enters through the bottom of the cable tray, with the exception of the locations within the communications equipment rooms (dropping into equipment racks via properly installed waterfall accessories, for example). In general, the cable path will be design and installed such that putting normal installation pulling tension on any given cable will not cause it to exceed minimum bend radius anywhere along its path. All cable paths, unless properly shielded, will maintain a minimum of a 12 inch separation from sources of electromagnetic noise, such as power cable, electrical motors or generators, arc welders, radio frequency sources, fluorescent light fixtures, etc. of up to 480 VAC and less than 5kVA. Power cabling rated at greater than 5kVA power rating or a voltage rating greater than 480 VAC will require a minimum separation of 24 inches, unless the cable path is properly shielded (ie. Both the power cabling and the communications cabling in separate enclosed metallic pathways, properly grounded, such as metallic conduit). Cable bundles in J-hook or cable tray type cable paths will be managed approximately every five feet by wrapping “hook and loop” type reusable cable straps around the bundles, however, the cable straps will not be used to fasten the cable bundle directly to the cable tray, nor will they be used to manage bends in the cable bundle, such as going around corners or at locations where a cable or bundle of cables leave the cable tray to be routed to another cable management path. In cases where cable installations are developed such that cables for multiple systems are being run in the same basic cable path, provisions will be made to keep the cable types bundled and separate from each other. As an example, if a cable tray was going to be used for unclassified copper horizontal cable, copper riser cables, and coax cable TV cables, then this might take the form of bundling all the horizontal copper cable on one side of the cable tray, bundling all the cable TV coax cables down the center of the cable tray, and bundling all the riser cables down the other side of the cable tray. In no case will an installation be accepted that intermingles (cables woven in and around each other as they traverse a cable path) various types of system cables. This same principle applies to discrete system cable bundles, such that individual cables within the bundle shall not weave back and forth through cable support structures, such that an overall bundle of cables is effectively tied to a supporting structure. An example of this would be the case where it is necessary to support a cable tray system with center hung supports and cables weave back and forth passing by opposite sides of the cable supports as they traverse the cable support path, effectively tying the cable bundle to the support structure.

3.3. Copper Installations

3.3.1. Backbone/Outside Plant Connectivity: Connectivity to the base copper distribution system will be determined on a case by case basis. In areas where it is determined that a connection to the base copper backbone is required, the minimum cable size run to the building will be 25 pr, 24AWG. The cable requirements may be increased dependent on the expected end building requirements. Any outside plant copper installed as a main distribution cable, or as an outside plant feeder cable, inside a manhole duct system, to tie a building to a distribution trunk cable will be an RUS PE-39 specification direct bury rated cable such as Superior-Essex SealPic-F type cable, minimum 24 AWG, with the pair count sized according to the defined requirements of the project. Outside/direct bury rated cables will be routed into the protected terminal entry equipment from the bottom side, to ensure that the open end of the cable is facing up to prevent the gel filling from running out as the cable warms up over time. Unless otherwise defined, all new cable segments will include all terminations and splices necessary to create a fully functional cable path from the end user building to the appropriate telecommunications service node (direct cable connectivity, splices into existing trunk cables, etc.). Splices will be accomplished using a pluggable splice module, similar to a 3M MS*2 4005 product. In cases where a cable is being installed through an existing path that does not contain sufficient existing cable management systems to properly support and protect the cable from stress or bend radius violations (cable racking brackets with load bearing standoffs and step arms in manhole/handholes, interior cable tray/J-hooks, waterfall accessories, etc.), the installation of this material will be included as part of the cable installation project. In addition, cables will be fully tested and labeled throughout the cable path, to include ensuring each access point container (manhole, handhole, etc.) is properly labeled as well. The minimum effort for full and complete labeling will include a machine printed tag attached to the cable sheath at each point where the cable enters or exits the container and where a sheath enters a splice case or termination panel, as well as ensuring the container itself (stenciling inside manhole necks, etc.) is properly identified and marked. The exact label format and information content will be provided for each project by the 673CS Project Manager. Installation personnel will coordinate with 673CS Project Managers for specified pair counts in trunk cables, cable naming conventions, scheduling of potential cable outages, etc. In cases where there is no copper backbone capacity in the nearby vicinity capable of servicing the building, it may be necessary to implement an outside plant cable infrastructure project to supply this capability to the general area. When a project of this nature is implemented, any cable that is installed shall not leave any cable segments with ends exposed below grade. All cable segment ends will be enclosed within an appropriate splice case, even the very end segment of a cable run that is merely being prepositioned to support a follow on construction project. In cases where it is not feasible to work a copper infrastructure project to support an area, 673CS may allow the use of a fiber optic based channel bank system to support connectivity requirements to the building as a cost saving measure, versus an extended distance buried copper installation. These systems are typically much less expensive than the installation of large multi-pair trunk cable systems back to the Dial Central Office. In these cases, it is expected that the channel bank system will be provided in lieu of the outside plant copper connectivity, as part of the project. The channel bank system will be compatible with the system currently used by the base (currently Tellabs 1000 series equipment, which was formerly AFC UMC1000 and DMAX1120 series equipment). Outside plant cables sized up to 600 pair being terminated in end user buildings will be terminated using typical surge suppression equipment (similar to AVAYA 489BCB1-050 with plug in modules), then extended to 66 blocks on the telephone backboard. These 66 Blocks, similar to a Siemon S66M1-50, with standoff legs, similar to a Siemon S89B, will include a hinged cover assembly and circuit ID label system, similar to a Siemon MC4LH-2 and MC4-LBL-25. Termination, pair breakout, and surge suppression installation will be addressed on a case by case basis for pair counts above 600 for an end user building, or for termination of cables of any size pair count at a communications node building (DCO, RST, ITN, etc.), but will generally involve the installation or expansion of a vertical/horizontal frame assembly with appropriate surge suppression blocks and other standard cable routing and termination accessories. An additional set of 66 blocks will be installed with 24AWG house cable extending to RJ-45 high density patch panels installed in the equipment racks as voice cross connect panels. All pairs of all ports of the RJ-45 voice patch panels will be wired out to these sets of 66 blocks. In the case where a single CER exists to service the building, the number of voice panel ports provided will be equal to the number of pairs contained in the entry service cable supplying the building, ie, if there is a 100 pair outside plant cable fed to the building, then there will be 100 port capability installed in the voice patch panel location and wired back to 66 blocks on the TTB. In the case where there are multiple CERs in the building, the voice patch panels will be sized in each satellite CER to correspond to the size of the riser cable feeding the individual CER. Where there is a 50 pair cable feeding one CER, then there will be 50 voice panel ports wired to the TTB in that location. If there is a 100 pair backbone riser cable feeding another CER, then that CER will have 100 voice panel ports wired to the TTB in that location. In the case of the main CER (location where the outside plant cable is terminated) in a building with multiple CER locations, the number of voice panel ports wired to the TTB in the main CER will be equal to 50% of the outside plant cable capacity, ie, if the outside plant cable feeding the building is 300 pair, then there will be 150 voice panel ports wired to the TTB in the main CER location. The riser cable sizing in any satellite CER will be developed to fully meet user generated requirements as part of the design effort, but as a minimum working requirement, each riser cable will also be sized at 50% of the outside cable plant capacity. All backbone/riser/outside plant/house cables will have all pairs properly terminated on an appropriate device (66 blocks, protected entry panels, rack mounted patch panels, etc.) unless specifically noted otherwise. Multipair backbone type cables will not be installed such that some pairs are directly terminated on a piece of end user equipment with pairs left un-terminated. Any deviation to this standard will be handled on a case by case basis and will require approval, in writing, by the 673rd Communications Squadron Project Management.

3.3.2. Horizontal Cabling (unclassified telecommunications drops):

For buildings that are primarily Air Force functional buildings, interior cabling will meet a minimum of Cat 5e level. For buildings that are primarily Army functional buildings, interior cabling will meet a minimum of Cat 6 level.

