SECTION 27 00 00

COMMUNICATIONS

PART 1 – GENERAL

1.01 SUMMARY
A. The University of Colorado at Boulder (UCB) Division 27 specifications are to be used for all UCB projects that involve Office of Information Technology (OIT) or working within the existence of OIT infrastructure.
B. UCB OIT has the right to change and update these Division 27 specifications at any time without notice. Contractors and consultants shall make sure they are working with the latest addenda to these specifications.
C. These specifications are posted on the UCB Facilities Management website every year around July 1 however the document form and addenda files are only supplied from UCB OIT.
D. All related services and fees for moves, adds and changes to existing telecommunications station cabling are not covered by these specifications.

1.02 RELATED DOCUMENTS
A. The products and execution from these standards are the accepted practices from the OIT department and any products or execution outside these specifications will require written approval from OIT.
B. Drawings, contractor forms, conditions of the contract, construction manager/general contractor agreement exhibits and other Division 1 specifications.
C. In the event of a conflict or discrepancy between these specifications and other documents project related such as but not limited to drawing files the contractor shall submit proper paper work to resolve the issue. Neither the specifications or the drawing files (or other documents) prevail unless you have clarifications in writing for the project your working on from UCB OIT.
D. The contractor shall review related project documents and report any and all concerns prior to installation.

1.03 COMMUNICATIONS SYSTEMS
A. The communications shall have the following systems:
a. Communications Cabling and Hardware: T-Series
   i. Cover with Legends.
   ii. Site Plan with Outside Plant.
   iii. Riser Diagrams with Conduit, Grounding, Voice, Utility, Qwest, Multi-mode Fiber, Single-mode Fiber and CATV.
   iv. Floor Maps with all Outlet locations.
   v. MDF Details with Footprint, Relay Rack Layout and Wall Design.
   vi. All additional TR Details with Footprint, Relay Rack Layout and Wall Design.
   viii. Remote MDF/ER/TR Details involved in the project.
   ix. Details sheet with Faceplates, Wireless Plates (Surface Box), Wireless Boxes, Camera Box, Floor Box, Stiff Leg Racks, Box Assembly, etc.
   x. Manholes, Hand holes, etc.
   xi. Outside Plant Prints.
   b. Communications Demolition: TD-Series
   c. Audiovisual: T-Series
   d. Electrical Infrastructure: ET-Series

1.04 DIVISION 27 OVERVIEW
A. 27 00 00 COMMUNICATIONS
B. 27 01 00 OPERATION AND MAINTENANCE OF COMMUNICATIONS SYSTEMS
C. 27 05 00 COMMON WORK RESULTS FOR COMMUNICATIONS
D. 27 05 28 PATHWAYS FOR COMMUNICATIONS SYSTEMS
E. 27 05 43 UNDERGROUND DUCTS AND RACEWAYS FOR COMMUNICATIONS SYSTEMS
F. 27 08 00 COMMISSIONING OF COMMUNICATIONS
G. 27 11 00 COMMUNICATIONS EQUIPMENT ROOM FITTINGS
H. 27 13 00 COMMUNICATIONS BACKBONE CABLELING
I. 27 15 00 COMMUNICATIONS HORIZONTAL CABLELING
J. 27 18 00 TESTIN, IDENTIFICATION AND ADMINISTRATION
K. 27 20 00 DATA COMMUNICATIONS
L. 27 40 00 AUDIO- VIDEO COMMUNICATIONS
M. 27 50 00 DISTRIBUTED COMMUNICATIONS AND MONITORING SYSTEMS (CCURE, PAGING, ETC)

1.05 BIDDING REQUIREMENTS
A. Refer to 27 05 00 COMMON WORK RESULTS FOR COMMUNICATIONS for the minimum qualifications for the Communications Contractor.
   a. Proof of Hubbell certification of the Communication Contractor is required to be provided with project bid.
B. Refer to 27 05 00 for firestop requirements and refer to the Architectural drawings for ratings of existing and new walls, floors, and other surfaces in the project area.
   a. The base bid for communications cabling project is required to include all firestop materials and installation for all existing and new communication cabling in the project area.

PART 2 – MATERIALS

2.01 THIS SECTION NOT USED.

PART 3 – EXECUTION

3.01 THIS SECTION NOT USED.

END OF SECTION 27 00 00
SECTION 27 01 00
OPERATION AND MAINTENANCE OF COMMUNICATIONS SYSTEMS

PART 1 – GENERAL

1.01 RELATED DOCUMENTS
A. Drawings, Contract Forms, and Conditions of the contract, including Construction Manager/General Contractor (CM/GC) Agreement including Exhibits and other Division 1 Specification Sections, apply to this section.

1.02 CONTRACT ADMINISTRATION
A. The Contractor shall carefully study and compare the Contract Documents and shall at once report to UCB and/or the Consultant/Engineer any error, inconsistency or omission identified. If the Contractor performs any construction activity knowing it involves a recognized error, inconsistency or omission in the Contract Documents without such notice, the Contractor shall assume appropriate responsibility for such performance and shall bear an appropriate amount of the attributable cost for correction.
B. The Contractor shall advise UCB as early as possible of any product delays and minimum quantity requirements that may affect the project timeline.
C. Should conflicts, discrepancies, deficiencies, or errors arise which require changes in the Contract Documents, immediately notify UCB PM’s and the Consultant/Engineer. Failure to do so shall be interpreted as the intention of the Contractor to supply all necessary labor and materials for the suitable completion of this work. Obtain written approval on necessary adjustments before the installation is started.
D. In the event that the consultant/Engineer is required to provide additional engineering services as a direct result of Contractor’s errors, omissions or failure to conform to the requirements of the Contract Documents, then the Engineer’s expenses in connection with such additional services shall be paid by the contractor and may be deducted from any monies owed the Contractor.
E. In the event that the Consultant/Engineer is required to provide additional engineering services as a result of substitution of equivalent materials or equipment by the Contractor, or changes by the Contractor in dimension, weight, power requirements, etc., of the equipment and accessories furnished, or if the Engineer is required to examine and evaluate any changes proposed by the Contractor solely for the convenience of the Contractor, then the Engineer’s expenses in connection with such additional services shall be paid by the Contractor and may be deducted from any monies owed the Contractor.

1.03 PROJECT MANAGEMENT AND QUALITY ASSURANCE
A. The Contractor shall designate and identify a Project Manager to oversee the project work specified in this Division and to attend all project meetings as a representative of the Contractor. The Contractor’s Project Manager shall have the authority to act for the Contractor, and all communications given to the Project Manager will be deemed to have been given to the Contractor.
B. Contractor shall not begin construction on any project without written notice to proceed.
C. All additional costs must be approved in writing with a change order signed by UCB project manager or UCB OIT management.
D. Perform project management and coordinate all phases of the project with UCB staff.
   a. Attend weekly project management meetings on site or at the Telecommunications (Information Technology Services) Building on the UCB campus.
   b. Provide and maintain a complete project schedule and timeline for all project activities including installation, inspection, and testing for each work activity in each building. The project schedule will be provided by the Contractor’s Project Manager at the first project meeting within one week of contact award. The project schedule and timeline shall be updated as appropriate and will be provided and reviewed at each weekly project meeting thereafter.
E. Job supervision
   a. Designate and identify job supervisor in advance.
   b. Provide no more than one supervisor per job.
   c. Provide one primary contact, one backup contact.
   d. Inform UCB if contact is unavailable.
   e. Remove employees with behavior unacceptable to UCB.

