

UNLV Campus Wiring Specification
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1. PART I - GENERAL

1.0. PURPOSE

The intent of this document is to provide a standard specification that will be used for all UNLV facilities requiring cable installation. This document provides the minimum performance criteria for the components and sub-systems comprising a complete cabling system that shall accommodate UNLV's requirements in excess of ten years.

Product specifications, general design considerations, and installation guidelines are provided in this written document. Quantities of telecommunications outlets, typical installation details, cable routing and outlet types for a specific UNLV facility will be provided as an attachment to a Request for Proposal. If the bid documents are in conflict, the Request for Proposal specification shall take precedence. The successful vendor shall meet or exceed all requirements for the cabling system described in this document.

This specification is intended to provide general design guidelines for new construction, and performance criteria for additions/renovations to existing facilities. Since all new construction will have telephone/data communication service raceways provided by an electrical subcontractor under the general contract, the specifications included in this document are intended as supplemental information to insure an acceptable, effective installation.

1.1. CONTRACTOR QUALIFICATIONS

Contractor must possess a valid State of Nevada Contractor's License and have successfully performed at least three projects of low voltage cable installation with similar size and work scope, within two years of the date of the job they are bidding on. Proof of performance shall be in the form of reference sheets which shall include a brief description of the project, the start and end dates, and contact information. For projects that require a Request for Proposal this information will be required as part of the submittal. See section 1.3. For work that does not require a Request for Proposal, this information should be available upon request.

All contractor personnel who will be performing work on this project shall have been trained on the work they will be performing. They shall have been trained on the Contractor's company policies with respect to personnel safety, telecommunications industry cabling quality and neatness standards, and use of Construction Standard Institute (CSI)-standard specifications and drawings.

Contractor, at all times during performance and until work is completed and accepted, shall have on the premises a competent supervisor, satisfactory to the Customer and with authority to act for the Contractor. The supervisor must be a BICSI certified Installer and BICSI member in good standing.

As a requirement to bidding and performing awarded work, the Contractor must have a current BICSI certified Registered Communications Distribution Designer (RCDD) on staff, either as a full-time employee or as a hired consultant. At UNLV's discretion, on a project-by-project basis, a RCDD consultant may be hired by the university to inspect work during and after completion. In these cases, the RCDD requirement will be met by the university and the Contractor will not be required to have a RCDD on staff. Based upon the inspection by UNLV's hired RCDD consultant or Network Development & Engineering (NDE) staff the Contractor will be responsible for correcting any work that does not meet requirements detailed in this document.

For projects that require a Request for Proposal the RCDD certificate and BICSI member number will be required as part of the submittal. See section 1.3. For work that does not require a Request for Proposal, this information should be available upon request.

For jobs that require more than 24 data connections, weekly inspections and approval of all work performed shall be conducted by the contractor's RCDD certified employee. The contractor will submit a weekly status report to the Customer detailing what work has been completed and inspected. The report will also include any issues encountered as part of the install. See Appendix A5 for report template

Contractor must provide at least one lead technician on site at all times during project who is a BICSI certified installer and a BICSI member in good standing. For projects that require a Request for Proposal a copy of certificate and BICSI member number will be required as part of the submittal. See section 1.3. For work that does not require a Request for Proposal, this information should be available upon request must be provided with bidding documents.

1.2. APPLICABLE REGULATIONS

A. RELATED DOCUMENTS

Equipment and material shall be Underwriter's Laboratories listed and labeled. The latest editions of the following standards are minimum requirements. If a conflict exists between applicable documents, then the order in the list below shall dictate the order of precedence in resolving conflicts. This order of precedence shall be maintained unless a lesser order document has been adopted as code by a local, state or federal entity, and is therefore enforceable as law by a local, state, or federal inspection agency.

1. ANSI/TIA-569-D Telecommunications Pathways and Spaces
2. ANSI/TIA 568.0-D Generic Telecommunications Cabling for Customer Premises
3. ANSI/TIA-568.1-D Commercial Building Telecommunications Cabling Standard
4. ANSI/TIA-568-C.2 Balanced Twisted-Pair Telecommunications Cabling and Components Standard
5. ANSI/TIA-568.3-D Optical Fiber Cabling Components Standard
6. ANSI/TIA-606-C Administration Standard for Telecommunications Infrastructure
7. ANSI/TIA-607-C Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
8. ANSI/TIA-1152 Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling National Electrical Manufacturers Association (NEMA)
9. National Electrical Code, latest revision (NEC)
10. National Fire Protection Agency (NFPA) – 70
11. Local, State and Federal Codes including Nevada Revised Statute (NRS) 278.583
12. UL 497 Protectors
13. UL 1459 Standard for Safety for Telephone Equipment
14. UL 1863 Standard for Safety for Communications Circuit Accessories
15. UL 2024 Standard for Safety for Optical Fiber Cable Raceway
16. UL 723 Standard for Safety for Surface Burning Characteristics of Building Materials
17. UL 1581 Standard for Safety for Reference Standard for Wires, Cables and Flexible Cords
18. National Electrical Safety Code (NESC)

19. ANSI/EIA 310D

1.3. SUBMITTAL

- A. For jobs that require submittals, the Contractor shall furnish the following in a single consolidated submittal with an Approval copy to the Customer at the time of submission:
 - 1. Contractor's license number and proof of qualifications.
 - 2. Reference sheets which provide three references. Each reference shall include a brief description of the project, the start and end dates, and contact information.
 - 3. The make and model of the materials to be used.

- B. The Contractor shall furnish the following in a single consolidated submittal with an Approval copy to the Customer at the time of award:
 - 1. A copy of the RCDD certificate and BICSI member number as described in the above Contractor Qualifications section.
 - 2. A copy of the BICSI certificate and the BICSI member number of the lead technician as described in the above Contractor Qualifications section.
 - 3. A copy of the BICSI certificate and the BICSI member number of the supervisor as described in the above Contractor Qualifications section.
 - 4. A copy of a valid manufacturer certified installer certification.

- C. The Contractor shall furnish the following in a single consolidated submittal with an Approval copy to the Customer upon request:
 - 1. For all Category 6A and 6 installation technicians, provide the training certificates with a brief description of the training courses associated with each certificate.

1.4. DESIGN REQUIREMENTS

Work must conform to the design requirement for each identified element.

A. BUILDING SERVICE

Plans for all new buildings shall include a design for extending the campus voice, data and video networks to the building. Consistent with this design, network trunks shall be extended as a part of the initial construction and equipment shall be installed to provide connection to the building. Every building, regardless of size, shall be constructed to allow for an air-blown fiber tube-cell conduit to enter through individual 4" conduits from the campus underground plant from two diverse locations. Exact air-blown fiber tube-cell conduit size will be determined by Network Development and Engineering on project by project basis. Voice cables shall enter from the campus underground plant from one location. In addition, every building shall be equipped with at least two empty 4" conduits to the campus underground plant for later use by UNLV after installation of all voice and data cables. All raceways to have 880 lb. nylon pull strings installed. All new service entrance conduits shall be a minimum 4" trade size and of sufficient number to provide 50% growth capacity, and will terminate 4" above finished floor in the equipment room (ER) inside the building.

1. Service – Data

Data communication service to each building shall consist of a minimum of 72 strands of 9.0/125-micron single-mode fiber and terminated at two separate major distribution locations on campus as determined by UNLV Network Development and Engineering. Fiber optic cable is to be contained in its own air-blown fiber tube-cell conduit. Single-mode fiber is to be terminated

with LC style connectors, UPC. Single-mode fiber will be terminated in a separate rack-mounted fiber optic enclosure. Contractor will install an air-blown fiber distribution unit in all MDF and IDF locations. Each fiber optic enclosure must be labeled with building, IDF room number and fiber enclosure identifier of opposing end. Patch panels to be mounted in such a manner as to allow the maximum usage of each rack. Appropriate wire management, determined by consultation with Network Development and Engineering and with regards to building design, shall be installed. Service loops of fiber-optic cable will be coiled, to meet manufacturer specifications, at both termination points. Complete IDF room design, including rack layout, power requirements, cable management will be provided by UNLV Network Development and Engineering.

2. Service – Voice

Voice communication service to each building shall consist of a minimum of one 24 AWG, solid annealed copper cable. Cable count to be determined by customer on a per project basis. Cable to enter building through a separate, dedicated conduit. Cable to be terminated patch panel(s) in data rack(s). One pair per RJ-45 block, terminated on blue/white-blue. Lightning protection to be provided as required per design specifications and/or applicable codes and regulations.

B. SERVICE ENTRIES

Elements of the service entry facilities design are to include type, size, gauge, and insulation of distribution cables. Every copper cable shall be bonded and grounded for lightning protection per NEC 800-30A at both terminations using solid-state 5-pin protectors, 50 to 100 volt range.

Building entry conduit shall allow for 50% growth and have a minimum of four 4” conduits from manhole to ER room.

C. VAULTS

All new cable vaults shall be at minimum 4’W by 6’L by 6’H or NDE approved equivalent and encased in concrete. All cable is to have service loops and be racked and mounted. Each vault shall have drainage holes and be engineered so water will not accumulate. Vault lids shall be adjustable torsion spring assisted openings with safety latches, lift handles, and hold down bolts. Vault labels shall meet labeling specification referenced in [Section 1.4.F.e](#). Top of vault lids shall be flush with paved areas, or 4” above finished grade in landscaped areas.

D. CABLE SPLICING

Copper cable splicing is only allowed where previously approved by UNLV Network Development and Engineering. Fiber-optic cable will only be spliced at the termination point. Fiber-optic splicing must be fusion based with two fibers optic strands of the exact make and model on each end using factory terminated connectors on pigtails. Splicing is not acceptable outside of Tele/Data rooms. Epoxy based splices shall not be acceptable.

The following cable splicing techniques and materials for copper cable shall be utilized:

1. Preparation for Splices

All copper cables shall be thoroughly cleaned and scuffed in a manner to insure a good mechanical bond when splicing. 3M Scotchcast 4435 non-conductive aluminum oxide abrasive strip, or UNLV approved equal shall be used. All cable shall be thoroughly cleaned with a non-toxic solvent, 3M Scotchcast 4414 or 4415 or UNLV approved equal.

2. Splicing requirements

a. No splice cases will be permitted in cable trays.