3.3.2.1. Horizontal cabling and installation will be a minimum of a Category 5e Unshielded Twisted Pair (UTP) specifications with a plenum rated, blue colored jacket. All components that are part of the end to end horizontal cable installation will, as a minimum, meet Cat 5e specifications and capabilities. In cases where additional performance capability is required from the cable plant, Cat 6 augmented/enhanced cable and components will be used, capable of supporting 10 Gb throughput rates. The cable will be terminated on 48 port, RJ-45 high density style patch panels in the equipment racks at the comm. closet end. The patch panels used will provide for the wire pairs to be laid down in the same visual order as the wiring pinout standard they are supporting (ie, if the wiring standard calls out for the blue pair to be pair one, the orange pair to be pair two, the green pair to be pair three, and the brown pair to be pair four for the port, then the visual order of the wire pairs on the termination block on the patch panel will show the wire pair to be punched down in the order of blue, orange, green, brown, from left to right , as viewed from the back of the panel. A Siemon HD5-48 is an example of an acceptable type of patch panel layout for Cat 5e requirements, with a Siemon HD6-48 type being appropriate for a Cat 6 installation). The cable will be installed in accordance with industry standard installation practices, guidelines, and any specific manufacturer recommendations to protect the integrity and long term performance capability of the horizontal cable system (this will include things such as water fall assemblies on cable trays, horizontal support members across the back of the patch panel areas to support cable bundles from putting strain on the termination points similar to a Chatsworth 12176-501, etc.). Signs of abuse of the cable, such as slits or tears in the outer jacket, kinks in the cable, signs of stretching due to excessive pulling tension, or signs of severe scuffing due to being pulled over sharp or rough surfaces will be grounds for reinstallation of a given cable. Simply trying to massage out the stressed area to make it look better is not an acceptable fix action. At the wall plate end, the general practice will be to terminate two cables in a downward angled double coupler in the bottom of the faceplate and two cables in the top position using a flat double coupler assembly for a total of four drops per faceplate. The faceplate/coupler assembly will also be designed such that it can readily support a flexible, reconfigurable color coding scheme for each port on the faceplate, without having to replace and re-terminate the actual coupler, such as the capability provided by a Siemon CT faceplate/coupler system with the interchangeable colored plastic inserts. This system allows for the easy insertion and later changing of color coded icons to help identify the specific use of a port by a specialty network then be remarked as the utilization of the port changes later without having to change out the actual coupler assembly or impact the termination of the cable within the faceplate. The cable will be installed to a T568A pinout as referenced in the TIA/EIA-568-C standard, unless the work is a partial renovation or small addition to a building that is currently wired to the T568B pinout standard, in which case the new terminations should match the existing format already in place. Signage will be installed on the front of each rack location where horizontal cabling is terminated denoting the wiring pinout standard used at that location. Excessive service loops shall not be installed at either end of a horizontal cable installation. Enough slack should be left at the faceplate end to allow for re-termination of the cable, in the event that a coupler must be replaced. There should also be enough slack left in the cable to allow for re-termination at the CER patch panel end, in the event a patch panel would need to be replaced. Any excess cable should not be coiled in any location, but should be loosely snaked in the cable path (for example, above the ceiling at the wall jack location, or in the cable tray system at the patch panel end). All cabling will be tested to its designed installation rating and results will be provided to 673CS in an acceptable format. Telecommunications faceplates will be installed approximately every 2.5 meters along walls at an appropriate height to match other utilities (power, cable TV, etc.). Exceptions to this spacing requirement will be addressed on a case by case basis, such as Hangar Bays, Warehouses, etc. Installations will utilize flush mounted wall boxes, with conduit risers internal to the wall structure that feed into the area above a drop ceiling. Other forms of installation infrastructure should be considered undesirable and will only be considered on a case by case basis where conduit risers are not feasible. Individual drop identification will be accomplished by referencing the CER room number that services the faceplate, followed by a contiguous number scheme to uniquely identify the port on the face plate (ie. If the CER room number is 121, then the drops being fed from the room should be identified as 121-1,121-2, 121-3, etc.) at the wall plate end, and laid down in order on the horizontal patch panels in the CER. The labeling scheme will be defined and included on the telecommunications design drawings no later than the 95% design review level documents. This will allow for both the approval of the labeling scheme, as well as insuring it is fully understood which CER will be supporting a specific drop location. The patch panels will be numbered to reflect the contiguous numbering pattern. As a general design goal, all drops will be considered as general purpose telecommunications ports using RJ-45 ports with all pairs wired out. There will be no effort made to delineate different functionality such as voice ports or data ports at a given face plate. All drops should be installed and tested to the same performance capability. The only exception to this would be specific locations that may require a specialty type wall jack such as wall mounted telephone locations. These locations will be addressed on a case by case basis. All pairs of any horizontal cable will be properly terminated on an appropriate device (faceplate, termination block, patch panel, etc.). In no case will a horizontal cable intended for unclassified telecommunications support (a cable running between rooms to support end user distribution and connectivity for systems such as telephone, niprnet, etc. ,) have individual conductors directly terminated on end user equipment or have un-terminated conductors.

3.3.2.2. Feeder/Riser Cables: Riser cable requirements will be determined on a case by case basis, and will be used to push service out from the CER to each riser closet. The main backbone cable will be a multipair (minimum size of 25 pair, but may be larger depending on building requirements), terminated on 66 blocks on each end. In addition, distance limitations permitting, a minimum of six Cat 5e links (Air Force buildings) or Cat 6 links (Army buildings), terminated on RJ-45 high density style patch panels will also be extended from the CER to each satellite communications equipment room (SCER), and from SCER to SCER, in the case of multiple SCER rooms within a building. Signs of abuse of the cable, such as slits or tears in the outer jacket, kinks in the cable, signs of stretching due to excessive pulling tension, or signs of severe scuffing due to being pulled over sharp or rough surfaces will be grounds for reinstallation of a given cable. Simply trying to massage out the stressed area to make it look better is not an acceptable fix action. All backbone/riser/outside plant cables will have all pairs properly terminated on an appropriate device (66 blocks, protected entry panels, rack mounted patch panels, etc.). Multipair backbone type cables will not be installed such that some pairs are directly terminated on a piece of end user equipment with pairs left un-terminated. Any deviation to this standard will be handled on a case by case basis and will require approval, in writing, by the 673rd Communications Squadron Project Management.

3.3.2.3. Channel Bank Systems: In cases where no copper trunk cable is run to the building, a channel bank system will be provided as a substitute transport system for signals such as telephone or alarm signals. The system will be compatible with an Advanced Fibre Communications UMC-1000 (or Tellabs 1000) system. The channel bank system will include all necessary equipment to be fully functional after installation, to include any material and installation efforts needed at both the end user building, as well as the telephone switch location that will be servicing the end user building. This includes, but is not limited to fiber optic transport cards, telephone termination cards, and any other specialty termination cards required to meet the users requirements. The system will be provided with built in redundancy for power supply, signal transport, and system processing capability. The system will also include a battery backup capability that will allow the system to function for a minimum of 12 hours after the loss of primary AC power. The chassis assemblies will have factory connectorized pigtail cables, approximately three feet long, from the output of the backplane to standard female telco connectors. These cables will be extended to connectorized 66 blocks, using factory terminated and tested intermediate cables, on the telephone backboard to allow cross connections to be established to the voice panels at the end user buildings. Channel bank equipment being terminated at a voice distribution node location (ITN, RST, DCO, etc.) will be terminated in a manner similar to other terminations at those respective locations (ADC connectorized wire wrap blocks on a distribution frame, for example). Channel bank systems will be installed, tested, and certified operational by factory approved installers.

3.4 Testing/ Inspection and Acceptance (Copper): A basic visual examination of the installed cable plant will take place prior to any formal testing. The examination will look for signs that proper installation techniques were not used. The visual inspection will include, but is not limited to, looking at cable bend radius, proper cable support, separation from sources of electrical interference, signs of kinking, stretching, damage to cable jackets, or snagging of cables during installation, or any other sign that basic installation standards were not adhered to for a given cable type. Violation of any of these standards is grounds for rejection of the installed cable plant. Once the visual inspection is passed, all conductors in each cable will be tested to standards applicable to the rated performance standards of the cable type. In cases where work is related to existing, active cables, all conductors will be tested before and after the work, once appropriate down time is scheduled for any active circuits that may be routed through the cable. The organization performing the tests will be responsible for removing and re-establishing cross connects as necessary to perform the necessary tests and return the cable(s) to service once down time has been coordinated.

3.4.1. Test Plan: A Test plan defining required tests and type of test equipment to be used during testing is required to ensure the system meets technical, operational, and performance specifications. The proposed test plan shall be submitted for review 60 days prior to the proposed test start date. The test plan must be approved before the start of any testing. The test plan shall identify the capabilities and functions to be tested as well as an outline of detailed instructions for setting up and executing the test plan. Additionally, the plan is required to outline the procedures for evaluating and documenting the results of the test. Once actual test dates are determined, 673CS/SCXP will be given at least a seven calendar day advance notice, with the option to observe the test procedures.

3.4.2. Test Reports and As-Built Prints: Test reports shall be submitted in booklet or CDROM format with witness signatures verifying execution of all tests listed in the test plan. Reports shall show the field tests performed to verify equipment compliance with specified performance criteria. The test reports will include a record of all physical parameters verified during testing. Test reports will be submitted to 673rd Communications Squadron Project Management Office for submission and review by the 673 CS OPR, usually O & M Activity, within 14 days after completion of testing. As-Built prints will include, as a minimum, overall floor plans showing telecommunications drop locations and associated drop label locations, CER floor plan layouts, TTB layouts, equipment rack layouts, and riser cable drawings. In the case of the installation of any specialty equipment that directly supports communications requirements, additional as built drawings will be provided as needed to fully document the installation of the equipment (WAP antennas in Hangar bays, or on the exterior of a building, etc.). The format of any as built documentation will conform to those listed in section 1.1.2. In addition, any electronic versions of as-built documentation will be supplied in a version that is fully capable of being edited at a later date (i.e., a CAD drawing will be provided in an unlocked/ungrouped format so that individual items can be edited or more readily merged into existing floor plans. Adobe PDF or similar documents are not an acceptable format for as-built documentation.).

3.4.3. Materials & Documentation: Materials and documentation to be furnished under this specification are subject to inspections and tests. All components must be terminated before testing. Equipment and systems will not be accepted until the required inspections and tests have been made, demonstrating that the signal distribution system conforms to the specified requirements, and that the required equipment, systems, and documentation have been provided. To support this initiative, an appointed 673rd Communications Squadron Quality Control (QC) representative shall observe operational tests, and analyze both observed and annotated test results provided by the contractor. Any system, equipment, or hardware installed will meet the most stringent Department of Defense (DOD), manufacturers, or ANSI TIA/EIA standard applicable. Systems, equipment, or hardware that does not meet the applicable standard will not be accepted. All discrepancies must be re-tested/re-inspected after resolution efforts are completed and the results certified correct in writing by the 673rd Communications Squadron QC representative prior to any final acceptance.

3.4.4. Unshielded Twisted Pair Tests: All metallic cable pairs must be tested for proper identification and continuity. All opens, shorts, crosses, grounds, and reversals will be corrected. Correct color-coding and termination of each pair will be verified in the communications equipment room and at the outlet. Horizontal wiring will be tested from and including the termination device in the communications equipment room to and including the modular jack in each room. Backbone wiring must be tested end-to-end, including termination devices, from terminal block to terminal block, in the respective communications closets (from the main demark location back to the supporting telecommunications node in the case of an outside plant backbone cable). These tests must be completed and all errors corrected before any other tests are started. In addition, the testing will take place while other systems (PA systems, background music systems, generators in adjacent rooms, or any other potential forms of EMI/RFI noise in the general proximity of the installed cable plant) are operational an on line to ensure there is no bleed over from these other systems onto the telecomm cable plant. In the case of outside plant copper cable (telephone trunk and distribution cabling), a bad pair rate of less than one per cent will be considered acceptable (no more than one bad pair per 100 pair count of a given cable segment, or overall cable path tested from end to end). In the case of a trunk cable being installed that will leave pairs unterminated in a splice case for later use, all pairs will be tested and failures corrected, prior to sealing up the splice case, or clear capping the end an installed cable segment.

3.4.5. Category 5 or higher Circuit Paths: All installed drops shall be tested using a test set that meets the Class II accuracy requirements of EIA TSB 67 standard. Testing will use the Basic Link Test procedure of EIA TSB 67. Cables that contain faulty circuit paths will be replaced and re-tested to verify the standard is met.