F. Maintain the following information on the job site
   a. CU OIT Standards specifications (Division 27).
   b. All project related drawings.
   c. All addenda’s.
   d. Submittals.
   e. All Change Orders.
   f. The Field Observation and inspection reports.
   g. Test results.
   h. Schedule and outage logs.
   i. As-built drawings set showing all changes.

G. Assist UCB in performing periodic inspections for evaluation and functional testing of communications subsystems or sections, as completed. Assist UCB in performing evaluation and functional testing of complete communications system(s).

H. Conduct an overall quality assurance program.

I. Apply and install materials, equipment, and specialties in accordance with manufacturer’s written instructions. Conflicts between the manufacturer’s instructions and the specifications shall be referred in writing to UCB for resolution.

J. All products, components, devices, equipment and materials shall be new and unused, clean, free from defects, and free from damage and corrosion.

K. Installation and service shall be performed by manufacturer trained and authorized personnel.

1.04 SUBMITTALS
   A. The Contractor shall submit for review and approval a complete list of all materials, components, equipment, systems, and products proposed. Any requests for substitutions must be submitted with complete product data.

   B. Product Data
      a. Product submittals shall show, as a minimum, the following:
         i. Manufacturer, color, complete model and part number.
         ii. Dimensions.
         iii. Complete technical specifications and performance data.
         iv. Any other pertinent information necessary to determine adequacy for the intended application.

      b. Product submittals are not required for manufacturer’s products listed as “approved” in this specification unless specifically required in individual sections of this Division. However, listed manufacturers products are held to all conditions of this specification. Contractor may be required to provide submittals for clarification of a specific item of equivalency prior to installation.

   C. Substitutions
      a. Requests to substitute for specified items or previously approved materials or equipment shall be submitted by the Contractor to UCB and the Engineer for review. Substitution requests shall include all required submittals and shall be complete with reasons for substitutions and savings which will accrue to UCB if substitutes are approved. Substitutes will be considered only if equal or superior to that specified.

      b. Approval of alternate or substitute equipment or material in no way voids the Contract Document requirements.
c. Under no circumstances shall UCB be required to prove that an item proposed for substitution is not equal to the specified item. It shall be mandatory that the Contractor submit to the Owner all evidence to support the contention that the item proposed for substitution is equal to the specified item. The UCB decision as to the equality of substitution shall be final and without further recourse.

d. The Contractor shall be liable for Engineer’s costs for review and for incorporation of accepted substitutions if the proposed substitutions require design modifications. The Engineer will bill the Contractor standard hourly rates for the time used to review substitutions and to incorporate proposed substitutions into design documents.

e. It shall be the responsibility of the Contractor to assure that the substitute material and/or equipment fits into the space provided and the Contractor shall pay for all extra costs incurred by other trades for any and all changes necessitated by these substitutions.

D. Statement of Warranty

a. The Contractor shall provide statement(s) of warranty based on the vendors’, manufacturers’ and Contractor’s warranties.

E. The Consultant shall submit the proposed outlet numbers, using the T-5 template provided by OIT, for review and approval prior to construction. The T-5 shall be submitted in two phases ad the CD level, one as a “Draft” T-5 at which time UCB OIT will return corrections to be made and within one week the “Final” shall be submitted with all the corrections made to the T-5 by the Consultant to UCB OIT (some projects have the Contractors building and submitting the T-5 because of older specifications).

F. As-Built Drawings

a. All print changes shall be hand written by the contractor and signed off by the engineer and submitted to the CU OIT engineering or project Design Consultant for final AutoCAD prints to be submitted to CU OIT directly (this will be in addition to any submittals to the Architect).

b. At the beginning of work, the Contractor shall set aside one complete set of the project drawings which shall be maintained as a complete “as-built” set. The Contractor shall record all changes and deviations on the as-built drawing set. Changes that must be noted on the as-built drawing set shall include equipment numbering and labeling and any change in cabling or materials, cable routing, equipment placement, etc. In addition, installed cable footages for all backbone cabling shall be recorded on the as-built drawings.

c. Preliminary as-built station cabling drawings, with all outlet numbers identified on the floor-plans and a pre-numbered T-5 jack numbering template, shall be provided to UCB OIT at CD phase on big projects (within two days on small projects, by the Contractor instead of the Consultant for all submittals) and are expected to not change or adjust after the submittal unless errors are found which are corrected immediately after approval from UCB OIT. Additional T-5 lists shall be submitted for all deletions and additional outlets by the Consultant with an updated floor-plan. The submittal shall also include the contractor’s construction timeline with all milestones included.

d. At one (1) week prior to occupancy, or as agreed on per the project schedule with UCB OIT, the contractor shall submit an updated hard copy of the as-built drawings and an updated electronic and hard copy of the T-5 jack numbering template of which the installed work was based with all the changes and device locations. All changes must have the approved signature of the UCB OIT project manager. Notations and changes shall be done in a neat and legible manner by marking the original drawings with red pencil to indicate additions and green pencil to indicate deletions. Within four (4) weeks of the testing the “As-built” T-5 shall be submitted (electronic) to UCB OIT and the Consultants by the Contractor with all testing corrections.

e. Contractor shall comply with the following attached document: CONSTRUCTION DRAWINGS AS-BUILT REQUIREMENTS.
f. A hard copy and electronic copy of the as-built files shall be submitted to UCB OIT from the contractor and communication consultant within four (4) weeks of completion of the project. All re-submittals shall be submitted within two (2) weeks to UCB OIT. These as-built documents apply to all projects unless written approval from UCB OIT. This submittal shall not be held up for delivery to UCB OIT for any reason. The Consultant has the final responsibility to get As-built files to UCB OIT within five (5) weeks of completion of the project. The Consultant has the final responsibility to get As-built files to UCB OIT within five (5) weeks of completion of the project.

G. Test Results and Configuration Information
   a. Upon completion of the work, but before final approval, the Contractor shall submit test results and configuration information as required by each of the individual specification sections.
   b. Standard UCB test sheets will be provided by UCB OIT for fiber optic cabling.
   c. Test sheets for communication jacks will not be supplied to the Contractor by UCB OIT. The Contractor shall comply with the most current Hubbell Mission Critical Warranty documentation and procedure. All documentation including, but not limited to the “Structured Cabling System Registration Request Form,” “testing disk,” “Horizontal Schematic,” and “Backbone Schematic” shall be completed in full and shall include the installers full name, company name, telephone number, date completed, and UCB jack outlet with faceplate port numbers (e.g., 202-1D-1C5e-1D-3). All documentation shall be provided to both Hubbell and the University of Colorado OIT for warranty. The testing disk to UCB OIT shall be converted to a text format. Most projects will require as-built submittals of this information no later than 4 weeks following project completion and large projects may be subject to submittal on a monthly basis as determined by UCB OIT. Daily contractors will e-mail completions on a weekly basis.
   d. Pursuant to required warranty validation documentation and procedures for cabling to support specialized technology systems, Contractor shall provide such documentation as required to the system manufacturer, with a copy to appropriate UCB representatives.