- b. All splice closures for use on underground non-pressurized systems shall be manufactured of clear, self-extinguishing, tongue and groove fitting PVC.
- c. End caps must be tapered and flexible and be capable of separate cable entries.
- d. Rigid bonding and strain relief bars must be an integral part of the finished closure.
- e. Re-enterable, polyurethane compound shall be used.
- f. All cable splices must be tagged or marked showing the cable number and pair count spliced. Markings may be placed on the splice closure or on both the in and out cables.
- g. Supports: All cable splices shall be supported by a minimum of two cable hooks. Horizontal racking for support may utilize 3M Brand RC-100 rack adapters, manhole racks, or University approved equivalent.
- h. Closures: 3M splice closures or University approved closures will be used for splicing throughout the system.
- i. Protection: All cable splices must be protected from damage at sheath openings by mechanically protecting all conductors utilizing 3M Scotchcast Pair Saver 4458 or approved equivalent.

E. BUILDING VOICE AND DATA TERMINAL ROOMS

All new building structures shall have minimum one primary Data communication room in which the outside cable terminates, henceforth referred to as the Main Distribution Facility (MDF). Each building may have additional data rooms for end wiring, henceforth referred to as Intermediate Distribution Facilities (IDFs).

1. Main Distribution Facility (MDF) Specifications

- a. The MDFs shall **not contain any equipment not specified by UNLV Network Development and Engineering**. This includes, but is not limited to, Marlok equipment, transformers, sinks, fire or building alarm equipment. They shall be kept clear of all other equipment.
- b. Each MDF will be provided with an isolated electrical panel with 200-amp service.
- c. The MDF will require the installation of a secondary bonding busbar (SBB) to building primary bonding busbar (PBB) that is directly bonded to the AC electrical ground system with a conductor the same size as the largest telecommunications bonding backbone (TBB). The connections of the telecommunications bonding conductor (TBC) and the TBB to the PBB shall utilize exothermic weld, Listed compression two-hole lugs, or two-hole exothermic lugs. All equipment racks shall be connected to the secondary bonding busbar (SBB) with a telecommunications bonding conductor (TEBC) that is continuous copper conductor not less than #6 AWG.
The SBB shall:
 - Be provided with holes for use with correctly matched listed lugs and hardware.
 - Be made of copper, or copper alloys having a minimum of 95% conductivity when annealed as specified by the International Annealed Copper Standard (IACS).
 - Have minimum dimensions of ¼ in. (6.35mm) thick by 2 in. (50mm) wide and shall be long enough to accept all current connections with additional room for growth.
 - Be listed.
 - Where a backbone bonding conductor (BBC) is required it shall be bonded to the SBB.
- d. The MDF will require the installation of a rack bonding busbar (RBB) connected with a rack bonding conductor through a telecommunications equipment bonding conductor (TEBC) using an irreversible compression connector sized to match the conductor gauges. The

TEBC is then bonded directly to the SBB that is continuous copper conductor not less than #6 AWG.

The RBB shall:

- Be provided with holes for use with correctly matched listed lugs and hardware.
 - Be made of copper, or copper alloys having a minimum of 95% conductivity when annealed as specified by the International Annealed Copper Standard (IACS).
 - Have minimum dimensions of 3/16 in. (4.76mm) thick by ¾ in. (50mm) wide and shall be 19 in. (482.6mm) long.
 - Shall mount to the back rack rails at the top of each rack.
 - Be listed.
- e. Each MDF will have two quad 20 amp, 110 V.A.C. outlets, terminated with NEMA 5-20Rs, two 30 amp 208 V.A.C. outlets, terminated with NEMA L6-30Rs. All outlets will require dedicated electrical circuits. When available, all outlets will be serviced by the emergency power system and colored orange or otherwise marked as such. All outlets will be positioned within 4 feet of the rear of the provided racks at standard outlet height.
- f. All MDFs shall be accessible only from inside the building. No outside entrances are permitted. All doors between the outside and the MDF must be at least 36” wide and 80” high.
- g. Rooms will be rectangular or square, have a minimum clearance height of eight feet without obstructions (sprinklers, etc.), be at least 14’ x 12’, and not have false floors or ceilings.
- h. No exposed water or gas pipes shall enter in or run through the main terminal room or data room. No drains, ducts or clean-outs will be permitted.
- i. A separate HVAC thermostat control will be installed for all MDF rooms, and shall be air conditioned with separate zone or air conditioning unit 24 hours a day, seven days a week. A positive pressure shall be maintained with a minimum of one air change per hour.
- j. All MDFs shall be secured using a UNLV-approved card access reader and striker.
- k. All MDFs shall be provisioned with at least one standard data rack, Panduit R4PCN, bolted to the floor. These rack(s) shall be placed side-by-side, with vertical cable management, Panduit part# PEV8 in between and on both sides. Vertical cable management shall have doors (Panduit Part # PED8) on both front and rear of the cable managers. The racks must have a minimum of 36” of clearance front and back and at least 24” on one side. OIT provided room drawings must be followed.
- l. Ladder rack shall be provided and installed sufficient to secure the equipment rack to the adjacent wall(s) as determined at installation and to provide support for incoming cables.
- m. A minimum of two walls must be covered by backboards as defined in Part II.
- n. Floor loading shall be designed to support a minimum of 1000 pounds of equipment per data rack provided.
- o. All other elements of room to be designed and provisioned per ANSI/EIA/TIA 569-D or better.

2. Intermediate Distribution Facility (IDF)

- a. The IDFs shall not contain any equipment not specified by UNLV Network Development and Engineering. This includes, but is not limited to, Marlok equipment, transformers, sinks, fire or building alarm equipment. They shall be kept as clear of all other equipment.
- b. Each IDF will be provided with a SBB connected by a TBB to the PBB. The TBB shall be no smaller than a #6 AWG conductor and/or use the recommended sizes in accordance with ANSI-TIA-607-C. All equipment racks shall be connected to the SBB with a TEBC that is continuous copper conductor not less than #6 AWG.

The SBB shall:

- Be provided with holes for use with correctly matched listed lugs and hardware.
 - Be made of copper, or copper alloys having a minimum of 95% conductivity when annealed as specified by the International Annealed Copper Standard (IACS).
 - Have minimum dimensions of ¼ in. (6.35 mm) thick by 2 in. (50.8mm) wide and shall be long enough to accept all current connections with additional room for growth.
 - Be listed by authority having jurisdiction.
 - Where a backbone bonding conductor (BBC) is required it shall be bonded to the SBB.
- c. The IDF will require the installation of a rack bonding busbar (RBB) connected with a rack bonding conductor through a telecommunications equipment bonding conductor (TEBC) using an irreversible compression connector sized to match the conductor gauges. The TEBC is then bonded directly to the SBB that is continuous copper conductor not less than #6 AWG.

The RBB shall:

- Be provided with holes for use with correctly matched listed lugs and hardware.
 - Be made of copper, or copper alloys having a minimum of 95% conductivity when annealed as specified by the International Annealed Copper Standard (IACS).
 - Have minimum dimensions of 3/16 in. (4.76mm) thick by ¾ in. (50mm) wide and shall be 19 in. (482.6mm) long.
 - Shall mount to the back rack rails at the top of each rack.
 - Be listed.
- d. Each IDF will have two quad 20 amp, 110 V.A.C. outlets, terminated with NEMA 5-20Rs and two 30 amp 208 V.A.C. outlets, terminated with NEMA L6-30Rs. All outlets will require dedicated electrical circuits. When available, all outlets will be serviced by the emergency power system and colored orange or otherwise marked as such. All outlets will be positioned within 4 feet of the rear of the provided racks, at standard outlet height.
- e. All IDFs shall be accessible only from inside the building. No outside entrances are permitted. All doors between the outside and the IDF must be at least 36” wide and 80” high.
- f. Rooms will be rectangular or square, have a minimum clearance height of nine feet without obstructions (sprinklers, etc.), be at least 10’ x 10’, and not have false floors or ceilings.
- g. No exposed water or gas pipes shall enter in or run through the main terminal room or data room. No drains, ducts or clean-outs will be permitted.
- h. A separate HVAC thermostat control will be installed for all IDF rooms, and shall be air conditioned with separate own zone or air conditioning unit 24 hours a day, seven days a week. A positive pressure shall be maintained with a minimum of one air change per hour.
- i. All IDFs shall be secured using a UNLV-approved card access reader and striker, the access of which is to be managed by the Network Operations Center.
- j. All IDFs shall be provisioned with at least one standard data rack, Panduit R4PCN, bolted to the floor. These rack(s) shall be placed side-by-side, with vertical cable management, Panduit part# PEV8 in between and on both sides. Vertical cable management shall have doors (Panduit Part # PED8) on both front and rear of the cable managers. The racks must have a minimum of 36” of clearance front and back and at least 24” on one side. OIT provided room drawings must be followed.
- k. Enough rack space must be provided to terminate all fiber and copper, with associated cable management, plus 200%.
- l. Ladder rack shall be provided and installed sufficient to secure the equipment rack to the adjacent wall(s) as determined at installation and to provide support for incoming cables.

- m. A minimum of two walls must be covered by backboards as defined in Part II.
- n. Floor loading shall be designed to support a minimum of 1000 pounds of equipment per data rack provided.
- o. All other elements of room to be designed and provisioned per ANSI/EIA/TIA 569-D or better.

F. BUILDING INTERIORS

1. Underground Plant

- a. The cables from the underground plant shall enter the building in an MDF room. Appropriate wire management shall be installed such as ladder racks, D-rings, and hook and loop tape so as not to exceed the acceptable cable bend radius.

2. Data Rooms

- a. Additional IDF(s) shall be provided on each floor, and if necessary, to prevent total length of data cable runs from exceeding 295 feet. IDF rooms in multistory buildings shall be aligned vertically with the MDF room, if possible.

3. Internal Backbones (Risers)

- a. A minimum of two 4" conduits shall run between every IDF and the MDF within buildings. Pull strings shall be provided in every conduit. Data interconnections between each IDF and the MDF shall be via fiber optic cable containing a minimum of 24 strands of single-mode fiber, as defined in Part II. Fiber optic cable is to be contained inside air-blown tube cell conduit. Patch panels are to be mounted in such a manner as to allow the maximum usage of each rack.