3.4.6. Shielded Twisted Pair: Wiring configuration will be tested for continuity, opens, shorts, crossed pairs, and correct pin configurations; DC resistance both pair-to-pair and wire-to-shield must be verified. Cable lengths must be verified. Near end cross-talk must be tested from 772 kHz to 300 MHz. Ground potential difference between wiring closets, ground potential difference between patch panel and wall outlet, and ground path resistance will be tested per IBM GA27-3361-07.

3.4.7. CATV Cable: CATV cable must be tested for continuity, shorts and opens. Characteristic impedance shall be verified over the range of intended operation. Cable length must be verified. Cable will be sweep tested for attenuation over the range of intended operation.

3.5 Fiber Optic Cable

3.5.1. Outside Plant Connectivity: Outside plant (OSP) fiber optic connectivity for the building will be accomplished by extending a fiber optic cable back to the nearest fiber distribution point. In some cases this may be a distribution cable with dark strands in the nearest manhole. In other cases, it may be the nearest fiber distribution node at an ITN building. The minimum fiber connectivity will be 12 strands of Single Mode (SM) fiber optic cable. Any new cable will be a loose tube, dry water blocked, all-dielectric (non-metallic), direct bury rated type cable, equal in construction and performance to Corning ALTOS cable. The glass strands will be optically and mechanically equal to and compatible with Corning Altos cable (same index of refraction, cladding grade index, same light propagation delays, thermal performance, nominal dimensions, light spectrum loss ratings at all wavelengths between 1310 and 1550 nm, mode diameter, water loss rating, etc). In cases where a project is impacting an existing cable, for example, a new building being constructed on top of an existing cable path that requires the re-routing of the existing cable plant, any fiber installed as a section throw to lengthen or repair an existing cable will be of a type identical to the existing cable (same cladding index, mode diameter, thermal expansion, index of refraction, light propagation delay, basic cable construction such as direct bury rating or loose tube construction, etc.). In cases where the exact type of cable is no longer available, or if it is deemed economically advantageous, the existing cable may be replaced in its entirety as if it was a new cable installation, in which case the new cable will be equal to and compatible with Corning Altos fiber optic cable with at least the same strand count as the existing cable or a standard 12 strand count, whichever count is greater. The cable will be installed in an innerduct of an appropriate type (corrugated inside of duct, or ribbed, solid wall direct bury, toneable for direct bury applications). There will be a minimum 15 meter (50 ft.) service loop left on each end of the cable, as well as in each access point container such as manholes, handholes, and pullboxes that the cable may pass through. The maximum diameter of service loops within a pass through, access point container will be three feet, unless a larger diameter is required to meet the minimum bend radius diameter specified by the cable manufacturer. Service loops will be individually created, bundled, and mounted, ie when multiple cables are installed through the same location as part of a project, they will not be coiled up, en masse, making it virtually impossible to separate out one cable to perform work on it without disturbing and having to work around additional cables within the same coil. The service loop coil will be strapped (tie wrap, hook & loop strips, etc. as appropriate for the installation environment. Hook and loop type strips would not be appropriate for use in a below grade manhole location, for example.) at a minimum of three points equally spaced around the loop and mounted at a location within the container that will not impede the installation of additional cables at a later date. Each service loop will also have a cable ID tag fastened at one of the strap points on the loop. The minimum effort for full and complete labeling will include a machine printed tag attached to the cable sheath at each point where the cable enters or exits the container and where a sheath enters a splice case or patch panel, as well as ensuring the container itself (stenciling inside manhole necks, etc.) is properly identified and marked. The exact label format and information content will be provided for each project by the 673CS Project Manager. In cases where a cable is being installed through a path that does not contain sufficient existing cable management systems to properly support and protect the cable from stress (cable racking brackets with load bearing standoffs and step arms in manhole/handholes, such as Inwesco 10A11 or 10A19 brackets and associated accessories, interior cable tray/J-hooks, etc.), the installation of this material will be included as part of the cable installation project. In cases where two cable segments must be spliced together to continue the run, or a service loop is being opened up to tap into the cable in support of a new building requirement, a service loop will be left on each cable segment entering the splice case. In no instance will a fiber optic cable segment ever be left with the end "unsealed" below grade. All ends of each cable segment below grade will be properly sealed in a Preform Fiberlign splice case, including the end of a cable segment that may have been installed to pre-position it for a future project, but currently does not have a distribution cable being tied to it as part of the initial installation project. In these instances, the splice case will be fully populated with a splice tray organizer, three piece end plates, splice trays, and any other accessories necessary to prepare the splice case for future use. The exterior sheath of the cable will be removed from the length of cable within the case, leaving at least four full wraps of buffer tube (10 ft.) inside the case, ready for final preparation and splicing at a later date. Splice cases set up to support 72 strand or smaller cables will use 12 strand trays, with each buffer tube of the largest cable managed in a separate tray. For cables larger than 72 strands that cannot be fully managed with 12 strand trays, 24 strand trays will be used and two buffer tubes will be associated with each tray. Strands from an individual buffer tube will not be managed across multiple trays. In some instances, it may be necessary to home the new building off two separate ITN buildings due to support of a critical mission, or it may need more than 12 strands run to the building. These will be addressed on a case by case basis. These cables will be terminated using a hot melt adhesive type connector, ST style on each end, and will be spliced using an approved and recently serviced fusion splicer for any intermediate splices. Mechanical crimp type connectors or splices will not be accepted. Generally, the cable terminations will then be installed into a fiber optic patch panel mounted in the equipment racks at each end of the cable segment. Each individual fiber strand will be a minimum of 16" long from the buffer tube/fan out kit transition point to the ST coupler termination. All buffer tubes and individually broken out strands will be properly routed and managed inside the patch panel, making full use of the manufacturer's designed accessories for safely managing, routing, or anchoring the fiber strands and strength member(s) once they exit the external cable sheath. An installation that requires constant manipulation of the buffer tubes or fiber strands to keep them from getting pinched, kinked, or otherwise damaged (ie. strands/tubes trying to spring out of the patch panel chassis or being put under tension when the door is opened, strands/tubes being bent tighter than minimum bend radius, or in danger of being pinched between the door and frame, etc.) when opening or closing the rear door of the patch panel housing will not be accepted. Terminated strands will be installed on the rear of the coupler plates as per industry standard color code ordering. The fiber optic patch panel will be of a fixed panel type with coupler plates that may be changed out to support various types of connectors at a later date. All coupler plate positions within the fiber optic patch panel will be populated with coupler plates containing ST type couplers. A sliding tray style of fiber optic patch panel is not an acceptable type of patch panel due to the continual movement of the outside plant fiber strands during patching operations, as well as the fiber pinch hazards presented by this type of patch panel. The spacing of the individual couplers in the coupler plates will also be given consideration to help minimize the stress on adjacent fiber strands while installing patch cables. A "high density" or small form factor type patch panel (or coupler plate assembly) is not acceptable for outside plant or riser cable terminations. At a minimum, an acceptable design for a fiber optic patch panel for outside plant and riser cables will also incorporate an all encompassing chassis (solid top, bottom, sides-with the exception of sides in front of the termination coupler plates or cable entry slots at the rear of the cabinet), rack mount ears that can support either 19 inch or 23 inch rack mounting, capability to front mount or center mount the chassis in the rack, and have latching front and rear access doors with a fiber strand utilization management record system integral to the front access door. In the case of a patch panel supporting 72 or more ports, there will be a minimum clearance of 3.5 inches from the front of the coupler plate to the inside of the front door. The lowest connector on the coupler plate will be at least 2.5 inches above the bottom of the patch panel chassis and there will be patch cord management retaining clips (several spaced evenly across the front internal portion of the chassis) that are at least 2" x .75" internal dimensions. The minimum connector spacing on the coupler plates will be 0.75 inches on centers. In the case of a 24 to 36 port patch panel assembly, the basic clearances and dimensions regarding the connector locations will be the same with the exception of the clearance between the lowest connector position and the bottom of the chassis, which may be reduced to a minimum 2" clearance. An example of an acceptable style of patch panel is a Corning CCH-04U (for a 72 port patch panel) using 6 port ST coupler plates (p/n CCH-CP06-19T). Generally, a Corning CCH-03 patch panel with 6 port ST coupler plates would be acceptable for communication equipment room locations with a maximum projected fiber strand count of 36 strands. Patch panels installed at ITN or fiber node type locations will be standard density, 72 port patch panels, such as a CCH-04U type cabinet, fully populated with 6-port coupler plates, even if a lower strand count cable is being terminated in that location. Fiber patch panel labeling will, at a minimum, reference cable name, strand count, and far end location (building number, room number, etc.) of each cable segment terminated within the panel. Any proposed deviation from this setup will be addressed on a case by case basis and will require written approval by 673CS Project Management prior to implementation.

3.5.1.1 The physical care of the fiber cable during installation will conform to the most conservative manufacturer, Air Force, or industry standard or guideline related to installation practices of fiber optic cable. At a minimum, a functional ball-bearing swivel pulling eye will be used to draw the cable through the duct. The maximum pulling tension and minimum bend radius will be limited by the manufacturer specifications, but will not exceed 450 lbf pulling tension as per Air Force technical orders, nor will the minimum bend radius under tension be less than 20 times the outer diameter of the cable. In addition, some form of tension monitoring device or a tension limiting device will be used during the installation, particularly when using any form of power assist device to pull the cable to prevent the cable from being exposed to pulling tensions that exceed the maximum rated values. This may take the form of any industry standard practice, such as a dynamometer, in line tensionometer, or properly calibrated slip clutch mechanism on the pulling device, properly configured to measure the pulling tension applied to the cable. The only exception to the requirement to monitor the tension is if the segment being installed is a short, hand pulled section. Properly sized sheave wheels, lip rollers, or other approved devices for controlling the bend radius of the cable will be used at all locations where the cable must change direction under tension, such as crossing a manhole lip or being redirected into ducts. Signs of abuse of the cable, such as slits, tears, or gouges in the outer jacket, kinks in the cable, signs of stretching due to excessive pulling tension, discoloration of the jacket or buffer tube material, or signs of severe scuffing due to being pulled over sharp or rough surfaces will be grounds for replacement and reinstallation of a given cable. Simply trying to massage out the stressed area to make it look better, taping to restore the integrity of the cable sheath (or exposed buffer tubes), or straightening a distorted sheath is not an acceptable fix action.

3.5.1.2 OSP cable installations will be designed/planned to minimize the number of splices needed in any cable run between specified end points or distribution splice points.