H. Design Consultant submittal
   a. The final 100% CD comments shall be made to the design prints within one week and the final 100% CD prints shall be submitted to UCB OIT department.

1.05 PERMITS, LICENSES, INSPECTIONS AND FEES
   A. The Contractor shall obtain all required permits, licenses and inspections and shall pay all legal and proper fees and charges including taxes, royalties, and other related charges. No work shall be started before obtaining all necessary permits and paying all required fees.
   B. The Contractor shall, at inception of the work, provide UCB with copies of all required building and trade permits, if said are required.
   C. The Contractor shall furnish and file with the proper authorities all drawings required by them in connection with this work.
   D. The Contractor shall be responsible for arranging all inspections and for securing all required signatures. Upon completion of the work, properly completed permits shall be returned to UCB, if any are required.

1.06 PERIODIC FIELD OBSERVATION REPORTS
   A. UCB will conduct site visits as required to monitor the progress and quality of the workmanship and the work environment as well as the surrounding facility. Any item found by UCB to be deficient will be documented in a Periodic Field Observation Report.
   B. The Contractor shall take appropriate action to immediately correct and rectify any items deemed unsatisfactory by UCB. The Contractor shall not wait for a hard copy of the Periodic Field Observation Report if the action required to rectify the situation is obvious and clear.
   C. Contractor shall post and shall comply with the following attached document: CONSTRUCTION INSPECTION REPORT – VOICE AND DATA COMMUNICATIONS for all aspects of this project.
1.07 INSPECTIONS AND TESTS

A. The Contractor shall furnish promptly, without additional charge, all test equipment, instruments, facilities, labor, and material needed to perform safe and convenient inspection and testing.

B. Prior to beginning work, the Contractor shall submit to UCB a complete project schedule and timeline including installation, inspection, and testing for each project area so that interim inspections can be conducted as work progresses. UCB shall not be obligated to inform the Contractor of its intent to inspect job sites while work is in progress.

C. The Contractor shall perform pre-testing of the installed telecommunications systems to determine compliance and notify UCB OIT personnel when the system is ready for final inspection and testing. UCB shall be present for final inspection and testing within five business days of such notification by the Contractor.

D. At such time as UCB and/or the Consultant/Engineer may direct, and in the presence of the UCB OIT representative and/or Consultant/Engineer, conduct final inspection and testing of all telecommunications systems, both new and existing where modified.

E. Except as otherwise provided in the specifications, inspection and testing of materials and workmanship shall be made at reasonable times and at the site of the work. UCB may determine that inspection or testing of materials shall be made off-site, at the place of production, manufacture, or shipment of the material. Such off-site inspection or testing shall not relieve the Contractor of responsibility for damage to or loss of the material prior to acceptance, nor in any way affect the continuing rights of UCB after acceptance of the completed work.

F. Work shall not be covered up or enclosed until inspected by UCB personnel or other proper authorities. Should any work be covered up or enclosed before such inspection, it shall be uncovered, inspected, and after approval, restored by the Contractor to finished condition at no additional cost to UCB.

G. All work that is determined to be unsatisfactory shall be corrected immediately. The Contractor shall, without charge, replace any material or correct any workmanship found by UCB not to conform to the specifications, unless UCB consents to accept such material or workmanship with appropriate adjustment in price. The Contractor shall promptly segregate and remove rejected material from the premises. The Contractor will pay the additional cost of any test or inspection of the replaced material or corrected workmanship.

H. The Contractor shall prepare a written report of final test results together with UCB standard test sheets and all additional pertinent information and submit these to UCB OIT and/or the Consultant/Engineer for acceptance.

I. The telecommunications rooms and other rooms employing communications technology systems identified as part of the work scope for this project shall be labeled and laid out well in advance of testing, including the outlet numbers on the patch panels (as soon as the racks are mounted) to allow pre-inspections and at least three (3) weeks prior to testing for large projects.

1.08 CONTINUITY OF SERVICES AND SCHEDULING

A. The buildings may be in use during construction operations. Insofar as possible, the Contractor shall employ such methods or means as will not cause interruption of, or interference with, the owner’s scheduled use of the building and will maintain existing systems in operation within all rooms of the building at all times.

B. For areas under renovation, coordinate all installation activities with UCB and other trades for renovations of architectural, mechanical, and/or electrical facilities. Insofar as possible, the Contractor shall employ such methods or means as will not cause interruption of, or interference with, the work of any other contractor.

C. Moving or removing any facility must be done so as not to cause interruption of the project work or of University operation.

D. Disruption of critical services will require after hour or weekend working constraints.
E. Existing communication services shall be interrupted only with consent from UCB. An advance warning time of seven working days shall be given. Such interruptions shall be preceded by all possible preparations which will minimize down time to expedite that particular phase of the work pursuant to good workmanship. This shall be done at regular and premium time as approved by UCB without additional expense to UCB.

F. Adjust work schedule within reason (weekly), as per direction of UCB, and coordinate with work or other trades in order to make portions of project available to UCB as soon as possible.

G. All expenses due to untimely or improperly coordinated work shall be the responsibility of the Contractor.

1.09 USE OF CABLE PRIOR TO ACCEPTANCE
A. The Contractor shall permit the placement and installation by UCB of cross-connects, patch cords, and/or equipment onto cable and terminations installed under this contract, prior to substantial completion of the contract as necessary. Such placement or installation shall not evidence completion of the work or portion thereof, nor signify UCB acceptance of the work or portion thereof.

B. Cabling and equipment provided under this contract, whether the work of the Contractor is partially or fully completed or not, shall be the property of UCB. UCB shall have certain rights and privileges in connection with use of same.

1.10 FINAL ACCEPTANCE AND WORK CLOSEOUT
A. Contractor shall inspect the entire telecommunications system installation to assure all work is completed and all systems are completely operational before calling for final inspection, testing and acceptance of work.

B. Punch-List Close-out:
   a. Notify UCB when telecommunications work is ready for final inspection and punch list preparation.
   b. Resolve all punch list items before final invoicing.
   c. Turn in all as-built prints to UCB OIT, the Architect and keep a copy for your file.
   d. Final payment will not be authorized until all punch list items have been resolved and completed to the satisfaction of UCB with as-built files turned in.

C. After the successful installation inspections and functional testing by UCB and the Contractor, UCB will determine if there are any open issues or discrepancies and notify the Contractor. Upon completion or determined failure, UCB will issue written notification to the Contractor as to the status of the installation acceptance.