4. Station Wiring

- a. Data Outlets
 - All outlets shall be constructed using single gang, 4-port faceplates, colored almond, or similar. All outlets shall have at least two network drops each.
 - The ports on the left side of the faceplates will always correlate to an odd numbered patch panel port. The ports on the right side of the faceplates will always correlate to an even numbered patch panel port.
- b. Copper Cabling
 - All drops shall be connected with blue network cabling from patch panels to each drop location and terminated on black data jack. Every cable shall be continuous and unspliced, with data cables attached to a single port in the patch panel at one end and to a single jack at the station end. All connections are to be done using the T568B wiring scheme. No cable run from patch panel to connection point may exceed 295 feet. All cabling must terminate in an IDF or MDF room on the same floor as the outlet unless building plans, certified by Network Development and Engineering, specify otherwise. Additional specifications for cabling, patch panels and data jacks as per specifications in Part II.
- c. Habitable Space Provisioning

- Every habitable space shall be provisioned a minimum of one data outlet per person planned for the space or one outlet per 60 ft², whichever is greater. If the number of people planned for a space is not known, the 60 ft² guideline must be used.

d. Non-habitable Space Provisioning

- Every non-habitable space shall be provisioned with two data outlets every 500 ft², minimum of 1 per enclosed space. Exceptions may be granted for unusual circumstances by Network Development and Engineering, in writing.

e. Labeling

The labeling system shall clearly identify all components of the system: racks, cables, panels and outlets. The labeling system shall designate the cable's origin and destination. Station identifiers shall match the corresponding patch panel port number for each drop. The drops will be in consecutive order whenever possible. They shall increment from left to right then top to bottom on each individual faceplate. All labeling information shall be recorded on the as-built drawings and all test documents shall reflect the appropriate labeling scheme. All label printing will be machine generated using indelible ink. Self-laminating labels will be used on cable jackets, appropriately sized to the OD of the cable, and placed within view at the termination point on each end. Faceplate labels will be the manufacturer's labels provided with the outlet assembly unless otherwise specified. The labeling schema shall be as follows:

- All labels will be in the format of "310-306-1-24" Where "310" is the Station room number, "306" is the IDF or MDF room number, "1" is the Patch Panel identifier, and "24" is the port that the drop terminates to in the patch panel.

- Cable Wrap labels:

Wrap labels are required within 6 inches of the cable's termination point at both ends. Wrap labels will follow the format listed in this section, i.e. "310-306-1-24" Splitting this into two lines is acceptable in which case "310-306" would go on the first line and "1-24" would go on the second line. The font size will be the largest size that fits the required information but no smaller than 8 point font.

- Station labels:

The Station label will follow the format listed in this section. However, the top label include both top ports i.e. "310-306-1-24,25". The first patch panel port number will always be the left face plate port and the second patch panel port number will always be the right face plate port. The bottom label will follow the same guidelines when used. When unused the label will be left blank. The font size will be the largest size that fits the required information but no smaller than 10 point font. See "Standard Outlet Configuration" in Appendix A2

- Data Room Patch Panel:

The patch panel identifier will be labeled by the installer on the left side of the patch panel in a place that is easily visible. Counting from the top of the rack down, the first installed patch panel will be identified with the number 1, the second with the number 2 and so on.

The patch panel port label will be in the format listed above "310-306-1-24". Space limitations will require the label to be in two rows. The font size will be the largest size that fits the required information but no smaller than 8 point font. These labels should be center justified and located directly above the port they are labeling or in other manufacturer provided locations for port labels.

- Tube Cell Conduit

The marker plate for tube cell conduit shall be 1"x 3" in size and must be made of a material able to withstand environmental conditions (e.g., extreme heat, underwater, and dirt/dust). The marker plate shall be placed approximately one foot from the conduit entry and exit.

The marker plate label will be in the format of V-41-D to V-44-D, where V stands for vault and 41 is the previous vault number and 44 is the next vault number. The letter D shows which section of campus the vault is located in.

- Individual Fiber Microducts

The individual microduct identifier will be labeled by the installer within 6 inches of the microduct leaving the cartridge. The label shall be three lines with the first line showing the number of strands and type of fiber. The second line shall show the distant termination points for this microduct. The third line shall show the local termination point for the microduct. The enclosure information (lines 2 and 3) is in the following format: SCS 114 F1 A-C, where SCS is the building name, 114 is the room the enclosure is located, F1 is the enclosure number, A-C are the enclosure slots the strands are located in.

All labeling information shall be recorded on the as-built drawings and all test documents shall reflect the appropriate labeling scheme. All label printing will be machine generated using indelible ink. Self-laminating labels will be used on cable jackets, appropriately sized to the OD of the cable, and placed within view at the termination point on each end.

- Fiber Optic Cables

The individual non-air-blown fiber identifier will be labeled by the installer within 6 inches of the fiber leaving the cartridge. The label shall be four lines with the first line showing the number of strands and type of fiber. The second line shall show the distant termination points for this fiber strand. The fourth line shall show the local termination point for the fiber strand. The third line may be included with lines 2 or 4, if space allows. The fiber information (lines 2 and 4) is in the following format: SCS 114, where SCS is the building name, and 114 is the room the enclosure is located.

All labeling information shall be recorded on the as-built drawings and all test documents shall reflect the appropriate labeling scheme. All label printing will be machine generated using indelible ink. Self-laminating labels will be used on cable jackets, appropriately sized to the OD of the cable, and placed within view at the termination point on each end.

- Fiber Enclosures

The fiber enclosure identifier will be labeled by the installer on the left side of the enclosure in a place that is easily visible. Counting from the top of the rack down, the first installed enclosure will be identified with the alphanumeric identifier of F1, the second with the F2 and so on.

The fiber enclosure label will be in the format of “A-C to TBEA 305 F1 F-H”, where “A-C” are the slots the fiber terminates in, “TBEA 305” is the distant end telecommunication room location, “F1” is the fiber enclosure number, and “F-H” are the slots the fiber terminates in the distant end. Space limitations could require the label to be in two rows. The font size will be the largest size that fits the required information but no smaller than 8 point font. These labels should be center justified and located directly in front of the slots they are labeling or in other manufacturer provided locations for labels.

- **Vault Lids**

The vault lid identified will be labeled by the installer by welding the label near the center of the vault or manhole covers. If the cover has two parts, the label shall be welded near the center of the north or west part.

The vault lid label will be in the format of “V-###-XXX” or “MH-###-XXX, where “V” is a vault and “MH” is a manhole. “###” shall be the number assigned based on the master CAD file and “XXX” shall correspond to the section of campus assigned on the master CAD file.

5. Wireless – 802.11

- a. Data cabling at wireless locations shall be terminated in electrical boxes that are mounted parallel to the ceiling, above the drop-ceiling grid panels. Two blue data cables shall be directly run from the IDF and will be terminated in data jacks. The jacks will be mounted in a faceplate and the faceplate will be mounted to the electrical box. For existing buildings the contractor will provide a minimum of 5 feet of data cabling service loop at the electrical box. For new buildings, the contractor will provide a minimum of 20 feet of data cabling service loop at the electrical box.
- b. Electrical boxes used for wireless AP installations shall have a minimum clearance of 14” x 14” x 8” and will be mounted to a wall or secured to equipment that meets local NEC, ANSI/TIA-568-D, and ANSI/TIA-569-D standards. No cable run from IDF to connection point may exceed 295 feet.
- c. At each access point location, connect the access point to the horizontal cabling using contractor provided patch cords (see section 2.2.B for patch cable requirements). The cable that correlates to an odd numbered patch panel port will plug into the access point’s LAN port and the cable that correlates to an even numbered patch panel port will plug into the access point’s CONSOLE port. All patch cables will use appropriate J-hook/supports or dressing.
- d. Wireless locations that are placed in locations with a hard-lid ceiling will have the cables be terminated inside of the electrical box but not placed in a faceplate. The electrical boxes at these locations shall be 4 inch square boxes with a depth of 3 ¼ inches, or 5-inch square boxes. Each box must maintain the minimum bend radius of the cable.
- e. Access point installations shall require the Contractor to use a Customer provided bracket. This might require the Contractor to cut a hole in drop ceiling acoustic tile. See Appendix A4 for an example of this install.
- f. For new buildings only, the Contractor will be required to move the APs and electrical boxes utilizing the service loop as required after the Customer completes a wireless survey.

6. Wireless Access Point Placement and Wireless Overlay for 802.11

Locations will be specified by consultation with UNLV Network Development and Engineering. The use of 3rd party professional RF Engineering design may be required under the special conditions. These conditions include but are not limited to the following:

- a. Any wireless bridge installation which requires rooftop cabling and mounting of wireless bridging hardware, antennae and masts.
- b. Installations which require access points to use antennae other than the standard dipole antennae.
- c. The finished ceiling plan is exposed and the customer has specified that wireless hardware and antennae placement must be as limited as possible in order to meet aesthetic requirements of the building.
- d. Wireless Access Points shall be furnished by the owner and installed by the low-volt contractor.

Consultation with UNLV Network Development and Engineering is required for all 802.11 Wireless infrastructure design.

7. Cable Trays

All cable trays must be UL rated and approved by UNLV Network Development and Engineering prior to their inclusion in specifications.

- a. Supports
Cable trays for horizontal distribution cables, utilizing a center support hanger method to support the cable trays, will utilize threaded rods of not less than 1/2" in diameter.
- b. Capacity
Cable trays shall be sized for a minimum growth of 50%.
- c. Grounding
Cable trays shall be grounded in accordance TIA-607-C.

8. Cable Installation

- a. Copper
Installation is to meet or exceed TIA 568-D and TIA 569-D.

All terminations are to follow TIA 568-B.

Completed installation is to be Certified Category 6 or 6A using the TIA 568-C.2 testing standard or better. Test documents/results to be supplied to UNLV in .PDF and CAD format. Completed installation is to be approved by UNLV Network Development and Engineering.

- b. Fiber
Installation is to meet or exceed TIA 568.3-D and TIA 569-D. Fiber terminations will be completed using one of the following methods:
 - No epoxy/no polish connectors
 - Factory-terminated pigtailed with fusion splicing

Single-mode will be terminated in a separate rack-mounted fiber optic enclosure.