3.5.2. Backbone/Feeder/Riser Cables: Fiber optic backbone cables will be run between the main CER and each SCER. The minimum requirement for fiber optic tie cables between unclassified CER locations will be a 12 strand single mode house cable. The glass strands of the backbone riser cable will be optically and mechanically compatible with Corning ALTOS cable, as per section 3.5.1. The basic construction of the cable will be that of a tight buffered cable such as a Corning MIC type cable. Additional fiber optic tie cables may be required on a case by case basis and will addressed as part of the normal design development and review process involve the projected end users, but the 12 strand single mode cable will always be required as a minimum as part of the back bone cable plant within the building. In cases where multimode backbone fiber cable is required between areas, the cable will generally be 50/125 micron cable (Laser Optimized Multi-Mode Fiber – LOMMF) of similar construction as Corning MIC cable capable of supporting 10 Gb links. Termination and testing of these cables will generally be the same as for the outside cable plant termination (hot melt ST connectors, Corning FDC type patch panels, etc.). Unless otherwise specified, single mode backbone cable jackets will be yellow in color and multimode backbone cable jackets will be orange in color (in the case of 50 micron laser optimized cable that is generally being produced with an aqua colored jacket, this is an acceptable color for the riser cable). The jacket colors will be deconflicted with any operationally classified riser and horizontal cables that may be specified within the building (for example, a siprnet riser cable would be red jacketed, etc.). Additionally, a given project may also require the interconnection of the individual SCER locations with each other, or the installation of backbone riser cables to specialized computer or data center support locations. This will also be addressed as part of the design and review process. When areas supporting classified systems (between classified CERs or between a classified CER and a distribution breakout point, for example) must be tied together with a multi-circuit or backbone type cable, the general cable construction will be the same as for unclassified runs, but the cable jacket and marking will be similar to that required for a horizontal run of the same system and security classification being supported (i.e. red jacketed cable stenciled with "Secret" at regular intervals of approximately one foot for a Siprnet backbone cable). All backbone/riser/outside plant cables will have all strands properly terminated on an appropriate device (fiber optic patch panel, telecommunications distribution faceplate, etc.). Multi-strand fiber optic cables running between rooms or entering the building will not be installed such that some strands are directly terminated/plugged into a piece of end user equipment, nor will they be left with un-terminated strands. Any deviation to this standard will be handled on a case by case basis and will require approval, in writing, by the 673rd Communications Squadron Project Management Office.

3.5.3. Horizontal Unclassified Fiber Cable: In cases where the use of Cat 5e or better UTP cable is not acceptable for use in supporting unclassified data runs due to distance limitations, EMI/RFI issues, EMSEC issues, or other functional concerns, it may be necessary to support these areas by installing fiber optic runs between the unclassified CER and the end user locations. General installation practices will be similar to those employed for UTP installation, but paying special attention to any specific issues raised by the use of fiber cable (different bend radius limitations, installation pulling tension limits, etc.). Generally any horizontal fiber optic horizontal cable plant shall be terminated on a patch panel that gives the same operational feel as a typical RJ-45 type high density patch panel. An example of this type of patch panel would be a Siemon CT-PNL-32-ID, filled with the appropriate CT modules for the type of system being installed. The installation of any horizontal fiber cable plant will include some form of cable management or strain relief to manage the horizontal cable entering the rear of the patch panel (similar to a Chatsworth 12176-501). The intent of this cable management is to relieve any strain on the fiber connectors on the back of the patch panels from developing as the weight of the cable bundles causes them to sag over time, and to help prevent the cables from being accidentally snagged or pulled while future work is being performed in the back of the patch panels. At the end user location, the fiber will terminate in a similar manner to the patch panel end. All strands of any horizontal cable will be properly terminated on an appropriate device (faceplate, termination block, patch panel, etc.). In no case will a horizontal cable intended for unclassified telecommunications support (a cable running between rooms to support end user distribution and connectivity for systems such as telephone, niprnet, etc. ,) have individual strands directly terminated on end user equipment or have un-terminated strands. Faceplate/coupler assemblies used at end user locations will also be designed such that it can readily support a flexible, reconfigurable color coding scheme for each port on the faceplate, without having to replace and re-terminate the actual connector or coupler, such as the capability provided by a Siemon CT faceplate/coupler system with the interchangeable colored plastic inserts. This system allows for the easy insertion and later changing of color coded icons to help identify the specific use of a port by a specialty network then be remarked as the utilization of the port changes later without having to change out the actual coupler assembly or impact the termination of the cable within the faceplate. In the case of unclassified network drops (i.e., Niprnet), the fiber used will be a 50/125 micron, laser optimized, blue jacketed, plenum rated duplex cable (such as a zipcord or DIB type cable). The fiber will be terminated with hot melt SC type connectors. The performance of this fiber will be certified to support full 10G Ethernet effective modal bandwidth (minimum 2000MHz*km EMB). The performance rating of the cable will have been certified using the minEMBc method to ensure high performance compatibility with all qualified source lasers being provided with end user equipment.

3.6 Testing/ Inspection and Acceptance (Fiber): A basic visual examination of the installed cable plant will take place prior to any formal testing. The examination will look for signs that proper installation techniques were not used. The visual inspection will include, but is not limited to, looking at cable bend radius, proper cable support, signs of kinking, stretching, or snagging of cables during installation, or any other sign that basic installation standards were not adhered to for a given cable type. Violation of any of these standards or any sign that a cable has been stressed during installation is grounds for rejection of the installed cable plant. Once the visual inspection is passed, all strands will be tested to standards appropriate to the performance rating of the installed cable type. In cases where work is related to existing, active cables, all strands will be tested before and after the work, once appropriate down time is scheduled for any active circuits that may be routed through the cable. The organization performing the tests will be responsible for removing and re-establishing cross connects as necessary to perform the necessary tests and return the cable(s) to service once down time has been coordinated.

3.6.1. Test Plan: A Test plan defining required tests and type of test equipment to be used during testing is required to ensure the system meets technical, operational, and performance specifications. The proposed test plan shall be submitted for review 60 days prior to the proposed test start date. The test plan must be approved before the start of any testing. The test plan shall identify the capabilities and functions to be tested as well as an outline of detailed instructions for setting up and executing the test plan. Additionally, the plan is required to outline the procedures for evaluating and documenting the results of the test. The test plan will also address any specific issues related circuit down time and removal/replacement/relocation of patch cords supporting existing circuit requirements that may be impacted by the test procedure. Once actual test dates are determined, 673CS/SCXP will be given at least a seven calendar day advance notice, with the option to observe the test procedures.

3.6.2. Test Reports and As-Built Prints: Test reports shall be submitted in booklet or CDROM format with witness signatures verifying execution of all tests listed in the test plan. Reports shall show the field tests performed to verify equipment compliance with specified performance criteria. The test reports will include a record of all physical parameters verified during testing. At a minimum, test reports will include power loss insertion measurements for each direction of each strand (two values for each strand) for each wavelength, as well as OTDR traces for each direction on each strand for each wavelength. In addition, the raw data collected by the test equipment will be copied to an optical disk and be provided. Test reports will be submitted to 673rd Communications Squadron Project Management Office for submission and review by the 673 CS OPR, usually O & M Activity, within 14 days after completion of testing. As-Built prints will include, as a minimum, overall floor plans showing telecommunications drop locations and associated drop label locations, CER floor plan layouts, TTB layouts, equipment rack layouts, riser cable drawings, and appropriate GPS/GeoBase survey data. In the case of the installation of any specialty equipment that directly supports communications requirements, additional as built drawings will be provided as needed to fully document the installation of the equipment (such as WAP antennas in Hangar bays, or on the exterior of a building, etc.). The format of any as built documentation will conform to those listed in section 1.1.2. In addition, any electronic versions of as-built documentation will be supplied in a version that is fully capable of being edited at a later date (i.e., a CAD drawing will be provided in an unlocked/ungrouped format so that individual items can be edited or more readily merged into existing floor plans. Adobe PDF or similar documents that cannot be edited are not an acceptable format for as-built documentation.).

3.6.3. Materials & Documentation: Materials and documentation to be furnished under this specification are subject to inspections and tests. All components must be terminated and labeled before testing for final acceptance. Equipment and systems will not be accepted until the required inspections and tests have been made, demonstrating that the signal distribution system conforms to the specified requirements, and that the required equipment, systems, and documentation have been provided. To support this initiative, an appointed 673rd Communications Squadron Quality Control (QC) representative shall observe operational tests, and analyze both observed and annotated test results provided by the contractor. Any system, equipment, or hardware that does not meet Department of Defense (DOD), manufacturers, or ANSI TIA/EIA standards as appropriate will not be accepted. All discrepancies must be re-tested/re-inspected and the results certified correct in writing by the 673rd Communications Squadron QC representative prior to any final acceptance.

3.6.4. Fiber Optic Cable Testing: Unless stated otherwise, tests must be performed from both ends of each strand, including those with active circuits in the case of work on an existing cable, once appropriate down time has been scheduled. Test results for each individual circuit path segment (contiguous fiber strand between connectors, or from an individual connector to the end of a strand in case of drop dead counts) and direction of test will be presented individually. Connectors will be visually inspected for scratches, pits, chips, or contamination and must be cleaned, repolished, or re-terminated if any of these conditions exist. Each multimode circuit leg and complete circuit will be tested for insertion loss at 850 and 1300 nm using a light source similar to that used for the intended communications equipment. Each single mode circuit segment and complete circuit path will be tested for insertion loss (power loss test) at 1310, 1490, and 1550 nm using a light source similar to that used for the intended communications equipment, and showing a flat response across the frequency spectrum. It is suggested that the fiber testing be accomplished using test equipment that is designed specifically for testing fiber optic cable, since a body of evidence is developing within the industry showing a significant amount of erroneous test results are being recorded using combination Fiber/Copper test equipment. In addition to the insertion loss testing, fiber backbone/riser and outside plant cables will also be tested similarly (same wavelengths, from both ends of the fiber strand, etc.) using an Optical Time Domain Reflectometer (OTDR). Scale of the OTDR trace will be such that the entire circuit appears over a minimum of 80 percent of the X-axis. Acceptable loss for fiber splices (fusion type splicing) is between 0 and 0.25 dB. Acceptable loss for connector interfaces (i.e. mated connector pairs such as patch panels, etc) is between 0 and 0.5 dB. The maximum acceptable reflectivity for any measured anomaly (connectors, splices, etc.) is 30 dB. The connector losses will be measured without any special effort to align the connector faces, i.e. jiggling or rotating a connector to try to get a better reading. The overall loss budget for the run will then be calculated based on the actual advertised attenuation budget for the cable being installed as a function of distance, at the wavelength being tested (i.e. 0.3 dB/km for Corning ALTOS single mode cable at 1550nm, multiplied by the length of the cable in km), plus the maximum allowable loss due to the number of splices plus the maximum allowable loss due to the connector interfaces under test, etc.