PART 2 – MATERIALS

2.01 THIS SECTION NOT USED.

PART 3 – EXECUTION

3.01 THIS SECTION NOT USED.

END OF SECTION 27 01 00
Memorandum of understanding between the University of Colorado at Boulder (UCB) Office of Information Technology (OIT), and the Contractors to the University of Colorado Telecommunication Department on all construction drawings issued for projects on Campus.

1. The UCB OIT CAD department shall issue two sets of drawings to the Contractor for OIT projects. Drawings for outside contractors, (i.e. not engineered by UCB OIT) shall be issued by the Architect/Consultant or Facilities Management Construction Manager for Facilities Management projects. Contractors may receive additional drawings. One set of drawings shall be kept on the job site for the purpose of marking as-built variations on the drawings. Drawings override any verbal statements made prior to, or during project walk-through, unless they are written on the drawing and a UCB OIT signature is next to the change.

2. Any changes (i.e. redlines) made to the design will need to be directed to the UCB OIT Engineering Department or the appropriate change order process. Changes made to the drawings shall require a UCB OIT signature next to redlines allowing the change to be made. If there is any change in cost of the project, a written submittal must be approved by UCB Construction Manager before proceeding. The Contractor may be requested to verify existing layout. Redlines on the drawings, based on field verification, shall not require a UCB OIT signature next to the redlines. Indicate “field verified” next to the redlines.

3. All copper/fiber and conduit jobs shall have cable and conduit distances noted on the “Cable Footage and Count Information” sheet. Footages from end-to-end, between splices, and from splice to building fiber termination point in building (relay rack or fiber can) are required. The “SYM” column on the form corresponds to the fiber and copper designation bubbles on the topo drawings. Conduit type and length shall be noted on the topo drawings.

4. The UCB OIT Construction Manager or UCB OIT Construction staff shall conduct an as-built walk-through with the Lead Contractor prior to project completion. During this walk-through a punch list shall be developed and the accuracy of the redline changes will be determined.

5. All drawings issued are required to be returned to the UCB Construction Manager, whether or not as-built modifications (redlines) were made to the drawings.

6. The UCB OIT Construction Manager and UCB OIT Construction will sign the prints after the punch list has been completed according to UCB drawings and specifications. As-built drawings for outside contracts shall be returned to the Architect/Consultant (or General Contractor depending on the project). Copies of the floor plans (i.e. jack maps) and jack position sheets shall be given to the UCB OIT Construction Manager prior to returning as-builds to the Architect/Consultant per this division standard.

7. The UCB OIT CAD department maintains the right to return drawings to the Contractor if information is incorrect or missing. The UCB OIT CAD Department is responsible for the accuracy of UCB OIT CAD drawings and shall require accuracy and clarity on all as-built drawings received from contractors and Architects/Consultants. Architects/Consultants shall provide UCB OIT CAD Department with both paper and electronic as-builds for a project.

8. The statement “Completed Per Print” is not acceptable.

Last document update was May 19, 2011.

Jerry Roehrs - Construction Manager

Robin Aragon - Construction

Don Thomas - Engineering Department

Outside Plant Contractor

Inside Contractor

Project Contractor (Bid Jobs)
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<th>Cable Count</th>
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<td>ROUGH-INS</td>
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SUB CONTRACTOR CERTIFICATION
SECTION 27 05 00

COMMON WORK RESULTS FOR COMMUNICATIONS

PART 1 – GENERAL

1.01 RELATED DOCUMENTS
   A. Drawings, Contract Forms, and Conditions of the Contract, including Construction Manager/General
      Contractor (CM/GC) Agreement including Exhibits and other Division 1 Specification Sections, apply to
      this section

1.02 SCOPE OF WORK
   A. Work includes, but is not limited to, the following:
      a. Placement of and additions to Telecommunications Room (TR) and Equipment Room (ER)
         hardware including equipment racks, cable routing hardware, copper and fiber termination
         equipment, patch cords, and grounding and bonding.
      b. Placement of and additions to hardware for AV Educational Technology systems for classrooms
         and lecture halls, including technology cabinets, equipment racks, cable routing hardware, copper
         and fiber termination equipment, patch cords, and grounding and bonding.
      c. Placement of and additions to interior telecommunications pathways including conduit, pull-
         boxes, and metallic surface-mount raceway systems.
      d. Placement of and additions to exterior telecommunications pathways including trenching/backfill,
         conduit system, pull-boxes, handholes, manholes and cable routing hardware.
      e. Installation and termination of backbone cabling including copper cabling, coaxial cabling, and
         singlemode and multimode fiber optic cabling.
      f. Installation and termination of horizontal cabling including copper cabling, coaxial cabling, and
         multimode fiber optic cabling.
      g. Testing, identification, and administration for the above telecommunications systems.
      h. Removal of existing horizontal cabling, terminations, and outlets in coordination with electrical
         contractor for removal of associated conduit.
   B. All work shall be conducted in coordination with UCB OIT and other building trades.
   C. The work covered by this Division consists of furnishing all materials, accessories, connectors, supports,
      electrical protection, equipment, tools, setup, preparation, labor, supervision, incidentals, transportation,
      storage, and related items and appurtenances, and performing all operations necessary to complete the
      telecommunications work as indicated in the project drawings and specified herein. It is the intent and
      purpose of this specification to have, upon completion of the project, a “turn-key” telecommunications
      system designed, built, coordinated and integrated with the existing telecommunications system and
      complete and operable in all respects. Completely install, connect, and test all systems, equipment,
      devices, etc., shown or noted or required to final connections and leave ready for satisfactory operation.
      Provide any minor items omitted from the design, but obviously necessary to accomplish the above intent.
   D. All telecommunications designs for UCB buildings on and off campus must be approved by the UCB OIT
      department for standard and design structure. Any design outside of these OIT standards must be
      approved and include a written agreement for the design from the UCB OIT department.
   E. Minimum composition requirements and/or installation methods for the following materials and work are
      included in this section:
      a. Cables
      b. Factory Assembled Products
      c. Compatibility of Related Equipment
      d. Special Tools and Kits
      e. Firestops and Penetration Seals
f. Anchoring and Supports  
g. Grounding and Bonding  
h. Cutting and Patching  
i. Concealment  
j. Equipment Modification

1.03 GLOSSARY
A. ANSI American National Standards Institute  
B. ASTM American Society of Testing and Materials  
C. BICSI Building Industry Consulting Services International  
D. FCC Federal Communications Commission  
E. IEEE Institute of Electrical and Electronics Engineers  
F. ISO International Organization for Standardization  
G. OIT Office of Information Technology  
H. NEC National Electrical Code  
I. NEMA National Electrical Manufacturer’s Association  
J. NESC National Electrical Safety Code  
K. NFPA National Fire Protection Association  
L. OSHA Occupational Safety and Health Administration  
M. TIA Telecommunications Industry Association  
N. UCB University of Colorado at Boulder  
O. UFBC Uniform Fire Prevention and Building Code  
P. UL Underwriter’s Laboratories, Inc.