Completed installation is to be certified using TIA 568.3-D testing standard or better. Test documents/results to be supplied to UNLV in .PDF format. Completed installation is to be approved by UNLV Network Development and Engineering.

9. Pull and Splice Boxes

a. Location

- Pull boxes must be installed in easily accessible locations. It is not permissible to locate a pull box in a fixed false ceiling unless immediately above a suitably marked access panel.
- All pull boxes shall be placed in a straight section of conduit. Align the corresponding conduits at each end. All boxes shall be properly and adequately secured. They are not to be supported by the conduits entering the box. Install boxes for station cabling immediately above the suspended ceiling.

b. Access

- Provide boxes with a suitable cover.

c. Grounding

- If the pull box is comprised of metallic components, it shall be bonded to ground in accordance with the authority having jurisdiction.

G. GROUNDING

1. Regulations

All conduit and cable tray systems, supports, cabinets, equipment, etc., shall be properly grounded in accordance with the latest edition of the National Electrical Code (NEC), TIA-607-C, and all other applicable codes and regulations.

2. Installation Requirements

Provide all bonding wire and jumpers, grounding bushings, clamps, etc., required for complete grounding. Route ground conductors to provide the shortest, most direct path to the ground electrode system.

3. Grounded Connectors

Provide a separate grounding conductor, securely grounded on each side of all conduit and cable trays that do not provide a continuous, metallic path. Size shall be in accordance with the National Electrical Code (NEC). All ground connections will have clean contact surfaces, tinned and sweated while bolting. Avoid splices in bonding or grounding conductors. If splices are required they must be cad welded. Any grounding or bonding conductor that is run through a metallic conduit should be bonded to the conduit on both ends. Do not use a gas or water pipe as the grounding electrode.

2. PART II – PRODUCTS AND ACCEPTED MATERIALS

2.0. GENERAL

All material required for a complete installation shall be furnished by the Contractor unless otherwise specified by UNLV Planning and Construction Department

All materials provided by the Contractor must be new, free from defects and must meet the Customer's specifications. A parts list for the approved manufacturers can be found in Appendix A6. For projects that require a Request for Proposal, bidders shall submit the make and model of materials that will be used as part of their submittal. See section 1.3

All fixtures and hardware must be installed as per requirements detailed in this document. No custom items shall be used except as reviewed and approved by NDE. The contractor shall be held financially responsible for any work or re-work required due to improper approval and /or acceptance of that work performed which differs from the construction documents.

All products shall be new, and brought to the job site in original manufacturer's packaging. Electrical components (including innerduct) shall bear the Underwriter's Laboratories label

All station cables shall be CMR Riser rated when entire cable runs are installed in conduit and cable tray.

All station cables shall be CMP Plenum rated when any section of the cable run is not installed in conduit.

The Contractor shall inspect all products and materials prior to installation. Damaged cable or any other components failing to meet specifications shall not be used in installation.

2.1. BACKBOARDS

All backboards required in the IDF/MDF rooms shall be plywood, $\frac{3}{4}$ ", 4' by 8' sheets, grade A, treated on one side with fire resistant paint or material, installed with finished side exposed with the bottom of the plywood at 8" above finished floor.

2.2. CABLE SPECIFICATIONS

A. WARRANTY

All copper and fiber cabling installations must be covered by an end-to-end manufacturer warranty of no less than 20 years. Vendors must be certified installers of the products they select for installation. The warranty is required to cover cabling, components, and performance. Parts and labor for replacements must also be included in the warranty.

B. APPROVED CABLING MANUFACTURERS

1. Copper Installation:

Vendors may select from the following list of approved copper cabling manufacturers:

Commscope

Leviton
Siemon
TE Connectivity
Panduit

Products selected from these vendors must meet requirements detailed in this document.

a. New Building

All copper installations in new buildings on campus will be completed using products from a manufacturer on the approved list. All cabling and components will be certified Category 6A / Class EA and will meet all requirements listed Section 2.2-C.

b. Existing Building

In cases where vendors install cabling in existing IDFs, installers shall use open ports on existing category 6 patch panels. The warranty requirement listed in section 2.1-A will apply to these installations. This will require vendors to be certified installers for the existing components in the IDF. If there are no open ports, not enough ports to complete the job, the existing patch panel is not category 6, or the installer is not a certified installer of the existing components, the contractor will use a Leviton QuickPort patch panel (Model number 49255-H48), Siemon MAX Copper patch panel (Model number MX-PNL-48K), or equivalent that has been viewed, tested and approved by Network Development and Engineering staff. The installer shall use authorized products that they are certified to install from a manufacturer on the approved list in Appendix A6.

5. Fiber Installations:

Vendors may select from the following list of approved air-blown fiber cabling solution manufacturers where air-blown fiber is required:

Future Flex Air-Blown Network Solutions by Sumitomo Electric Lightwave
eABF solutions by AFL/Duraline

Vendors may select from the following list of approved fiber cabling solution manufacturers where Air-Blown Fiber is not required:

AFL
TE Connectivity
Siemon
Leviton
Commscope
Corning

Products selected from these vendors must meet requirements detailed in this document.

a. Building to Building

- All fiber installations for building to building interconnects will use air-blown fiber solutions. Contractors shall install components from a manufacturer on the approved air-blown fiber manufacturer list.

b. New Building

- All fiber installations for new buildings on campus, including building to building interconnects and MDF to IDF connections will use air-blown fiber solutions. Contractors shall install components from a manufacturer on the approved air-blown fiber manufacturer list.

c. Existing Building

- All fiber installations for buildings with existing air-blown fiber infrastructure will be installed using use air-blown fiber solutions. Contractors shall install components from a manufacturer on the approved air-blown fiber manufacturer list.
- All fiber installations for buildings without existing air-blown fiber infrastructure will be installed using traditional fiber cabling. Contractors shall install components from a manufacturer on the approved fiber manufacturer list.

d. Innerduct

- Installation of non-air-blown (traditional) fiber cabling into a conduit shall require the installation of tube type innerduct. Innerduct sizing shall be large enough to ensure no more than a 60% fill ratio. Innerduct flammability requirements (e.g., plenum, non-plenum) shall be verified prior to installation and shall have a pull string inside the innerduct.

C. DATA COPPER

All copper data cable for existing buildings will be Category 6, 4 pair, UTP (Unshielded Twisted Pair) unless specified differently, and must meet or exceed TIA and ISO Category 6 /Class E requirements. All copper data cable for new buildings will be Category 6A, 4 pair, UTP (Unshielded Twisted Pair) and must meet or exceed TIA and ISO Category 6A /Class E_A requirements. Only materials from accepted manufacturers in section 2.1.B will be installed. Cables will be rated as plenum or riser based on installation requirements.

D. PATCH CABLES

All patch cables installed by the contractor will be factory terminated and tested to meet requirements stated in section 2.2.C.

E. EXTERIOR CABLE

All telephone cable that supports devices external of a building such as emergency phones use outdoor-rated Category 6, 4 pair, UTP (Unshielded Twisted Pair) and must meet or exceed TIA and ISO Category 6 /Class E requirements.

F. SINGLE-MODE FIBER OPTIC

All single-mode fiber optic cable must be 9.0/125. All single-mode terminations are to be LC, UPC finish. A 12- or 24-fiber adapter panel must be used in the fiber optic enclosure.

G. AIR-BLOWN FIBER COMPONENTS

Tube cell count for tube-cell cabling will be determined by Network Engineering and Development Staff on a project by project basis.

All new building IDF's and MDF's will require the installation of fiber distribution boxes. Other locations such as manholes and other splice or junction locations will require fiber distribution boxes as needed.

2.3. DATA TERMINATIONS

B. COPPER DATA COMPONENTS

1. Patch Panels

All data patch panels for existing buildings are to be a Leviton QuickPort patch panel, (Model number 49255-H48) or equivalent, that has been viewed, tested and approved by Network Development and Engineering staff. Equivalent patch panels must accept keystone Category 6 or 6A jacks, in 2U, 48 port configuration, and must meet or exceed EIA/TIA and ISO/IEC Category 6/Class E or Category 6A/Class E_A requirements. They must also be capable of housing keystone data jacks from other manufacturers, be viewed, tested and approved by Network Development and Engineering staff.

Every group of 48 must be separated by 2U of horizontal cable management, Panduit part# WMPF1E. All cabling will route through the rear cable management prior to termination in the patch panel. All terminations are to follow TIA 568-B.

2. Voice Copper Termination Blocks

All voice wire terminations are to be terminated on patch panel(s) in data rack(s). One pair per RJ-45 block, terminated on blue/white-blue.

3. Data Jacks

All data jacks for existing buildings shall be modular, unshielded, 4-pair, 8P8C, Category 6, black unless otherwise specified, and must meet or exceed EIA/TIA and ISO/IEC Category 6/Class E requirements. Data jacks must be compatible with patch panel from Section 2.3.A.1. Compatible jacks are listed in Appendix A6, in each manufacturer section, item description "Jacks – Universal, Black".

All data jacks for new buildings shall be modular, unshielded, 4-pair, 8P8C, Category 6A, black unless otherwise specified, and must meet or exceed EIA/TIA and ISO/IEC Category 6A/Class E_A requirements.

All terminations are to follow TIA 568-B.

4. Faceplates

All faceplates shall be 4 port, light almond (or vendor equivalent), single gang, low profile, with a window for labels. All unused ports must be covered with a blank insert.

C. FIBER OPTIC

d. Terminations

Terminations will be completed with one of the two following methods:

- No epoxy/no polish connectors

- Factory-terminated pigtails with fusion splicing
Fusion splices will be protected in splice cases or other suitable enclosures.
- e. Connectors
Single-mode fiber is to be terminated with LC style connectors, UPC Polish.
- f. Fiber enclosures
AFL fiber optic enclosure models XFM-2-U-B-O or XFM-4U-B-O will be used. XFM-4U-B-O will be used when installing more than 24 fiber strands or at the request of network engineering. XFM-2-U-B-O will be used when installing 24 fiber strands or less. Equivalent enclosures can be approved by Network Development and Engineering on a case-by-case basis.
- g. Fiber Adapter Panels
Single-mode fiber will terminate in 12- or 24-fiber standard adapter panels.

2.4. DATA EQUIPMENT RACKS

All racks are to be four post, open frame, square hole, black, Panduit part number R4PCN. Substitutions must be authorized in writing by UNLV Network Development and Engineering.