In cases where a mid-sheath opening (cable tap/splice) is being performed to tie into a trunk cable, the strands that are part of the specified splice effort will be tested as specified above. A trunk cable would be considered to be any cable in which all strands terminate at the same node building on one end, but various strand counts are broken out and delivered to (or planned for delivery to) different end user locations. In addition, all other strands within the trunk cable that are not supporting active circuits will also be tested with an OTDR to ensure no damage was inflicted on these strands during the mid-sheath opening and splicing operations. Any blatant damage or anomalies noted within 100 ft. on either side of the splice location, as measured by the OTDR, will be grounds for an appropriate remediation effort to the trunk cable. The scope of this effort will be dependent on the exact location and type of problem identified via the testing process, but could range from reworking existing splices to replacing complete cable sections. Installing short sections thows in a fiber optic cable path which add additional splice points and cable sheath vulnerabilities to an overall run will not be deemed an acceptable remedy to a new cable installation that does not pass initial testing, nor to fix an existing cable that is damaged as part of an installation effort.

Any pre-installation test results generated as part of the project to validate the condition of the fiber cable prior to work commencement will also be provided to the 673CS/SCXP project manager. Any damage or performance issues noted before work begins will be addressed and appropriate actions will be determined prior to work proceeding. If no pre-installation tests are performed, then all risk will be assumed by the installing entity and any damage or out of specification test results will require corrective action by the installing entity prior to project acceptance by the 673CS. This will apply to all strands within the same cable sheath that is directly involved in the project.

3.6.5. CATV: Must be coordinated with local cable provider.

3.7 Mass notification/Giant Voice: In the case of a new area being developed, In addition to the mass notification system being installed internal to the building, attention will be paid to the Giant Voice coverage external to the building. This may require the upgrade of an existing node located in the general area of the new building. In other cases, it may require the installation of a new node to ensure proper coverage within the area. Any new equipment being installed will be compatible with the current, wireless Giant Voice system in operation on JBER (Federal Signal based system). The equipment will include all necessary material to be compatible with the wireless transport system and interoperable with the control consoles located in buildings 11550 and 10471. In the case of construction in an area requiring a new node, it will be necessary to consider and install all components necessary, such as utility pole, 120 VAC power feed, number of speaker cell assemblies to fully cover the area, etc. The installation of the pole will generally adhere to the Whelen-2900 series installation specifications with any additional concerns due to the local environment taken into account (wind loading presented by the equipment, soil conditions, effects due to freeze/thaw cycles, etc.). All new Mass Notification Systems installed internal to a building will include any interface equipment necessary to allow the Giant Voice system to broadcast announcements inside of the building as well.

3.8 Specialty Telecommunications Systems: In the case of any specialty networks or other specialized communications requirements, full specifications will be fully developed as needed. The general installation practice will be the same as that used for unclassified fiber or copper installations, while meeting any specialty requirements dictated by the specific system (cable jacket color/markings, type of connectors, etc.). This is to include things like working clearances around equipment, dedicated power circuits provided to each equipment location, general cable management practices, etc. The following information is included as a convenience to be used as a design starting point for some of the more common specialty networks now being employed and to create a general awareness of additional standards that must be incorporated into the design process for these systems. This standard is not to be treated as a complete standard for these systems, nor is it intended to over ride any other specific standards related to a specialized/secure system. All specialty network support equipment locations will be designed with an unclassified telecommunications quad faceplate being located inside the main distribution cabinet/rack in support of the distribution equipment, reaching back to the appropriate unclassified CER location. The faceplate installation location and cable routing path will need to be worked in such a manner as to take into account all necessary working clearances between the unclassified cable plant and the classified equipment and cable routing also being located within the cabinet/rack. At a minimum, a dedicated/isolated (separate phase, neutral, ground conductors for each circuit back to breaker panel) circuit terminated in a quad outlet in the base of the respective equipment mounting racks will be included in the design, unless other more specific power requirements are levied for a given location. Physical construction of a room supporting any specialty telecommunications system or unsecured end user drop location will be constructed to a physical security rating appropriate for housing and protecting that system (for example, a CER housing a Siprnet system will be constructed to at least a Secret/Open Storage rating).

3.8.1 Air Force PDS: In the case of any network that is considered to be classified at a security level of secret or higher, the cable paths, often referred to as Protected Distribution Systems (PDS), used to protect these specialized cable plants when run outside of the secured vault or enclosure will, as a minimum, adhere to specifications contained in AFSSI 7703 (as well as any other specifications pertinent to the specific system being installed). Any of the systems included in this section will be installed fully to their respective specialized standards to ensure they are fully operational and can be fully accredited by the appropriate agencies. The basic performance level and installation practices of the specialty network cable plants will be similar to the unclassified horizontal and riser cable plants referenced previously in this standard unless otherwise noted in the specific design requirements or specific standards related to these specialized systems. In general, any reference to a telecommunications drop within a design document (RFP, shop drawings, etc.) will be taken to mean a fully functional transport path (appropriate kind of cable, connector termination, protected pathways as needed, etc.) as appropriate to the classification level and operational requirements of the given telecommunications type (Siprnet, Cafnet, classified IMIS, etc.). This would include instances where the term PDS is used to reference locations for classified drops. The PDS system shall be considered to include the appropriate type of cabling, terminations, cable paths, etc. as necessary to create a fully functional communications path as defined for a specific network type. Once the basic PDS installation is complete and is ready to be inspected/accredited, all locations that need to be sealed (conduit fittings, screw down lids, etc.) will be sealed with red colored epoxy. Any pull boxes that must be installed in the PDS system will utilize a basic construction similar to an end user lock box (similar gauge steel, tamper resistant hinge, padlock fitting appropriate for a GSA approved lock to secure the access door, no prepunched knockout fittings, etc.) , but sized according to the conduits and number of cables associated with it. The pull boxes will be installed in manner that allows easy access to the interior of the box when the door is opened (the doors will swing open horizontally, working clearance around the door will allow for opening in an arc greater than 100 degrees from the closed position, the door will naturally stay in the opened position without needing to be propped open, etc.). Each lockbox and pull box location will be provided with a GSA approved tamper resistant padlock such that the end result of the construction effort is that the PDS system is ready to be accredited and the secured communications lines can be activated with no further effort (i.e. a turnkey system). The general design practice for PDS installation will avoid the use of alarmed PDS since the 3WG has no general provision to support remote monitoring of the PDS. The installation of alarmed PDS will not relieve the end user of responsibility for maintaining the security or integrity of the PDS supporting their mission.

3.8.2 Air Force Siprnet (classified): General connectivity for Siprnet will be accomplished using duplex 50/125 micron laser optimized multimode fiber optic cable (LOMMF) that is compatible with MT-RJ connectors. The cable will be red jacketed and marked with “Secret” stenciled at approximately three foot intervals along the cable. The cable will be terminated with standard MT-RJ connectors (no special keying or color coding). The cables will be landed in a Siemon CT coupler plate, using the appropriate coupler assemblies to support the required port count at the end user locations. The cables will be landed on an appropriately sized CT panel such as a Siemon CT-PNL-32-ID with horizontal cable management and strain relief devices used on the back side of the patch panel locations to prevent the cables from being pulled or jostled in a manner that creates strain on the connectors. The general practice will be to mount end user accessible lock boxes 48 inches above finished floor. In dedicated comm. rooms classified for open storage, open equipment racks may be used with appropriate vertical and horizontal cable management installed, similar to an unclassified comm. rack. In cases where the Siprnet termination point and equipment mounting location is to be shared with other systems not owned/maintained by 673CS or where the area is routinely accessed by multiple entities, an appropriate enclosed equipment cabinet will be factored into the design and approved by 673CS Project Managers in writing, prior to implementation. This cabinet will need to be designed such that it readily accepts the customer furnished end equipment while also properly managing all the cable terminating within the cabinet and fully supporting any operational requirements, such as power outlets within the equipment cabinet or powered ventilation to prevent heat buildup. Generally this will mean an equipment cabinet that is approximately 7 ft tall and at least 30” deep, with a width that supports standard 19 inch rack mounting of equipment and some form of vertical cable management on each side of the equipment mounting rails, but other installation requirements may be addressed on a case by case basis. The installation location of the cabinet within the room will allow for front and rear access to the cabinet and to allow doors to be opened beyond a 90 degree swing to permit full access into the cabinet.

3.8.3 Cafnet (classified): General connectivity for Cafnet will be accomplished using duplex 50/125 micron LOMMF cable, terminated with hot melt LC connectors. The cable sheath will be colored red and marked with “Secret/SAR” stenciled at regular intervals of approximately three feet. The end user drops will extend directly to the appropriate secured communications equipment room located within an operational SAP vault. All Cafnet drops will terminate on a patch panel designated for Cafnet drops only and will not be intermingled with any other network terminations.

3.8.4 ODS (classified): General connectivity for ODS will be accomplished using duplex 50/125 micron LOMMF cable, terminated with hot melt LC connectors. The cable sheath will be colored red and marked with “Secret/SAR” stenciled at regular intervals of approximately one foot. The end user drops will extend directly to the appropriate secured communications equipment room located within an operational SAP vault (same location as Cafnet). ODS drops will be terminated on a patch panel designated for ODS drops only, but in the same equipment rack as the Cafnet patch panels.

3.8.5 IMIS (Classified): General connectivity for classified IMIS drops will be accomplished using duplex 50/125 micron LOMMF cable, terminated using hot melt LC connectors. The cable sheath will be colored red and marked with "Secret/SAR" stenciled at approximately three foot intervals. The end user drops will extend directly back to a classified IMIS server room, or other appropriately secure communications as designated for each project. Classified IMIS drops will be terminated on a patch panel designated for Classified IMIS drops only in appropriately classified equipment rack.