1.04 SUBMITTALS
A. References to regulations, codes, and standards mean the latest edition, amendment and revisions to the regulations, codes and standards in effect on the date of the Contract Documents.  
B. All work and materials shall conform to and be installed, inspected, and tested in accordance with the governing rules and regulations of federal, state, and local government agencies.  
C. Installations, materials, equipment and workmanship shall conform to the specifications and drawings and all applicable provisions of the following regulations, codes, and standards including all applicable addenda:  
   a. ANSI/NEC (NFPA 70)  
   b. NESC (IEEE)  
   d. ASTM Standards  
   e. IEEE Standards  
   f. NEMA Standards  
   g. ANSI/TIA – Telecommunications Cabling Standards including, but not limited to, 568-C.0, 568-C.1, 568-B.2, 568-C.3, 569-B, 598-C, 455 Series, 492 Series, 526 Series, 604 Series, 606, 607, 758-A, TSB-140, FIP 174, FIP 175, FIP 176, S-83-596, S-87-640  
   h. FCC Code of Federal Regulations (CFR)  
   i. Applicable State of Colorado codes including UFBC and Department of Labor Rules and Regulations  
   j. Applicable Municipal codes  
   k. Applicable codes and regulations of other authorities having lawful jurisdiction pertaining to the work required  
   l. Americans with Disabilities Act (ADA)  
   m. UCB Standards

D. All modifications required by the referenced codes, rules, regulations, and authorities shall be made by the Contractor without additional charge to UCB.

E. Report immediately to UCB OIT personnel and/or the Consultant/Engineer, in writing, any part of the telecommunication system design which does not conform to the requirements of these codes or regulations, or otherwise be held responsible to provide and install material which will comply with these codes and regulations.

F. Applicable codes and ordinances and local interpretations take precedence when they conflict with or are more stringent than the telecommunications design. Drawings and specifications take precedence where this design is more stringent than codes and ordinances.

G. All materials, appliances, equipment, and devices shall conform to the applicable standards of Underwriters Laboratories (UL), and shall be listed by UL if a UL listing category has been established. Furnish products that have been tested and qualified to meet the rating criteria by UL or other testing firm acceptable to authority having jurisdiction.

1.05 SAFETY AND HEALTH REQUIREMENT

A. These construction documents and all phases of construction completed are to be governed by applicable provisions of the “Williams-Steiger Occupational Safety and Health Act of 1970, Public Law 91-596” and the latest amendments including:
   a. Reporting/Investigating Accidents
   b. Enforcement of Program
   c. Telecommunications 1910.268
   d. Hazard Communication 1910.1200
   e. Confined Space 1910.146
   f. Lockout/Tagout 1910.147
   g. Asbestos 1910.1001
   h. Assured Grounding 1926.404
   i. Portable Wood Ladders 1910.25
   j. Portable Metal Ladders 1910.26
   k. Electrical Protection 1910.268
   l. Exposure and Medical Records 1910.20
   m. Emergency Evacuation 1910.38
   n. Hantavirus/General Duty Clause/CDC Guidelines

B. Comply with specific UCB safety requirements.

C. Receive training if working in hazardous areas.

D. Provide hazards training certificates.

E. Inspect work sites for hazards regularly.

F. Provide safety program documents.

G. Comply with National Electrical Safety Code NESC C2-1997 including, but not limited to:
   a. Section 42, General Rules for Employees.
   b. Section 43, Additional Rules for Communications Employees.

H. The contractor shall be aware of and comply with UCB regulations for confined spaces (contact EH&S 303-492-0215).

1.06 ASBESTOS/LEAD

A. The University manages asbestos/lead identification, removal and control. Normally the site of work operations will be identified by the University as suitable for construction to proceed and EH&S documentation is provided for the Contractor file. The Contractor shall refer to and comply with the
EH&S report from UCB prior to performing any work. If that documentation is not available, the Contractor will not proceed with the work.

B. The Contractor shall be aware of and comply with UCB specific procedures and policies related to asbestos and lead (contact EH&S 303-492-0215).

C. The University requires appropriate asbestos awareness training for Contractor employees. This shall be provided to Contractor employees at the expense of the Contractor and at no cost to the University.

D. In the event the Contractor encounters suspected asbestos/lead containing materials which have not been rendered harmless, the Contractor shall immediately stop work in the area affected and report the condition to UCB verbally and followed by written notice. If in fact the material contains asbestos/lead and has not been rendered harmless, the project work in the affected area shall not thereafter be resumed except by written agreement of UCB and the Contractor. In the absence of asbestos/lead, or when it has been rendered harmless, project work shall be resumed by written agreement of UCB and the Contractor.

1.07 DEFINITIONS

A. Every effort has been made to use industry standard terminology throughout this specification, but industry standard terminology is not used by all manufacturers and, in many cases, industry standard terminology does not exist. Contractor shall notify the UCB OIT Personnel and/or the Consultant/Engineer to define terminology used in specifications if they believe any questions could arise.

B. Approved/Approval Written permission to use a material or system

C. Contractor Telecommunications Contractor performing work under Division 27

D. Engineer Telecommunications engineer for Division 27

E. Equal/Equivalent Equally acceptable as determined by UCB or Engineer

F. Final Acceptance UCB acceptance of the project from Contractor

G. Furnish Supply and deliver to installation location

H. Inspection Visual observation at job site by UCB representative

I. Install Mount and connect equipment and associated materials ready for use

J. Jack Modular connector for station cabling medium (UTP copper, fiber, coax) at work-area outlet.

K. Outlet Box and faceplate to accommodate up to six (6) modular jacks at the work-area.

L. Pull-Box Box to be used for pull-through of cabling in a conduit run. Not to be used as a junction box.

M. Provide Furnish and install complete with all details and ready for use

N. Relocate Disassemble, disconnect, and transport equipment to new locations, then clean, test, and install ready for use

O. Replace Remove and provide new item

P. Telecommunications All work specified in Division 27

Q. Where this Division 27 indicates work to be performed by the words “shall” or “secure” or other performance functions, it shall be assumed that such work shall be performed by the telecommunications Contractor performing work under Division 27.

1.08 DRAWINGS AND SPECIFICATIONS

A. It is the intention of these specifications and related project drawings to call for finished work, tested and ready for operation in complete accordance with all applicable codes, regulations, standards, and ordinances.

B. These specifications and the project drawings are complimentary, and what is called for in either of these shall be binding as though called for by both. Should any conflict arise between the drawings and specifications, such conflict shall be brought to the attention of the Engineer for resolution. If the Contractor fails to contact the Engineer in writing of any conflict between the specifications and the project drawings, the Contractor shall be subject to re-work the area of conflict at the Contractor’s cost.

C. Omissions from the specifications and/or project drawings or the incorrect description of details of work which are evidently necessary to carry out the intent of the specifications and project drawings, or which
are customarily performed, shall not relieve the Contractor from performing such omitted or incorrectly described detail of the work. All work shall be performed as verified in field measurements, field construction criteria, material catalog numbers and similar data checked and coordinated with each shop drawing by the Contractor.