2.5. CABLE TRAYS

All cable trays for distribution of data cables within a building are to be a minimum of 18” wide by 4” deep, solid trough or ladder and will be approved by UNLV Planning and Construction and Network Development and Engineering.

2.6. EXCEPTIONS

Due to unique constraints and requirements of existing IDFs, exceptions may be authorized for existing buildings only with approval of UNLV Network Development and Engineering and shall be granted in writing.

3. PART III – EXECUTION

The University has drawings detailing existing cable runs, terminal cabinets/closets, risers, etc. Copies may be obtained from UNLV Network Development and Engineering to facilitate the requirements of Part III - Execution.

Unless otherwise expressly provided in the Contract, any provisions of the standard specifications, which require the University to inspect certain material or work, shall mean that the University has the option, rather than the obligation, to do so. Any warranty or guarantee provisions contained in the Contractors'/Vendors' standard specifications shall be of no effect and the warranty and guarantee provisions, if any, of the Contract shall apply.

3.1. DEMOLITION

A. COORDINATION WITH UNIVERSITY OPERATIONS

No telecommunication or data jacks, cabling terminals, or other hardware will be moved, disconnected, or removed without prior approval of UNLV Network Development and Engineering. Coordination of demolition activities with the departments will be strictly enforced to minimize service disruptions.

B. WORK TO BE PERFORMED BY OWNER

Upon notification by contractor, UNLV Network Development and Engineering will dispatch a technician to the requested work location. The technician will determine if the facilities to be moved or removed are in service (hot) or out of service (dead). If station cabling is dead the technician will insure that all cross-connects have been removed. If the facilities to be moved or removed are determined to be in service, the technician will take the necessary actions to render the facilities dead. Under NO circumstances will removal of telecommunications or data facilities begin until UNLV Network Development and Engineering has ensured that services are dead.

C. DISPOSAL OF SURFACE-MOUNT RACEWAY

Surface mount raceway that has been vacated, or otherwise determined not required, will be removed after all cabling has been properly removed.

3.2. EXCAVATION

The Contractor shall be required to excavate for underground mechanical piping, and shall perform all auxiliary work that may be required to do so.

No trenching will commence until UNLV Planning and Construction and UNLV Network Development and Engineering grants approval. The University has drawings of existing underground utilities to assist the Contractor to locate all underground utilities. All Contractors are to Call Before U Dig. All lines damaged by Contractor will be repaired at Contractor's expense.

Asphalt and concrete pavement shall be sawed or cut to a depth necessary to bring about a straight-line break parallel to the sides of the trench, so as not to disturb the adjoining pavement.

All underground construction work, during progress and after completion, shall conform truly to lines and grades.

If the trench is excavated to a greater depth than that given, the Contractor shall, at his own expense, bring such excavation to required grade with such material as directed, notwithstanding that it may be necessary to bring such material from other localities or to purchase suitable materials.

The material excavated shall be deposited along the side of the trench in such a manner as to create the least inconvenience possible.

Contractor shall not obstruct the gutter of any street or driveways, but shall use all proper means to provide the free passage of surface water along the gutters into storm water inlets. Contractor shall provide channels where required.

Special care shall be taken to keep all fire hydrants and gate valves on water mains accessible at all times. Fire lanes are to be kept open.

Wherever required, sides of the trench shall be sheeted and braced in strict accordance to the rules, orders and regulations of the State, County, and the City. Trenches shall be barricaded.

Grass will be replaced by a method approved by the University.

Bricks, blocks and other debris removed from trenches will not be used as fill for trenches.

3.3. INSTALLATION

A. REGULATIONS

All work and materials will comply with all federal and State laws, municipal ordinances, codes, regulations and direction of inspectors appointed by proper authorities having jurisdiction.

If there are violations of codes, the vendor will correct the deficiency at no cost to the University.

Working conditions must meet the industry standards for safety and work procedures, and protection of property established by prevailing rules, regulations, codes, and ordinances.

B. QUALITY ASSURANCE

Workmanship and neat appearance shall be as important as the mechanical and electrical efficiency of the system. All testing and clean-up shall be completed to the satisfaction of UNLV Network Development and Engineering before sign-off. This includes, but is not limited to, cable testing, proper labeling, debris removal, and proper cable bundling and routing.

C. DAMAGE OF EXISTING FACILITIES

The Contractors shall be responsible for replacing, restoring, or bringing to at least original condition any damage to floors, ceilings, walls, furniture, grounds, pavement, etc., caused by its personnel and operations. Any damage or disfiguration will be restored at the Contractor's expense.

D. COORDINATION

Contractor is responsible for insuring minimal disruption of existing television, telemetry, telephone and data communications facilities and networks.

Outages shall be scheduled only with permission from UNLV Network Development and Engineering at its convenience.

All work areas shall be cleared of all litter, and properly disposed of by Contractor on a daily basis.

At its own expense, Contractor shall erect temporary fencing where required or deemed necessary by University personnel, or where deemed necessary by the Contractor for securing materials.

Contractors shall provide all necessary temporary equipment and material, shall maintain them in a safe and adequate manner, and shall remove them immediately upon completion of work requiring their presence.

E. CABLE SUPPORT AND ANCHORS

All cables, wires and equipment will be firmly anchored. Fasteners and supports shall be adequate to support loads with ample safety factors.

All data cables installed without conduit in plenum spaces will be secured using j-hooks or other Network Development and Engineering approved mounting hardware.

F. FIRESTOP SYSTEMS

A firestop system is comprised of an item or items penetrating a fire rated structure, the opening in the structure, the sealing materials, and assembly of the materials used to seal the penetrated structure. Firestop systems comprise an effective block for fire, heat, vapor and pressurized water stream. All penetrations through fire rated building structures (walls and floors) shall be sealed with an appropriate firestop system. This requirement applies to through penetrations (complete penetration) and membrane penetrations (through one side of a hollow fire rated structure). Any penetrating items i.e., riser slots and sleeves, cables, conduit, cable tray, and raceways, etc. shall be properly fire stopped using state approved fire resistant materials installed in accordance with the manufacturer's tested methods. All penetrations through fire rated surfaces shall comply with the following:

1. ASTM E 84: Standard Test Methods for Surface Burning Characteristics of Building Materials
2. ASTM E 119: Methods of Fire Tests of Building Construction Materials
3. ASTM E 814: Standard Method of Fire Tests of Through-Penetration Firestops
4. ASTM C 719: Adhesion and Cohesion of Elastomeric Joint Sealants under Cyclic Movement
5. ASTM C 920: Standard Specification of Elastomeric Joint Sealants
6. UL 263: Fire Tests of Building Construction Materials
7. UL 723: Surface Burning Characteristics of Building Materials
8. UL 1479: Fire Tests of Through Penetration Firestops
9. UL 2079: Standard for Fire Tests of Joint Systems

G. CONDUIT

1. Conduit shall be Electrical Metallic Tubing produced in accordance with ANSI C80.3 standard and run in the most direct route practical.
2. Conduit runs containing more than two 90-degree bends, or a reverse (180 degree) bend require a pull box.

3. All offsets shall be considered equivalent to a 90-degree bend.
4. Sections of conduit longer than 100 ft. require a pull box.
5. Conduit bend radii will be a standard ten times the outside diameter of conduit unless otherwise approved by UNLV Network Development and Engineering.
6. Conduits entering the IDF through the wall shall be reamed or bushed, and terminated not more than 4 inches from the wall surface.
7. Conduits entering the IDF from below shall be terminated 4 inches above finished floor.
8. Conduit runs for distribution cables (both horizontal and vertical), except station outlets, shall be not less than 4" in diameter. They will be equipped with a plastic or nylon number 12 or larger pull line that is rated at 800-lb. test minimum.
9. Conduit installed for data and/or voice cabling may not be shared with any other cable.
10. All conduit runs for station outlets shall be not less than 1" in diameter. They will be equipped with a plastic or nylon number 12 or larger pull line that is rated at 800-lb. test minimum.
11. After installation, all conduits shall be clean, dry, unobstructed, capped for protection and labeled with their destination (by room number) for identification.
12. Allowable fill capacity is 40% or as defined by the National Electric Code, whichever is lower.
13. Conduit runs for horizontal distribution cables, utilizing the trapeze hanger method to support the conduits, shall utilize threaded rods of not less than 3/8" in diameter.
14. Conduit shall not block access to existing services.
15. All junction boxes will maintain the minimum bend radius for the cable being installed. Special consideration should be taken concerning the use of Category 6A/Type EA cabling, data termination jacks, and the minimum bend radius with required twelve (12) inch minimum excess cable at each outlet.
16. Pull boxes will be installed in position and relationship to adjoining work, securely anchored to supporting structure, sealed and finished, and in a manner which produces a level box with square, plumb, and straight edges.

H. CABLE INSTALLATION

1. All cable shall be installed free of kinks. A kink is defined as a violation of the manufacturer's specified Minimum Bend Radius for each type of cable. Cable shall not be formed into a condition that causes the outside sheath to wrinkle.
2. Any cable to be placed through an electrical room or any other potentially hazardous conditional shall be placed in conduit.

3. All cable will be secured to the backboard in such a manner as to allow cross connections to be made without crossing over any cables.
4. All data outlets will have a minimum of 12 inches of cable stored at each drop after the cable has been terminated. Cable shall not be stored in loops.
5. All data cabling will have a service loop with a minimum of 10 feet of data cabling that will be placed on the MDF/IDF ladder rack.
6. Where installation of conduit is not required, plenum cable will be used. Cables are not permitted to lie atop a lay-in ceiling or simply drape over pipe and ductwork; appropriate J-hook/supports or dressing will be used.
7. All cabling in an open ceiling and/or open-plenum space will be ran in conduit or cable tray.
8. Cable supports are to be anchored in accordance with TIA 569-D and NEC.
9. Cable pulled in a cable tray with existing cable should not be pulled where stress would be applied to the existing cable.
10. All cable is to be terminated at both ends, tested, labeled and ready to provide service to and within the building.
11. Hook and loop tape is the only approved product for bundling cable. Tie-wraps shall not be used bundle cable.
12. Installation to meet or exceed TIA 568.0-D and TIA 569-D. UNLV Network Development and Engineering must approve completed installation.