3.8.6 IMIS (unclassified): General connectivity for unclassified IMIS system drops will be accomplished as if they are an unclassified Niprnet drop (general purpose unclassified telecommunications drops). A given end user drop will terminate in the nearest unclassified communications equipment room as if it were a general purpose unclassified telecommunications drop with plenum rated, blue jacketed cable terminated to a T568A pinout RJ-45 port.

3.8.7 FIRM (unclassified): General connectivity for unclassified FIRM drops will be accomplished similar to general purpose unclassified telecommunications drops. A given end user drop will terminate in the nearest unclassified communications equipment room as if it were a general purpose unclassified telecommunications drop. In the case where FIRM requirements are to be supported as part of a given project, it will be necessary to install an additional equipment rack on the opposite side of the horizontal cable patch panel as the base network connectivity rack.

3.8.8 RELCAN (classified): General connectivity for RELCAN drops will be accomplished similar to Siprnet drops. The fiber optic cable will be green jacketed and stenciled "RELCAN" at regular intervals of approximately three feet. The fiber will be terminated with hot melt ST connectors at both ends of the cable.

3.8.9 Wireless Access Points (unclassified): In general, provisions for wireless access point (WAP) support will be provided in any large, open area, such as hangar bays, warehouse, conference rooms, training or class rooms, parking ramps in front of hangars, etc. Support for administrative type areas will be addressed on a case by case basis. A basic analysis will be performed to determine the number of overlapping coverage zones needed to ensure reliable service throughout the overall area. The minimum level of installation will consist of a design that provides the necessary infrastructure to support the installation of two active WAP units and mating antenna locations that will provide at least a 75% coverage overlap of each other, with a third WAP tied to an air monitor antenna location spaced between the two active antenna locations. Larger areas will require an expansion of this basic architecture as necessary to provide full coverage of the identified area. The basic installation requirements within an office type area will be based on an Aruba Networks AP-65 and associated accessories. The basic installation requirements for a large industrial type area (warehouse, hangar bay, etc.) or exterior location will be based on an Aruba Networks AP-85 series WAP and appropriate support accessories and antennas. Generally, this type of installation will involve mounting an appropriate type cabinet on a wall, at a readily accessible location (approximately 5-8 ft elevation, clear floor access to the location, etc.) with a minimum of four Cat 5e drops within the cabinet to house a minimum of three WAP units. Multiple cabinets may be used if this is more feasible from a physical architecture standpoint. Specific cabinet types and models will be appropriate to the locations being developed to provide general environmental protection as needed, or provide appropriate safety capabilities in hazardous rated areas. In general, there will be no need to open the cabinets on a regular basis during normal work processes in a given area. Access to cabinets in secure/hazardous locations can be coordinated with individual work centers to insure safe working environments. In addition, conduit risers sized to support antenna extension cables with connectors on them, will be installed between the cabinet(s) and the supported antenna locations. Antenna cables will be left installed in these conduits with the appropriate connectors as needed to an air monitor WAP unit. Antenna cables will generally be LMR-400 type cables (similar to an Aruba Networks AP-CBL-1) with an N-type male connector on the end to be connected to the WAP and the appropriate connector needed on the other end to connect to the specific antenna type being specified for use at that location (N-type female, RP-SMA, etc.). In cases where the distance of the run cannot be properly supported by the performance characteristics of the standard LMR-400 type cable, higher performance cable systems will be installed to ensure the full operational capabilities of the system can be achieved once the equipment is installed.

3.8.10 Army Siprnet (classified): For any installations supporting the Army Siprnet system, all aspects of the system (cable installation, faceplate layout, PDS layout and installation, separation from other systems, etc.) will defer to the Army as the CTA/DAA authority. Point of contact is the 59th Signal Battalion Plans Shop, 384-7877 or 384-2891. The information provided in this section is to help ensure general awareness of the special nature of supporting Army Siprnet infrastructure, but should not be considered as a limitation or sole source of design information for this system. Neither should it be considered as a substitute to in depth coordination with the subject matter POC. As a minimum, the most current versions of the following documents (or their subsequent operational replacements) will be used as design references. Other specific design references may also apply to specific projects as identified on a case by case basis, requiring coordination with the 59th Signal Battalion POC.

1. AR 380-5 CHAPTER 7, STORAGE AND PHYSICAL SECURITY STANDARDS, 7-12, 7-13.
2. NSTISSI 7003, PROTECTIVE DISTRIBUTION SYSTEMS (PDS), (LATEST VERSION).
3. USAISEC SECRET INTERNET PROTOCOL ROUTER NETWORK (SIPRNET) TECHNICAL IMPLEMENTATION CRITERIA (LATEST VERSION).
4. UFGS SECTION 27 05 28, PROTECTIVE DISTRIBUTION SYSTEM (PDS) FOR SIPRNET COMMUNICATIONS SYSTEMS.

Some basic design considerations are as follows.

a. Siprnet installation requirements - provide the following requirements: the siprnet room shall be designed in accordance with ar 380-5 standards. Siprnet room requirements will be dependent on the facility size and siprnet functional requirements. Smaller facilities with projected low (under 48 users) siprnet requirements will require a separate siprnet room with a GSA approved class 5 safe and connecting protected distribution system (pds) (ref.NSTISSI 7003). For facilites with projected high (over 48 users) siprnet reqirements, the siprnet room will be constructied to vault standards and connect to a pds. Interconnecting conduit and cableing infrastructure supporting the siprnet rooms shall be designed and constructed in accordance with the technical guide for the integration of the secret internet protocol router network (siprnet), AR 380-5, NSTISSI 7003 and associated documents (latest version). The siprnet room or vault shall be adjacent to the main telecommunications room (tr). The connection pathway to the main tr and from the siprnet room shall be via a 2-inch trade size steel conduit. The conduit shall transition into the siprnet room and connect to basket cable tray with seismic bracing. Provide a communications signal ground bus bar connected to the main tr bus bar via a properly sized ground wire and conduit (see MIL-HDBK-419-a, which is referenced in the technical guide for the integration of siprnet). Provide a dedicated 20-amp 120v general duty safety switch, with lockout capability in the siprnet room/vault. Provide a dedicated 20-amp, 120v quadruplex receptacle for siprnet rack. Provide a dedicated 20-amp, 120v quadruplex receptacle on the wall near the data rack in the vault and near the GSA safe in a siprnet room. Provide general purpose 110v outlets. Provide a RJ-11 modular jack for wall-mounted phone at 54" in the siprnet room entrance.

b. Provide a protected distribution system (pds) – secure raceway shall be used to provide a more aesthetically pleasing pds specifically designed for command and administrative office environments. The steel secure raceway pds shall include an interlocking "clam-shell" design that enhances security and flexibility in that it can be securely closed and locked, and then re-opened for security inspections and network changes or enhancements. The secure raceway pds shall also include an electrostatic power coating from the manufacturer, which provides an aesthetically pleasing appearance." The interlocking pds system shall be compliant with NSTISSI 7003 (latest version). The pds system shall include but not limited to steel secure raceway, pull boxes, distribution boxes, user drop boxes, outlets, GSA/NSA approved locks, multimode fiber optic cable (foc), sc-upc connectors, fiber optic panel(s), and loaded 84"h x 3.5"d x 19"w data rack. Provide 6 strands single mode fiber optic cable (foc), fo patch panel(s), sc-upc connectors, between TR and siprnet room data rack. Provide 4 strands multi-mode fiber optic cable (foc) for horizontal distribution from the user drop box to the siprnet room data rack, terminate "sc-upc" all strands. The current standard supported and maintained by the army in ALASKA, is Holocom pds products.

c. The siprnet installation practices - building telecommunications infrastructure and cabling shall be installed in accordance with NECA/BICSI 568-2006, standards for installing commercial building telecommunications cabling. All members of the siprnet installation team shall be certified on all components and installation practices of the protected distribution system (pds) manufactured products.

d. National security telecommunications and information systems security instruction (nstissi) no. 7003 - requires the design drawings/floor plans to be provided as part of the siprnet protected distribution system (pds) approval request package. Provide a separate drawing for both vertical and horizontal distribution. Provide a system cabling and one-line diagram. Vertical drawing will show pds runs between floors and horizontal drawings will show pds runs down hallways and into offices. Drawing packages must be submitted to the 59th Signal Battalion, plans and architecture section for review, well in advance of starting constructoin. The Alaska Network Enterprise Center (NEC) requires the pds design drawings/floor plans, to be provided in autocad format with the pds complete design, including the route, locations of user drop boxes and manufacturer product provided. The NEC will submit the package to the ctta for approval. The package must be approved by the CTTA prior to construction.

e. A 12 strand single mode fiber optic cable, terminated with hot melt type ST connectors will be run between the main fiber cable demark location in the main telecommunications room and any siprnet telecommunications room locations.

3.9 RF and other Antenna support requirements: Dependent on the expected type of RF communications equipment that will be associated with a particular building, this section should be considered as a general guideline and design starting point. The design contractor will be required to fully develop specific requirements and apply appropriate design standards associated with particular RF communications systems (ALMR, TRC-176, satellite dish antenna, etc.). As a starting point, the design of the building infrastructure will include a 4" conduit from the appropriate end user equipment location up to the roof, taking into account personnel access to this roof top location. This conduit will have a protective end bushing on the interior end and a weather head appropriate to routing RF type coaxial cables through on the exposed roof level end. On the roof, there will be a quantity of two each vertical 2"diameter steel pipes mounted to support antenna mounting accessories/brackets. The steel pipes will be positioned approximately four feet tall and 10 feet apart and will be of a strength rating and mounted in such a manner as to withstand a 100 MPH wind load with the types of antennas associated with the customer identified systems. The 4" conduit riser and the 2" steel poles will be installed relatively close to each other and will require some sort of cable management system between them to properly route and protect the RF cables running from the riser conduit to the mounting poles (i.e., possibly something like a small, elevated basket tray assembly running between locations to keep the cables off the actual roof surface, restrained during windy periods, not sitting in water during periods of precipitation, etc.). All appropriate installation standards and safety codes will apply with regards to fully grounding all metallic parts of the system for lighting protection, electrical noise reduction, protection of the integrity of the roofing system, etc. In the event that a single end user location is not determined related to all RF systems, an optional termination point for the 4" conduit inside the building may be in a centralized location between all the users, in the general vicinity of the interior comm. backbone path, or multiple riser conduits may be required to support multiple areas. In the case where it may be feasible to use a single riser conduit to support multiple locations located in close proximity to each other, an additional RF cable path will be developed to support the multiple areas. The RF cables will not be routed within 12 inches of other copper based signal cable infrastructure. Neither the conduit riser, nor any other item (such as RF cables, etc.) entering from the exterior of the building will be tied directly to the cable tray system or any other communications path devices in an attempt to create a ground path in this manner.