D. The telecommunications and technology project drawings are diagrammatic and indicate general design, layout, and arrangement of equipment and various systems. Being diagrammatic, the drawings may not necessarily show all details such as pull-boxes, conduit runs or sizes, etc., necessary for a complete and operable system. Unless detailed dimensioned drawings are included, exact locations are subject to approval of UCB.

E. Do not scale project drawings for dimensions. Take all dimensions and measurements from the site and actual equipment to be furnished. All dimensions, measurements, and the location and existence of underground equipment must be verified in the field since actual locations, distance, and elevations will be governed by actual field conditions. Contractor shall be responsible for all measurements taken from the field.

1.09 EXAMINATION OF PROJECT SITE

A. Prior to any project work, examine the project site carefully, including all project drawings showing existing systems and equipment. The Contractor shall be fully informed of and shall identify all utility, state, and local requirements that will affect the telecommunications work at the project site.

B. It shall be the Contractor’s responsibility to determine if the installation of the proposed systems will affect the operation or code compliance of existing systems. With UCB approval, relocate, modify, or otherwise revise existing telecommunications systems as required to maintain operational integrity and code compliance.

C. The Contractor shall become familiar with the local conditions under which the work is to be performed and correlate the on-site observations with the requirements of the specifications and project drawings. No allowance will be made for claims of concealed conditions which the Contractor, in exercise of reasonable diligence in examination of the site, observed or should have observed.

D. Before ordering any materials or doing any project work, verify all measurements and be responsible for correctness of same. No extra charge or compensation will be allowed for duplicate work or material required because of unverified differences between actual dimensions and the measurements indicated on the project drawings. Any discrepancies found shall be submitted in writing to the Engineer for consideration before proceeding with the project work.

1.10 WORKMANSHIP, WARRANTY, AND SUPPORT

A. Materials and workmanship shall meet or exceed industry standards and be fully guaranteed for one full year from final acceptance for each project. Cable integrity and associated terminations shall be thoroughly inspected, fully tested and guaranteed as free from defects, transpositions, opens/shorts, tight kinks, damaged jacket insulation, etc.

B. Furnish a written warranty to UCB for a minimum of:
   a. One-year materials warranty on parts and labor to repair/replace defective telecommunications materials specified herein. This warranty only applies to materials provided by Contractor and does not apply to materials provided by UCB.
   b. Twenty-five-year Hubbell and Mohawk materials warranty on parts and labor to repair/replace defective telecommunications station cabling materials. The installer/contractor shall be certified by Hubbell to provide the materials warranty.
   c. One-year installation workmanship warranty on parts and labor to resolve problems related to telecommunications system installation workmanship.

C. The Contractor shall be responsible for and make good, without expense to UCB, any and all defects arising during this warranty period that are due to imperfect materials, appliances, improper installation, or poor workmanship.
a. During the warranty period, provide all labor required to repair or replace defects in the telecommunications system, at no cost to UCB.
b. During the warranty period, provide new materials to repair or replace defects in the telecommunications system, at no cost to UCB.

PART 2 – MATERIALS

2.01 EQUIPMENT AND MATERIALS MINIMUM REQUIREMENTS
A. All materials and equipment shall be new, free from defects, installed in accordance with manufacturer’s current published recommendations in a neat manner and in accordance with standard practices of the industry.
B. Where no specific material, apparatus, or appliance is mentioned, any standard, first-class product made by reputable manufacturer regularly engaged in the production of such material may be used providing it conforms to the contract requirements and meets the approval of UCB OIT Personnel and/or the Consultant/Engineer.
C. Materials shall have a flame spread rating of 25 or less and a smoke developed rating of 50 or less, in accordance with NFPA 255.
D. Materials shall meet or exceed the following minimum requirements:
   a. Where applicable, all materials and equipment shall bear the label and listing of UL. Application and installation of all listed equipment and materials shall be in accordance with such labeling and listing.
   b. Equipment shall meet all applicable FCC regulations.
   c. Electrical equipment and systems shall meet UL standards and requirements of the NEC. This listing requirement applies to the entire assembly. Any modifications to equipment to suit the intent of the specifications shall be performed in accordance with these requirements.
   d. The listing of a manufacturer as “acceptable” does not include acceptance of a standard or catalogued item of equipment. All equipment and systems must conform to the specifications and meet the quality of the specified item.
   e. Materials and equipment shall bear the manufacturer’s name or trademark and model/serial number permanently marked.

2.02 CABLES
A. All telecommunications cabling inside the building shall be UL listed and marked type CM, CMR, CMP, CATV, CATVR or CATVP and shall be installed in accordance with NEC articles 300-22, 800-49, 800-50, 800-51, 800-52, 800-53, and 820. The substitutions listed in articles 800.154 and 820.154 shall be permitted.
B. All fiber optic cable inside the building shall be UL listed and marked type OFN, OFNR, or OFNP and shall be installed in accordance with NEC articles 300-22, 770-49, 770-50, 770-51, 770-52, and 770-53.

2.03 FACTORY ASSEMBLED PRODUCTS
A. Manufacturers of equipment assemblies that include components made by others shall assume complete responsibility for the final assembled unit.
   a. All components of an assembled unit need not be products of the same manufacturer.
   b. Constituent parts, which are alike, shall be the product of a single manufacturer.
   c. Components shall be compatible with each other and with the total assembly for intended service.
   d. Contractor shall guarantee performance of assemblies of components and shall repair or replace elements of the assemblies as required to deliver the specified performance of the complete assembly.

2.04 COMPATIBILITY OF RELATED EQUIPMENT
A. Equipment and materials installed shall be compatible in all respects with other items being furnished and with existing items so that a complete and fully operational system will result.
2.05 SPECIAL TOOLS AND KITS
   A. The Contractor shall furnish any special installation equipment, tools, or kits necessary to properly complete the telecommunications system installation. This may include, but is not limited to, tools for pulling, splicing, terminating, and testing the cables, communication devices, stands for cable reels, cable wenches, assembly and adjustment devices, etc.

2.06 FIRESTOPS AND PENETRATION SEAL MATERIALS
   A. Use qualified systems to firestop through penetrations in fire-rated walls and floors for pipes, cables, conduits, ducts, inner-ducts, and cable trays.
   B. Firestopping for openings through fire and smoke-rated walls and floor assemblies shall be listed or classified by an approved independent testing laboratory for “Through-Penetration Firestop Systems.” The system shall meet the requirements of “Fire Tests of Through-Penetration Firestops” designated by ASTM E814.
   C. Inside all conduits, the firestop system shall consist of a dielectric, water-resistant, non-hardening, permanently pliable/re-enterable putty along with appropriate damming or backer materials (where required). The sealant must be capable of being removed and reinstalled and must adhere to all penetrants and common construction materials and shall be capable of allowing normal cable movement without being displaced.
   D. Foam sealant shall meet all fire test and hose stream test requirements of ASTM E-119-73 and shall be UL classified as a wall opening protective device.
   E. Provide devices/systems fire tested by a third party according to ASTM E 814 (or UL 1479) tested under positive pressure.
   F. Provide specific combinations of materials installed and supported or anchored.
   G. Provide only material combinations that are qualified by independent agencies based on the material’s performance when tested in a particular configuration.
   H. Match the thickness (and/or depth) of firestop materials to that recommended by the manufacturer.
   I. Thickness of materials must be established by formal ASTM E814 or UL 1479 tests.
   J. Firestop for fire-rated floors and walls:
      a. 3M Fire Protection
      b. Specified Technologies, Inc. (STI)