I. CABLE TESTING

All cables and termination hardware shall be 100% tested for defects in installation and to verify cable performance under installed conditions. The contractor, prior to system acceptance, shall verify all conductors of each installed cable. Any defect in the cabling system installation including but not limited to cable, connectors, feed-through couplers, patch panels, and connector blocks shall be repaired or replaced in order to ensure 100% usable conductors in all cables installed.

1. Copper Data Cable

All Data cables shall be tested in accordance with TIA-568-C.2 Balanced Twisted-Pair Telecommunications Cabling and Components Standard or better and best industry practices. If any of these are in conflict, the Contractor shall be responsible to bring any discrepancies to the attention of UNLV Network Development and Engineering. All results shall be PASS. Any *PASS test results will require troubleshooting and repair of the cable in question to achieve a PASS test result.

a. Testing

Each cable shall be tested for wire map, length and performance. The data cables shall be bi-directional tested using a TIA 1152 level III or better cable analyzer. The cable analyzer shall be within the calibration period recommended by the manufacturer.

- Wire Map

Each pair of each installed cable shall be tested for continuity, opens, shorts, pair-reversals, split pairs, transposed pairs, and any other miss-wiring. The test shall be recorded as pass/fail as indicated by the test set in accordance with the manufacturers recommended procedures, and referenced to the appropriate cable identification number and circuit or pair number. Any faults in the wiring shall be corrected and the cable re-tested prior to final acceptance.

- Length

Each installed cable shall be tested for installed length using a TDR type device. The cables shall be tested from patch panel to patch panel, block to block, patch panel to outlet or block to outlet as appropriate. The cable length shall conform to the maximum distances set forth in the TIA/EIA-568-C.2 Standard. Cable lengths shall be recorded, referencing the cable identification number and circuit or pair number. For multi-pair cables, the longest pair length shall be recorded as the length for the cable.

- Performance Verification

Category 6 or 6A data cable shall be performance verified using an automated test set. This test set shall be capable of testing for the continuity and length parameters defined above, and provide results for the following tests:

1. Return Loss
2. Insertion Loss
3. NEXT (Near-End Crosstalk)
4. PSNEXT (Power Sum Near-End Crosstalk)
5. FEXT (Far End Crosstalk) Loss
6. ACRF (Attenuation to Crosstalk Ratio Far-End)
7. PSACRF (Power Sum Attenuation to Crosstalk Ratio Far-End)
8. TCL (Transverse Conversion Loss) – recorded for information only
9. ELTCTL (Equal Level Transverse Conversion Transfer Loss) – recorded for information only
10. Coupling Attenuation
11. Propagation Delay
12. Propagation Delay Skew
13. PSANEXT (Power Sum Alien Crosstalk) Loss
14. Average PSANEXT Loss
15. PSAFEXT (Power Sum Alien Far-End Crosstalk) Loss (connecting hardware only)
16. PSAACRF (Power Sum Alien Attenuation to Crosstalk Ratio Far-End)
17. Average PSAACRF
18. ACRN (Attenuation to Crosstalk Ratio Near-End) – recorded for information only
19. PS ACR-N (Power Sum Attenuation to Crosstalk Ratio Near-End) – recorded for information only
20. DC Loop Resistance

21. DC Resistance Unbalance (Channel Test)

- Equipment

Test results shall be automatically evaluated by the equipment, using the most up-to-date criteria from the TIA 568-C.2 Standard, and the result shown as pass/fail. Test results shall be printed directly from the test unit or from a download file using an application from the test equipment manufacturer. The printed test results shall include all tests performed and the actual test result achieved. All test results to be provided to UNLV Network Development and Engineering in .PDF format prior to acceptance of completed project. All test results must be labeled with the specific data cable that was tested by its identifier on the patch panel.

2. Fiber Optic

Test results shall be automatically evaluated by the equipment, using the most up-to-date criteria from the TIA 568.3-D Standard, and the result shown as pass/fail. The test results shall include all tests performed and the actual test result achieved. All test results to be provided to the UNLV Network Development and Engineering in .PDF format prior to acceptance of completed project. All test results must be labeled with the specific data cable that was tested by its identifier on the patch panel.

Test evaluation for the panel to panel (backbone) shall be based on the values set forth in the TIA-568.3-D, Optical Fiber Cabling Components.

Attenuation testing shall be performed with a stable launch condition using two-meter jumpers to attach the test equipment to the cable plant. The light source shall be left in place after calibration and the power meter moved to the far end to take measurements.

The expected results for each cable (or group of cables of the same nominal length) shall be calculated before the start of testing and recorded in a space provided on the Contractor's test matrix. Each strand of fiber in the respective cable shall be evaluated against this target number. Any fibers that exceed this number by more than -0.5dB shall be repaired or replaced at the installers' cost.

Where concatenated links are installed to complete a circuit between devices, the Contractor shall test each link from end to end to ensure the performance of the system. After the link performance test has been successfully completed, each link shall be concatenated and tested. The test method shall be the same used for the test described above. The evaluation criteria shall be established between UNLV Network Development and Engineering and the Contractor prior to the start of the test.

a. Single-mode

Single mode optical fiber attenuation shall be measured at 1310 nm and 1550 nm using a laser light source and power meter. Tests shall be performed at both wavelengths in one direction on each strand of fiber. The set-up and test shall be performed in accordance with TIA-526-7-A Standard, Method 1A. Two-meter patch cords shall be used as test references and for the actual test. This test method utilizes a one-jumper reference, two-jumper test to estimate the actual link loss of the install cable plus two patch cords. Single-mode fiber optic cable must meet or exceed the following limits:

- Attenuation
0.4dB/km at 1310nm, 0.3dB/km at 1550nm.
- Connectors
Max loss for a mated pair of connectors shall be less than 0.5dB

3. OTDR

Each cable shall be tested with an Optical Time Domain Reflectometer (OTDR) to verify installed cable length and splice losses. The OTDR measurements for length shall be performed in accordance with TIA 568-C.2. The measurements to determine splice loss shall be performed in accordance with manufacturer's recommendations and best industry practices.

4. As-Builts

All labeling information shall be recorded on the as-built drawings and all test documents shall reflect the appropriate labeling scheme. The As-built drawings shall clearly identify the patch panel label and its corresponding station side location. As-builts will be created from latest digital architectural drawings, to most closely resemble exact building conditions, as possible. Hand drawings are not acceptable. As-builts & test results must be provided in both .PDF and CAD format. In the CAD format, two layers shall be required for documentation. The first layer shall document the cable path from the station to the IDF. It shall show the conduit, junction boxes, cable tray, etc. locations used for the cabling. Any cable path in conduits does not need to be documented. The second layer shall document the endpoints of the cabling (station and IDF) with the cable labels. Upon acceptance of contract, vendor will be required to provide an acceptable time-line for provision of As-Built drawings. Acceptable time-line shall be verified by UNLV Network Development and Engineering. Ample time must be allocated for verification of As-builts & test results and subsequent corrected versions of those documents. Network equipment (Including Voice, Data and A/V services) will not be provisioned until this documentation is provided.

J. GROUND TESTING

Two-point ground and continuity testing will be performed to determine if there is an acceptable maximum level of resistance between any point in the telecommunications bonding and grounding system and the building's electrical grounding electrode system.

- a. Prior to performing a two-point test, a visual inspection shall be performed to verify the bonding and grounding system is installed according to TIA-607-C-1 guidelines.
- b. For the test to be valid it must be done prior to the installation of the telecommunications equipment
- c. The recommended maximum value for resistance between any point is 100 milliohms.
- d. The following areas will be tested:
- e. PBB/SBB to the electrical ground from each IDF/MDF.
- f. PBB/SBB to the building steel (if present).
- g. PBB to SBB
- h. Building steel (if present) to the electrical ground.
- i. The printed test results shall include all tests performed and the actual test result achieved. All test results to be provided to UNLV Network Development and Engineering in .PDF format prior to acceptance of completed project.

4. CONTRACTOR SUMMARY

This summary is intended to provide an overview of key requirements that contractors of small data cabling installations will most often need to reference. Contractors will still be responsible for maintaining compliance with the entire wiring specification.

A. Contractor requirements

1. Certified to install for one of the approved manufacturers.
2. RCDD on staff
3. Supervisor and/or lead installer shall be BCSI certified installers and members in good standing
4. For required installations, RCDD will conduct weekly inspections and submit weekly status report to Customer.

B. Approved manufacturers

1. Copper
 - a. Commscope/Uniprise
 - b. Leviton/Berktek
 - c. Siemon
 - d. TE Connectivity
 - e. Panduit
2. Fiber
 - a. Air-blown fiber
 - Future Flex Air-Blown Network Solutions by Sumitomo Electric Lightwave
 - eABF solutions by AFL/Duraline
 - b. Non-air-blown fiber
 - Corning
 - TE Connectivity
 - Siemon
 - Leviton
 - Commscope

C. Warranty

1. All copper and fiber cabling installations must be covered by an end-to-end manufacturer warranty of no less than 20 years. The warranty is required to cover cabling, components, and performance. Parts and labor for replacements must also be included in the warranty.