//SIGNED//
TONU ROODE, SCX Flight Chief

Typical Installation drawing attachments: The drawings shown in this section should be used as a functional example of rack layouts, telephone backboard layouts, cable interconnectivity between CERs, manhole/handhole construction formats, etc. This drawings should not be used directly as design/installation drawings for any specific project. Drawings specific to each project will need to be developed based on requirements and local conditions identified for each project, but these drawings should serve as a design template for the creation of the specific project drawings. Electronic versions of these drawings are available in a Microstation Version 8 format or as an Adobe PDF version on request, however, due to the nature of the conversion from a CAD format to the PDF, resolution and clarity of the drawings in the PDF format can be expected to suffer some degradation.

JOINT BASE ELMENDORF-RICHARDSON AFB STANDARD MH AND HH CONSTRUCTION LAYOUT

LAST UPDATED: 28JUL2016

PROPERTY OF 673RD COMMUNICATIONS SQUADRON, JOINT BASE ELMENDORF-RICHARDSON.

8'W x 10'L x 7'D
Maintenance Hole Layout

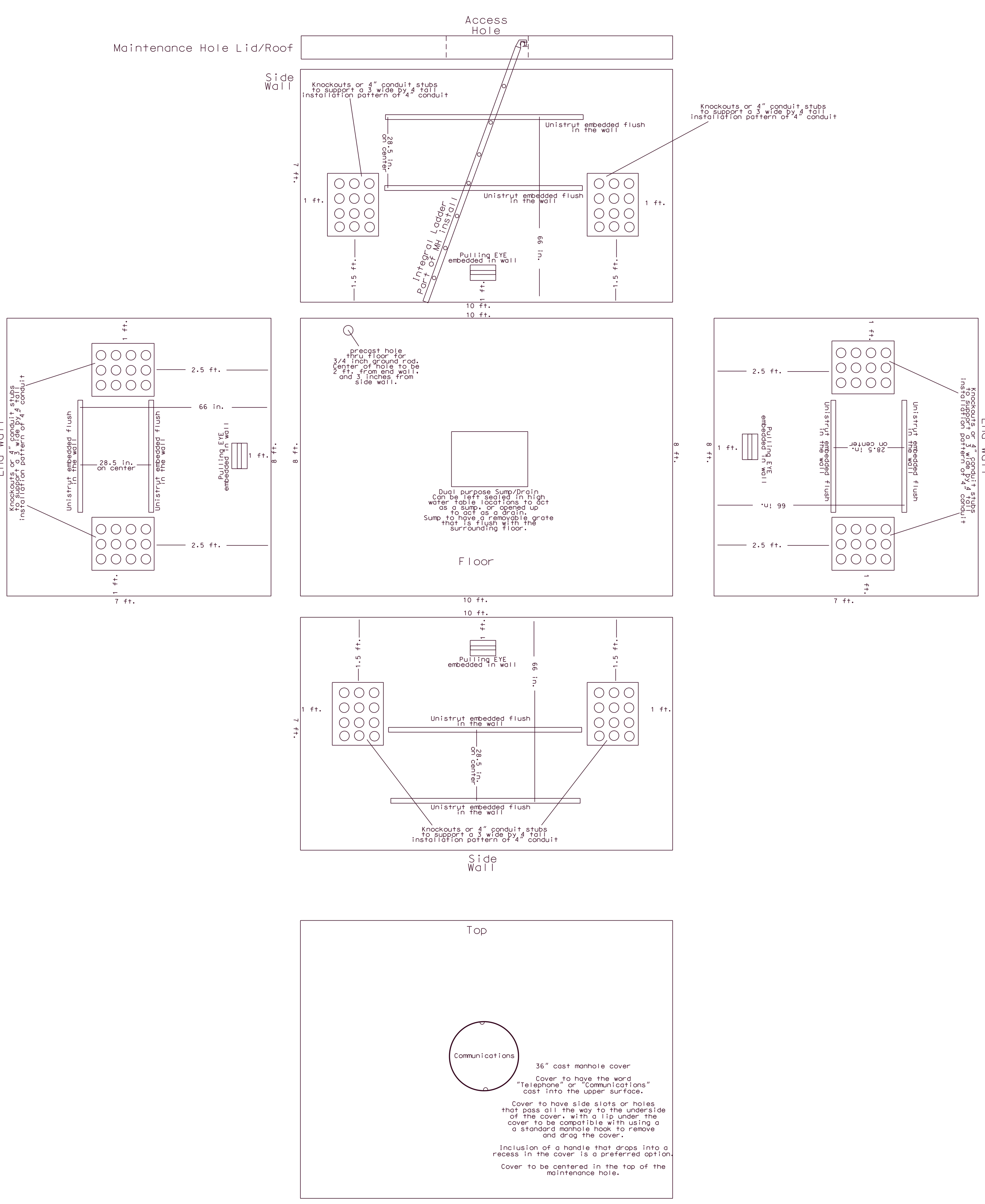
Features shown are not to scale. Locations shown are representative and should reference dimensions shown on the drawing for accurate placement. Dimensions are nominal interior dimensions such that there is a clear working floor space of 8'x10' with a vertical clear working space of 7'. Unistrut embedded in the walls will be parallel and vertically aligned with each other on a given wall. The ends of a given unistrut pair will generally extend horizontally to within 6" of an impeding feature, such as a side wall, conduit window, etc.

When constructed with knockouts to support conduit entry, the newly installed conduit will be grouted into the wall opening.

Reference JBER Telecommunications Installation Standards for additional construction requirements. This drawing is meant to give a basic understanding of the manhole and handhole requirements, but should not be considered as identifying every associated requirement.

Basic structural performance will be that of a typical manhole rated for traffic load bearing locations, constructed of re-inforced waterproof concrete.

Construction will include an integral entry ladder that is sloped from the from the manhole lid down to the floor level such that it does not terminate on/in the sump/drain area. Ladder will hook onto a rung that is integral to the access hole.



6'W x 8'L x 7'D
Maintenance Hole Layout

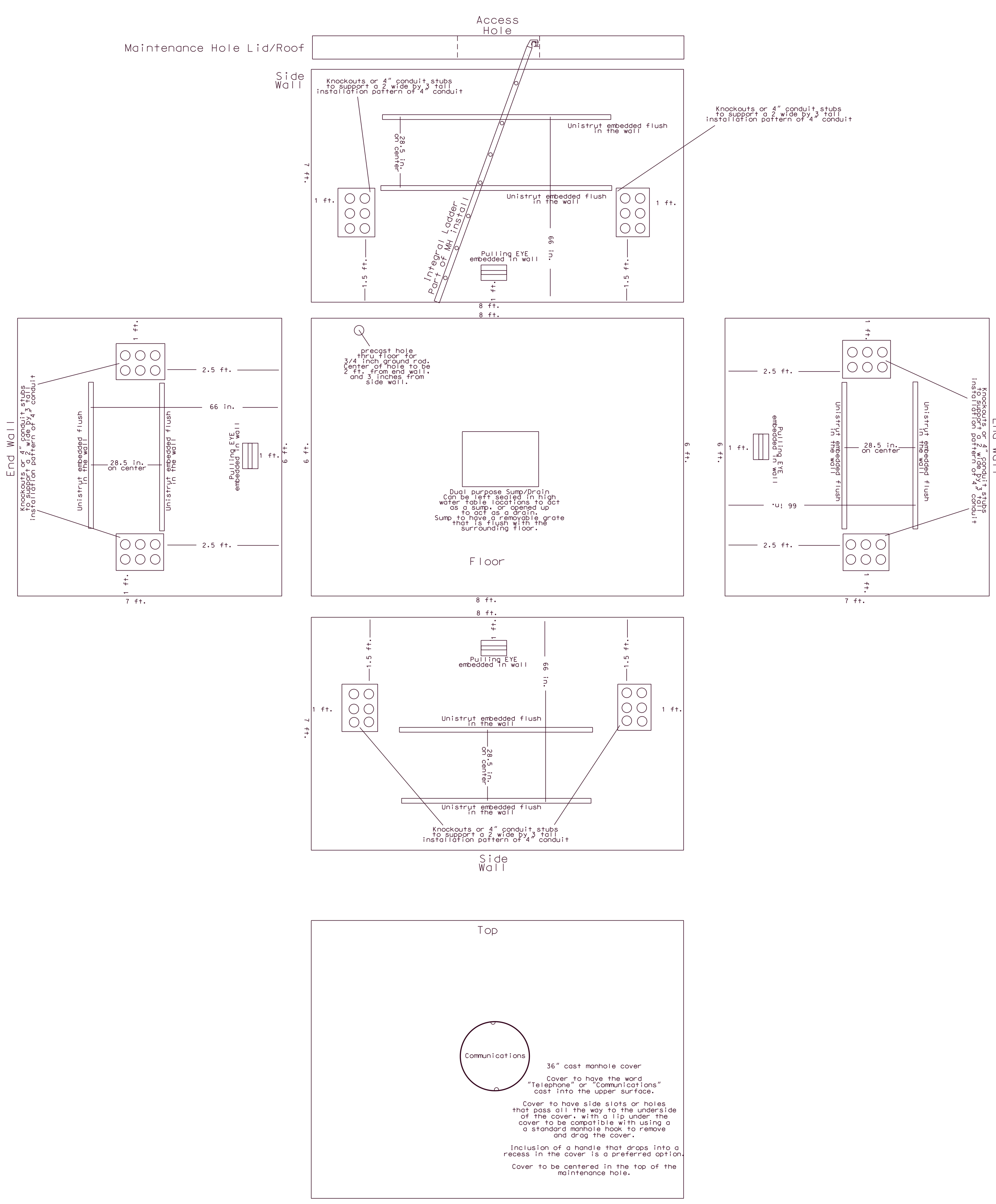
Features shown are not to scale. Locations shown are representative and should reference dimensions shown on the drawing for accurate placement. Dimensions are nominal interior dimensions such that there is a clear working floor space of 6'x8' with a vertical clear working space of 7'. Unistrut embedded in the walls will be parallel and vertically aligned with each other on a given wall. The ends of a given unistrut pair will generally extend horizontally to within 6" of an impeding feature, such as a side wall, conduit window, etc.