2.07 ANCHORING MATERIALS AND SUPPORTS
   A. Metal bars, plates, channel, tubing, etc. shall conform to ASTM Standards:
      a. Steel plates, shapes, bars, and grating – ASTM A36
      b. Cold-formed steel tubing – ASTM A500
      c. Hot-rolled steel tubing – ASTM A501
      d. Steel pipe – ASTM A53, Schedule 40, welded
   B. Metal fasteners shall be zinc-coated.
   C. Anchoring Materials:
      a. Structural Steel
      b. Steel Channel: Galvanized or painted
      c. Uni-Strut

2.08 GROUNDING AND BONDING MATERIALS
   A. Mechanical Connectors: Bronze.
   B. Bonding Conductor: 6 AWG minimum copper
   C. All grounding equipment shall be UL listed for that purpose.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS
A. The approximate locations of existing and new telecommunications outlets, cabling and equipment will be indicated on the project drawings; however, the drawings are not intended to give complete and accurate information. Contractor is responsible to field verify existing outlets and cabling prior to submitting quote. Determine the exact location after thoroughly examining the general building plans and by actual measurements before and during construction, subject to the approval of UCB and/or the Consultant/Engineer.

B. Before construction work commences, visit the site and identify the exact routing for all horizontal pathways and equipment placement. Verify all dimensions, locating the work and its relation to existing work, all existing conditions and their relation to the work and all man made obstructions and conditions, etc. affecting the completion and proper execution of the work as indicated in the project drawings and specifications.

C. If core drills are required, the exact core locations shall be identified and coordinated with the UCB Asbestos Management plan as necessary.

D. All equipment locations shall be coordinated with UCB, other trades and existing conditions to eliminate interference with required clearances for equipment maintenance and inspections.

E. Coordinate work with UCB, other trades and existing conditions to determine exact routing of cable, cable tray, hangers, conduit, etc., before fabrication and installation.

F. Install telecommunications cabling and equipment to facilitate maintenance and repair or replacement of equipment components. Provide easy, safe and code mandated clearances at equipment racks and enclosures, and other equipment requiring maintenance and operation. Coordinate with UCB exact location and mounting height of all equipment in finished areas, such as equipment racks, termination equipment, communication and electrical devices. As much as practical, connect equipment for ease of disconnecting, with a minimum of interference with other installations.

G. Coordinate ordering and installation of all materials and equipment with long lead times or having major impact on work by other trades so as not to delay the job or impact the schedule.

H. Set all equipment to accurate line and grade, level all equipment and align all equipment components. All work shall be installed level and plumb, parallel and perpendicular to other building systems and components.

I. Provide all scaffolding, rigging, hoisting and services necessary for delivery, installation, and erection of materials, equipment, and apparatus furnished into the premises. These items shall be removed from premises when no longer required. Use of University owned supplies and equipment is prohibited.

3.02 WORKMANSHIP

A. All labor must be thoroughly competent and skilled, and all work shall be executed in strict accordance with the best practice of the trades.

B. Good workmanship and appearance shall be considered of equal importance with telecommunications operation. Lack of quality workmanship shall be considered sufficient reason for rejection of a system in part or in its entirety. Carefully lay out all work in advance and install in a neat and workmanlike manner in accordance with recognized good practices and standards. Provide workmen who are skilled in their craft and a competent Project Manager who will be on the job at all times.

3.03 CABLES

A. Backbone and horizontal telecommunications cabling shall be placed in separate dedicated pathways. Cable trays shall be clearly divided between backbone and horizontal cabling.

B. Telecommunications pathways shall be dedicated for use for OIT voice, data & CATV cabling. Other services on OIT cables (intercom, audio, video, security, fire, BAS, etc.) may be placed in telecommunications pathways with prior written approval from UCB OIT.

C. Horizontal cabling for other services will be allowed within the OIT pathways per the following guidelines and acceptance of written approval from OIT. OIT must understand and accept the services to be used on the Horizontal cabling as to not create interference with other services within the pathways. OIT will be the sole owner of the Horizontal cabling with jacks on both ends that will be installed and tested to the TIA
standards on category 5e cable or better with the Hubbell / Mohawk standard cabling. Other terminations and systems can be reviewed by OIT but all Horizontal cabling for other services must be approved in writing from OIT.

D. All horizontal cabling terminating within a single faceplate must be routed to and terminated in the same ER or TR.

E. Consolidation points and multi-user telecommunications outlet assembly (MUTOA) configurations for horizontal cabling are not currently supported by UCB OIT and will not be permitted.

3.04 CUTTING AND PATCHING
A. Provide all cutting, patching and core drilling, etc., as necessary for telecommunications work. Locate holes and outlets to be drilled and coordinate with work of other trades. Obtain approval of UCB prior to cutting or core drilling holes greater than ¾” in structural members.

B. Cut and drill from both sides of walls and/or floors to eliminate splaying.

C. Patch adjacent existing work disturbed by installation of new work including insulation, walls and wall covering, ceiling and floor covering and other finished surfaces. Patch openings and damaged areas equal to existing surface finish.

D. Cut openings in prefabricated construction units in accordance with manufacturer’s instructions.

E. Openings for electrical work shall be carefully caulked or grouted as required. Spare conduits shall be tightly capped.

F. All cutting in the building construction made necessary to admit work, repair defective materials, defective workmanship, or by neglect of the Contractor to properly anticipate his requirements, shall be done in accordance with these specifications with no additional cost to UCB. Patching shall be complete in every detail. Actual work involved in these repairs shall be done by skilled craftsmen in the trades involved.

G. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

3.05 CONCEALMENT
A. Use existing conduit and cable trays where possible and practicable. Conceal all project work above ceilings and in walls, below slabs, and elsewhere throughout building. If concealment is impossible or impracticable, notify UCB and/or the Consultant/Engineer before starting that part of the work and install only after approval.

3.06 EQUIPMENT MODIFICATION
A. Where existing equipment is to be modified, Contractor shall furnish materials and labor as necessary to modify or add to the equipment. Modifications shall be done neatly with factory parts and assemblies approved for the application. Modification shall in no way jeopardize the compliance of existing equipment with any governing codes and regulations.

3.07 FIRESTOPS AND PENETRATION SEALS
A. All new and existing penetrations through fire-rated walls, floors, ceilings, etc. shall be sealed to prevent the spread of smoke, fire, toxic gas, or water through the penetration either before, during, or after a fire. The fire rating of penetration seal shall be at least that of the wall, floor, or ceiling into which it is installed, so the original fire rating is maintained. The installation shall provide an air and watertight seal. This includes all existing telecommunications cables and pathways to remain within the project area.

B. All new and existing conduit and sleeve openings used for the project shall be waterproofed or fireproofed upon cable placement through such passageways in compliance with Colorado Building and Fire Codes and UCB standards.