D. Cabling

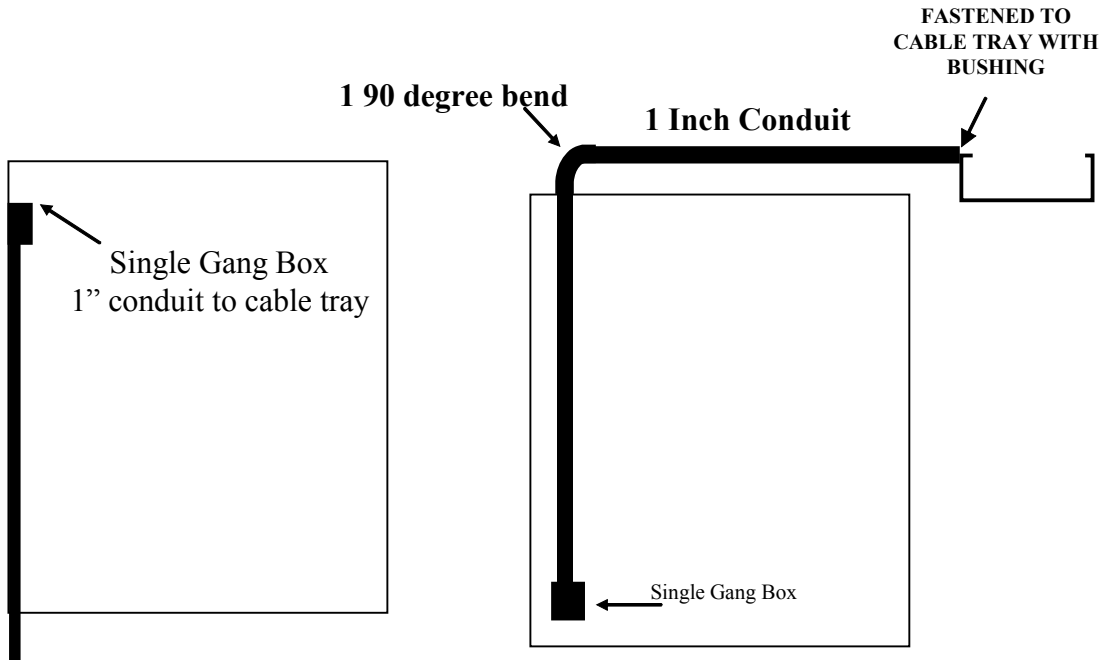
1. Copper Data Cabling and Components
 - a. New buildings will be installed with Category 6A cable and components from one of the approved manufacturer's parts in Appendix A6.
 - b. Existing building will be installed with Category 6 cable and components from one of the approved manufacturer's parts in Appendix A6.
 - c. All data cabling will have a service loop with a minimum of 5 feet of data cabling that will be placed on the MDF/IDF ladder rack.
 - d. All data patch panels for existing buildings are to be Leviton QuickPort patch panel (Model number 49255-H48) or Siemon MAX Copper Patch Panel (Model number MX-PNL-48). Equivalent patch panels must accept keystone Category 6 or 6A jacks, in 2U, 48 port configuration, and must meet or exceed EIA/TIA and ISO/IEC Category 6/Class E or Category 6A/Class E_A requirements. They must also be capable of housing keystone data jacks from other manufacturers, be viewed, tested and approved by Network Development and Engineering staff.

- e. All data jacks shall be modular, unshielded, 4-pair, 8P8C, Category 6 or 6A, black unless otherwise specified, and must meet or exceed EIA/TIA and ISO/IEC Category 6/Class E or Category 6A/Class E_A requirements. Data jacks must be compatible with patch panel from Section 2.3.A.1. Compatible jacks are listed in Appendix A6, in each manufacturer section, item description “Jacks – Universal, Black”.
 - f. Terminations will follow wiring scheme TIA568-B.
 - g. Where installation of conduit is not required, plenum cable will be used. Cables are not permitted to lie atop a lay-in ceiling or simply drape over pipe and ductwork; appropriate J-hook/supports or dressing will be used.
 - h. Hook and loop tape is the only approved product for bundling cable. Tie-wraps will not be used bundle cable.
 - i. Wire managers will be Panduit WMPF1E and WMPVHC45E
 - j. Racks will be Panduit R4PCN
 - k. Installations must comply with TIA 569-D and TIA568-C.2
2. Fiber Cabling and Components
 - a. Air-blown fiber tube cell conduit will be installed in all new buildings and in new building-to-building fiber installations.
 - b. Air-blown fiber will be used in existing buildings that contain existing air-blown fiber components.
 - c. Non-air-blown fiber will be used in existing buildings that do not have existing air-blown fiber components.
 - d. Installation of innerduct shall be required when installing non-air-blown fiber in conduits.
 - e. Terminations will be completed using no epoxy/no polish connectors or factory-terminated pigtails with fusion splicing
 - f. All fiber will be terminated with LC / UPC connectors and be mounted in 12- or 24- fiber adapter plates.
 - g. Fiber enclosures will be from a NDE-approved manufacturer. Adapter plates will of standard size and will fit these enclosures.
- E. Documentation
1. Labeling
 - a. Contractor will be responsible for labeling all installed cables.
 - The labeling scheme will use the format described in Appendix A2.
 - Contractor will label the patch panel port, cable termination points, and faceplates.
 - Contractor will also be responsible for labeling any new patch panel
 2. Testing
 - a. All installed cables will be certified by an approved cable analyzer. Test results will meet TIA-568-C.2 and TIA-568.3-C requirements. Test results will be provided to Planning and Construction in PDF format upon completion. Network Engineering and Development will verify all test results prior to activating ports.
 3. As-builts

All installed cables will be documented on an as-built diagram. The diagram will indicate the location and actual label of all installed cabling. As-builts will be provided to Planning and Construction in PDF and CAD format upon completion. Network Engineering and Development will verify all that the data contained the as-builts matches the actual labels prior to activating ports.

APPENDIX A – EXHIBITS

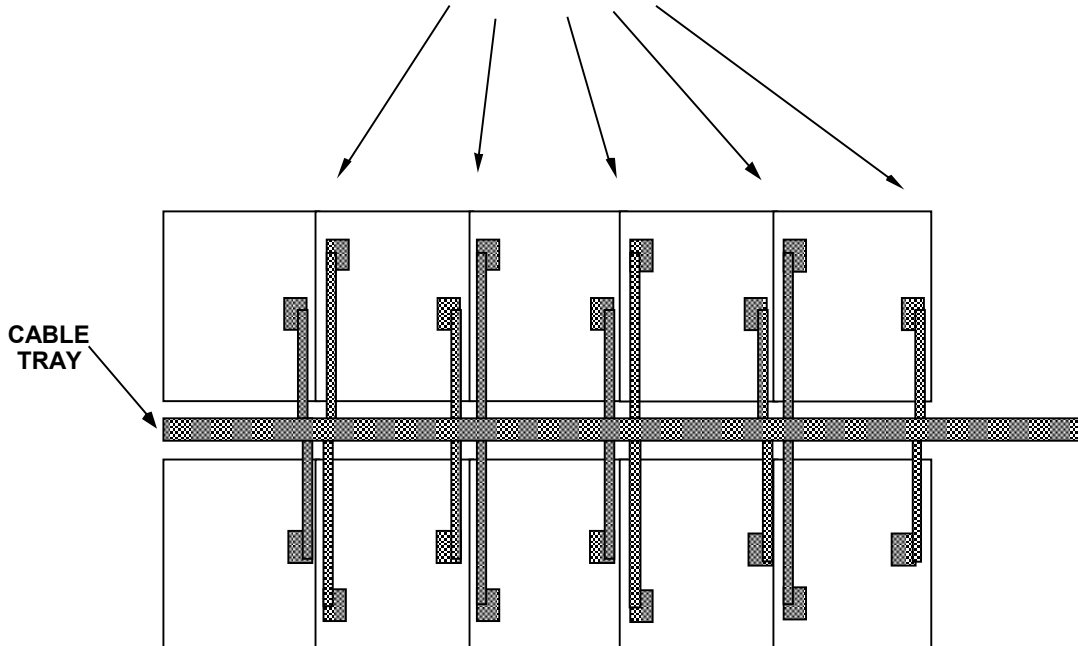
A1 Standard Conduit Routing



PLAN VIEW

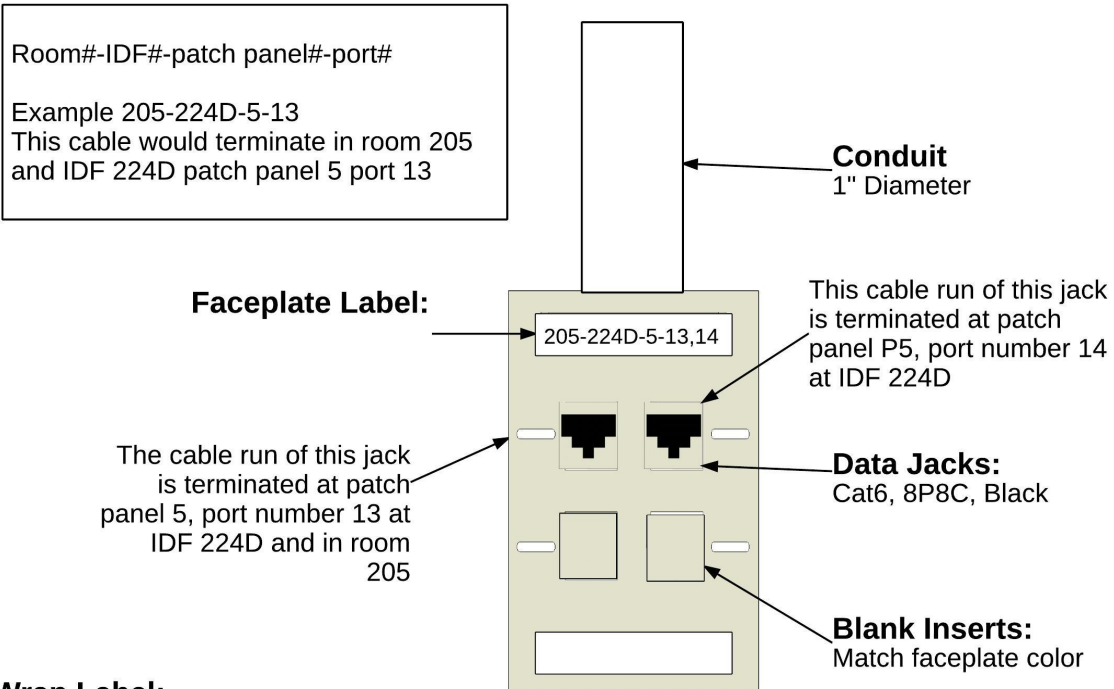
ELEVATION VIEW

STATION BOXES



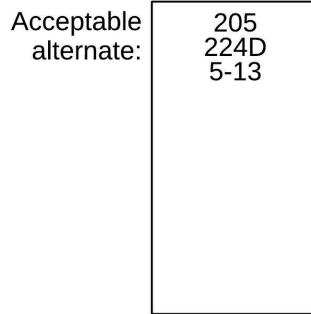
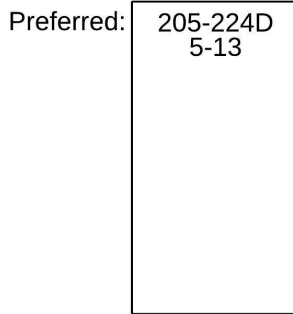
A2 Standard Labeling Scheme (Copper)

UNLV Labeling Scheme



Wrap Label:

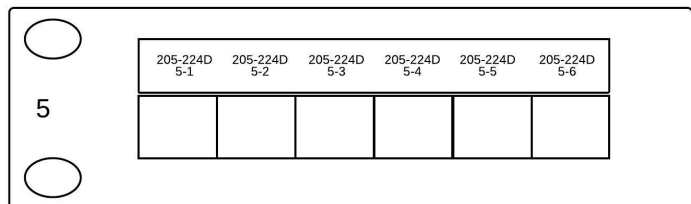
Required within six inches of both termination points



Patch Panel Labels:

Each patch panel port will be labeled as shown using the scheme listed above

Patch panels will be labeled as shown. The label will contain a number unique to the IDF. If it is the top patch panel in the rack it will be labeled "1". If is the next patch panel down from the top it will be labeled "2" and so on.