When constructed with knockouts to support conduit entry, the newly installed conduit will be grouted into the wall opening.

Reference JBER Telecommunications Installation Standards for additional construction requirements. This drawing is meant to give a basic understanding of the manhole and handhole requirements, but should not be considered as identifying every associated requirement.

Basic structural performance will be that of a typical manhole rated for traffic load bearing locations, constructed of re-inforced waterproof concrete.

Construction will include an integral entry ladder that is sloped from the from the manhole lid down to the floor level such that it does not terminate on/in the sump/drain area. Ladder will hook onto a rung that is integral to the access opening



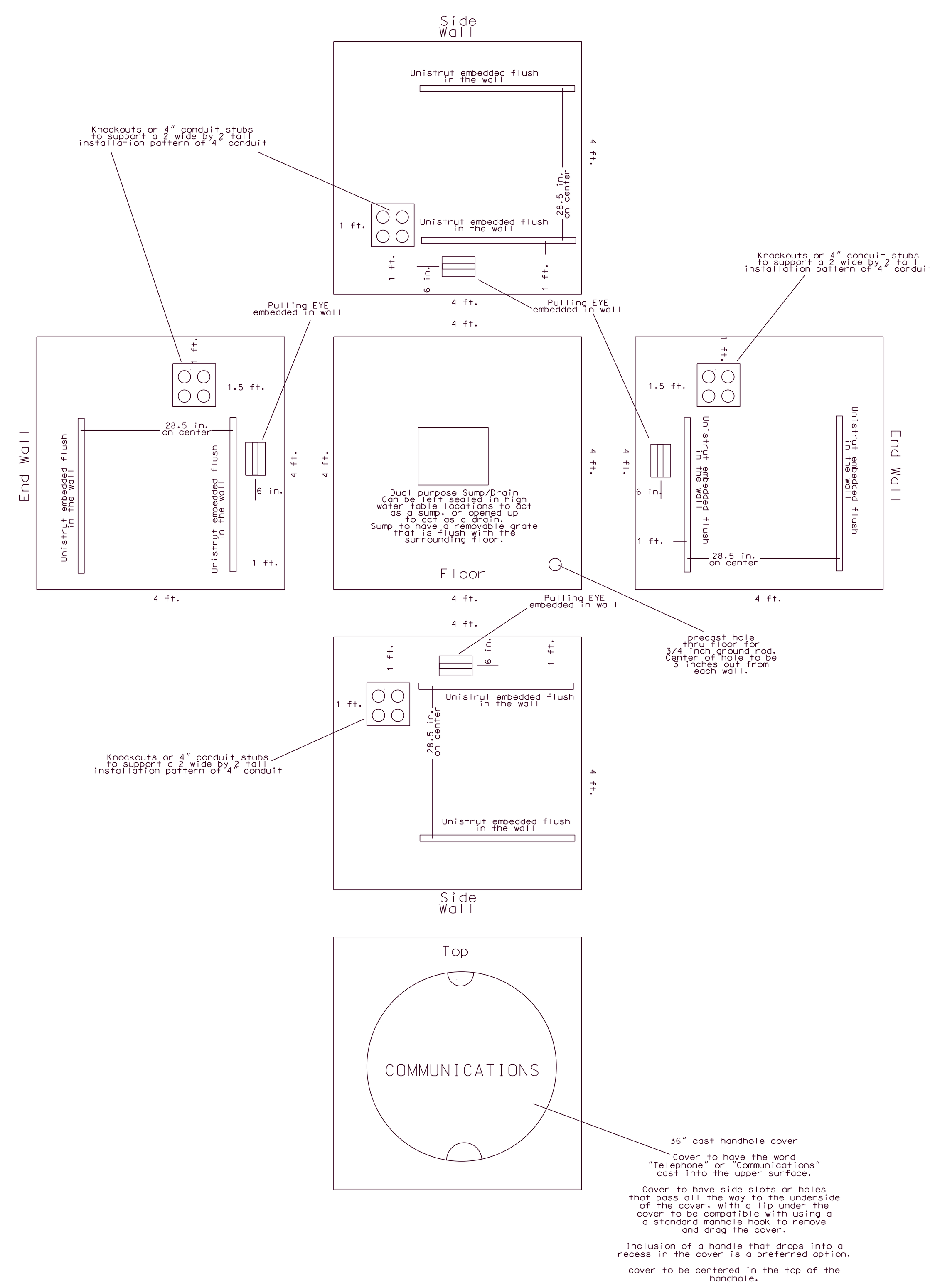
4'W x 4'L x 4'D
Handhole Layout

Features shown are not to scale. Locations shown are representative and should reference dimensions shown on the drawing for accurate placement. Dimensions are nominal interior dimensions such that there is a clear working floor space of 4'x4' with a vertical clear working space of 4'. Unistrut embedded in the walls will be parallel and vertically aligned with each other on a given wall. The ends of a given unistrut pair will generally extend horizontally to within 6" of an impeding feature, such as a side wall, conduit window, etc.

When constructed with knockouts to support conduit entry, the newly installed conduit will be grouted into the wall opening.

Reference JBER Telecommunications Installation Standards for additional construction requirements. This drawing is meant to give a basic understanding of the manhole and handhole requirements, but should not be considered as identifying every associated requirement.

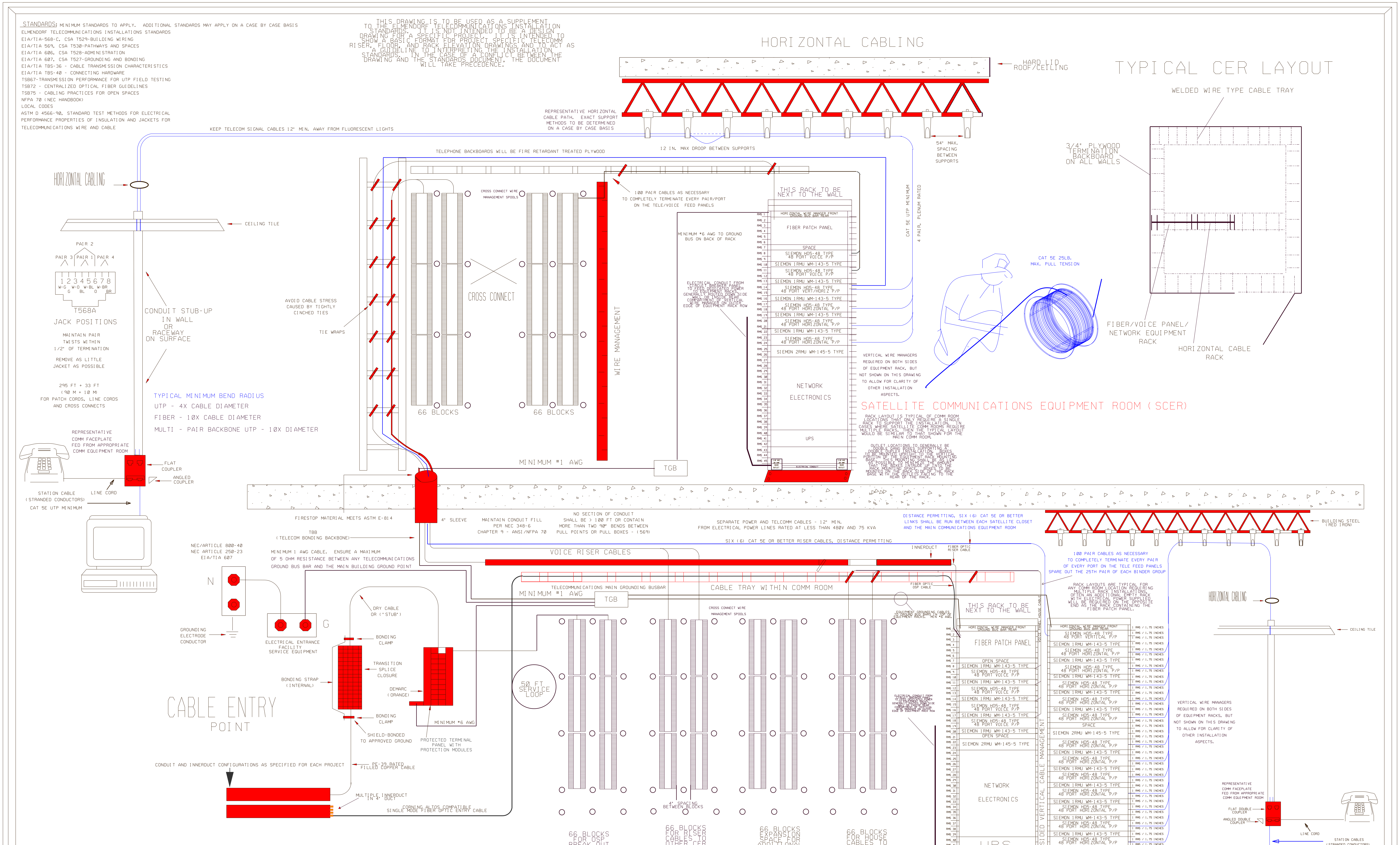
Basic structural performance will be that of a typical handhole rated for traffic load bearing locations, constructed of re-inforced waterproof concrete.



JOINT BASE ELMENDORF RICHARDSON - ALASKA, STANDARD CABLING SYSTEM REFERENCE

LAST UPDATED: 28JUL2016

PROPERTY OF 673RD COMMUNICATIONS SQUADRON, JBER - ALASKA.



THIS DRAWING IS TO BE USED AS AN EXAMPLE OF DRAWING FORMAT AND DESIGN LAYOUT ONLY
THIS DRAWING SHOULD NOT BE USED TO ADDRESS PROJECT SPECIFIC QUESTIONS, SUCH AS ITEM QUANTITIES OR CAPACITIES (RISER CABLE SIZES, NUMBER OF PATCH PANELS OR PORT COUNTS, ETC.)
SEE MOST CURRENT JBER TELECOMMUNICATIONS INSTALLATION STANDARDS FOR MORE DETAILED REFERENCES CONCERNING INSTALLATION REQUIREMENTS.