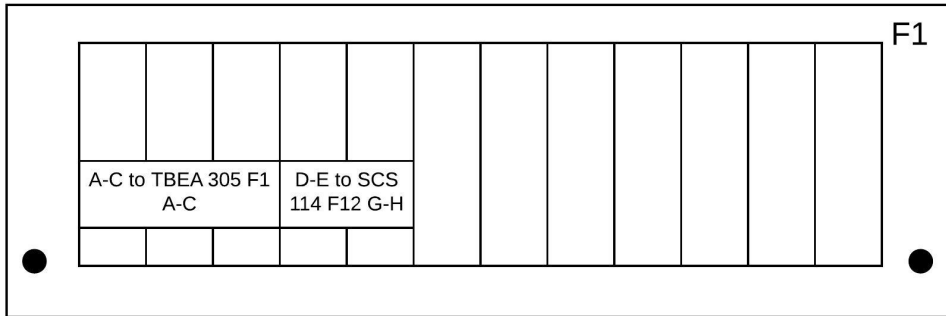


A3 Standard Labeling Scheme (Fiber Optic)

Label Example for Fiber Optic Cables

72 Strand SM
SCS 114
to
SU 229

Label Example for Fiber Enclosures



Label Example for Tube Cell Conduit

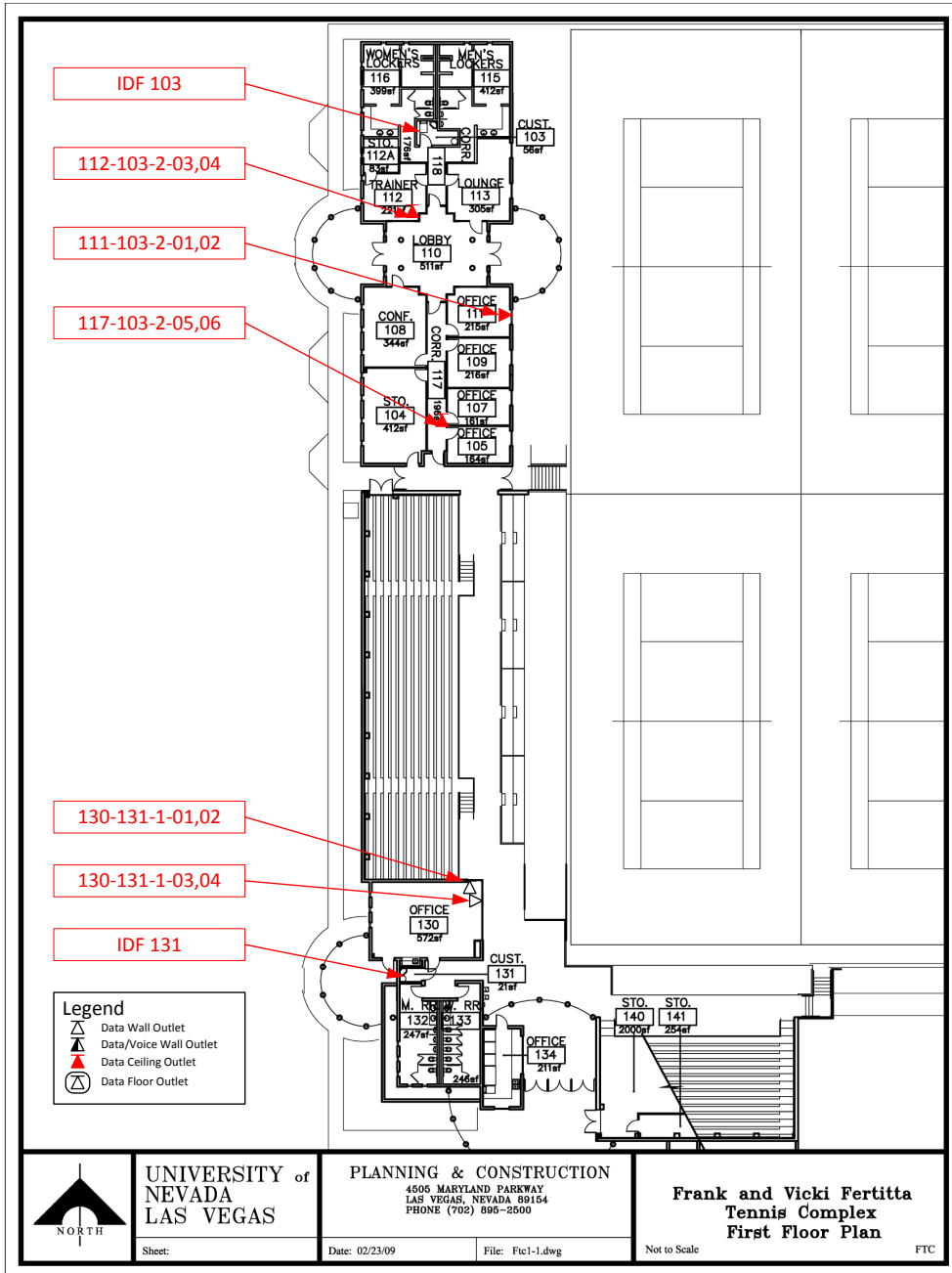
Rectangular Marker Plate

V-41-D to V-44-D

Label Example for Individual Microducts

72 Strand SM
SCS 114 F1 A-C
SU 229 F1 A-C

A4 As-Built Example



UNIVERSITY of
NEVADA
LAS VEGAS

PLANNING & CONSTRUCTION
4606 MARYLAND PARKWAY
LAS VEGAS, NEVADA 89154
PHONE (702) 896-2600

Frank and Vicki Fertitta
Tennis Complex
First Floor Plan

Sheet: Date: 02/23/09 File: F1c1-1.dwg Not to Scale FTC

A6 Approved Copper Manufacturer's Parts List

A. Commscope / Uniprise / NetConnect

Item Description	Model Number		
	Commscope	Uniprise	NetConnect
Category-6 (CAT-6) Products			
Cabling – 1000 ft bulk, Plenum	8773614/10	6504+ Blue CPK	TE620P-BL02
Cabling – 1000 ft bulk, Riser	8471514/10	65N4+ Blue CPK	TE620R-BL02
Patch Panels – Modular/Discreet	760237047	CPP-SDDM-SL-2U-48	
Jacks – Modular, Black	CC0020826/1	UNJ600-BK	9-1375055-2
Jacks – Universal, Black	2291216-2		9-1375055-2
Category-6 Augmented (CAT-6A) Products			
Cabling – 1000 ft bulk, Plenum	760234859	2091 SD BL 4/23 R1000	
Cabling – 1000 ft bulk, Riser			
Patch Panels – Modular/Discreet	760237047	CPP-SDDM-SL-2U-48	
Jacks – Modular, Black	760149922	UNJ10G-BK	1933476-2
Jacks – Universal, Black	760237661	USL10G-BLK	1933476-2
Faceplates with windows, Almond/Beige	108168543	M14L-262	2111011-1

B. Leviton / Berktek

Item Description	Model Number	
	Leviton	Berktek
Category-6 (CAT-6) Products		
Cabling – 1000 ft bulk, Plenum		10136226
Cabling – 1000 ft bulk, Riser		10136339
Patch Panels – Modular/Discreet	49255-H48	
Jacks – Modular, Black	6110-RE6	
Jacks – Universal, Black	6110-RE6	
Category-6 Augmented (CAT-6A) Products		
Cabling – 1000 ft bulk, Plenum		11082057
Cabling – 1000 ft bulk, Riser		11082062
Patch Panels – Modular/Discreet	49255-H48	
Jacks – Modular, Black	6110G-RE6	
Jacks – Universal, Black	6110G-RE6	
Faceplates with windows, Almond/Beige	42080-4TS	

C. Siemon

Item Description	Model Number
Category-6 (CAT-6) Products	
Cabling – 1000 ft bulk, Plenum	9C6P4-E3-06-RXA
Cabling – 1000 ft bulk, Riser	9C6R4-E3-06-RXA
Patch Panels – Modular/Discreet	MX-PNL-48K
Jacks – Modular, Black	MX6-F01
Jacks – Universal, Black	MX6-K01
Faceplates with windows, Almond/Beige	MX-FP-S-04-20
Category-6 Augmented (CAT-6A) Products	
Cabling – 1000 ft bulk, Plenum	9U6P4-A5-06-R1A
Cabling – 1000 ft bulk, Riser	9U6R4-A5-06-R1A
Patch Panels – Modular/Discreet	Z6A-PNL-U48K
Jacks – Modular, Black	Z6A-01
Jacks – Universal, Black	Z6A-K01
Faceplates with windows, Almond/Beige	10GMX-FPS04-20

D. Panduit

Item Description	Model Number
Category-6 (CAT-6) Products	
Cabling – 1000 ft bulk, Plenum	7131970
Cabling – 1000 ft bulk, Riser	7133970
Patch Panels – Modular/Discreet	
Jacks – Modular, Black	NK688MBL
Jacks – Universal, Black	NK688MBL
Category-6 Augmented (CAT-6A) Products	
Cabling – 1000 ft bulk, Plenum	7132849
Cabling – 1000 ft bulk, Riser	7133849
Patch Panels – Modular/Discreet	
Jacks – Modular, Black	NK6X88MBL
Jacks – Universal, Black	NK6X88MBL
Faceplates with windows, Almond/Beige	NK4FIWY