C. Patch all openings remaining around and inside all new and existing conduit sleeves and cable penetrations to maintain the integrity of any fire-rated wall, floor, ceiling, etc.

D. Manufacturer’s installation standards shall be closely followed (minimum depth of material, use of ceramic fiber, procedures, etc.).

E. Brick, Concrete, and Concrete Blocks Walls:
   a. Provide metallic sleeving systems for routing of cables through these surfaces.
b. Ensure that sleeve extends from the front and back of the wall only far enough to attach the required bushing or collar.
c. Secure sleeves in place according to manufacturer’s specifications.
d. Provide firestop seal between sleeve and wall, but do not use firestopping material to support or secure sleeve.
e. Firestop around any inner-duct used to contain fiber optic cable through a wall.
f. Firestop ends of sleeving or inner-duct after installation of cable, without exception.

F. Floor Openings:
   a. Install firestop materials to stop openings between sleeving (or other supporting material) and core.
   b. When coring through concrete flooring, use boots and packing materials to fashion core before installing firestopping materials.
   c. If rectangular openings exist in concrete floors, use steel sleeving to fashion opening before installing firestopping materials.
   d. Firestop around any inner-duct used to contain fiber optic cable through a floor.
   e. Firestop openings in slots, sleeves or ducts after installation of cable, without exception.

G. Cable Trays: All new cable tray pathways shall not penetrate fire-rated walls. Cable tray shall stop within 6 inches of the wall and fire-rated wall shall include EZ path product or equivalent approved by OIT fire stopping system.
   a. Close cable tray penetrations with a qualified firestopping system.
   b. Install the system according to the manufacturer’s instructions.
   c. Ensure that system provides proper support and relief of firestop materials.
   d. Firestop materials must be easily removable if required.
   e. Firestopping materials must provide for installation of cable through the opening without the replacement of material.
   f. Use of intumescent sheets of approximately .5 inch maximum thickness is preferred.

H. Fire-Rated Gypsum Walls:
   a. Sleeve all penetrations of gypsum walls used for cable routing if cable is not in conduit or inner-duct (fiber).
   b. Firestop seal between sleeve, conduit, or inner-duct and wall on both sides of the wall.
   c. Use qualified firestop systems to seal penetrations in gypsum wallboard assemblies.
   d. Verify that penetration conditions fall within the following firestop system parameters:
      i. Hourly rating.
      ii. Opening size.
      iii. Annular space.
   e. Install the firestop system symmetrically on both sides of the wall.
   f. Install the materials according to manufacturer-tested methods.
   g. Box out gypsum penetrations used for cable trays.
   h. Firestop gypsum box with qualified system.
   i. Use identical guidelines for penetrations of hollow lath or plaster surfaces.

I. Other Firestopping:
   a. Firestop through penetrations according to the guidelines for the basic construction of the two outermost layers of the combination wall.
   b. Firestop load-bearing stud walls that are part of combination walls by enclosing (i.e., boxing) the penetration in the cavity.
   c. Firestop partial penetrations according to the recommendations for the type of wall being penetrated.
   d. Firestop any penetrations which violate the fire-rating integrity of vertical shafts.
   e. Firestop openings around outlet boxes installed in fire-rated walls, on both sides.
J. Firestop Installation Methods:
   a. Use drop cloths to protect other surfaces when installing.
   b. Firestop completely around each cable individually – do not stop bundles of cables.
   c. If using putty around a vertical penetration, use putty to build flooring of seal, fill with fiber or rock wool to required thickness, then top with putty according to Manufacturer’s specifications.
   d. The methods used shall incorporate qualities that permit the easy removal or addition of conduits or cables without drilling or use of special tools.
   e. The product shall adhere to itself to allow repairs to be made with the same material and to permit the vibration, expansion and/or contraction of any items passing through the penetration without cracking, crumbling, and resulting reduction in fire rating.

K. The installed firestop system shall meet the requirements of “Fire Tests of Through-Penetration Firestops” designated ASTM E814.

L. Seal all foundation penetrating conduits and all service entrance conduits and sleeves to eliminate the intrusion of moisture and gases into the building. This requirement also includes spare conduits.

M. Spare conduits shall be plugged with expandable plugs.

N. All service entrance conduits through the building shall be sealed or resealed upon cable placement.

O. Entrance conduits with cables in them shall be permanently sealed by firmly packing the void around the cable with oakum and capping with a hydraulic cement or waterproof duct seal.

P. The firestop system shall be submitted to UCB OIT at the preconstruction meeting with a list or map of each location and system number used for the project.

3.08 ANCHORING METHODS

A. Anchor and brace all cabling, material, and equipment installed under this Division as required by all codes, regulations, and standards. Provide required supports, beams, angles, hangers, rods, bases, braces, straps, struts, and other items to properly support project work. Supports shall meet the approval of UCB.

B. Supports shall be fabricated from structural steel, steel channel, or uni-strut, rigidly bolted or welded to present a neat appearance.

C. Fastenings and supports shall be adequate to support loads with ample safety factors.

D. Fasten hanger rods, conduit clamps, outlet boxes, and pull-boxes to building structure.

E. Use toggle bolts, spider type expansion anchors, or hollow wall fasteners in hollow masonry, plaster, or gypsum board partitions and walls.

F. Use lead expansion shields or expansion anchors or preset inserts in solid masonry walls.

G. Use self-drilling anchors or lead expansion anchor on concrete surfaces.

H. Use sheet metal screws in sheet metal studs.

I. Use wood screws in wood construction.

J. In pre-cast structures, use cast-in inserts wherever possible. Expansion anchors can be used with caution, but only with prior approval.

K. In cast-in-place concrete, use expansion anchors, preset inserts, or self-drilling masonry anchors.

L. Use lead expansion anchors, or preset inserts on metal surfaces.

M. Do not fasten supports to piping, ceiling support wires, ductwork, mechanical equipment, or conduit.

N. Power-actuated anchors, plastic or fiber expansion anchors, and drive pin anchors are prohibited.

O. Do not drill structural steel members.

P. Any anchoring must be able to be unsecured and removed should relocation be required. The old Hilti HIT-pin is not acceptable.

Q. Where necessary and with approval from UCB, modify studs, add studs, add framing, or otherwise reinforce studs in metal stud walls and partitions as required to suit project work. If necessary in stud walls provide special supports from floor to structure above.

R. For precast panels/planks and metal decks, support communication work as determined by manufacturer and UCB.
S. Provide heavy gauge steel mounting plates for mounting project work. Mounting plates shall span two or more studs. Size, gauge, and strength of mounting plates shall be sufficient for equipment size, weight, and desired rigidity.

T. Install freestanding telecommunications equipment on concrete pads.

U. Support surface mounted cabinets, enclosures, and panelboards with a minimum of four anchors.

V. On exterior concrete walls below grade, provide 1” steel channel stand-offs for cabinets and raceways.

W. Use stud bridges at top and bottom of cabinets and enclosures that are flush mounted on hollow drywall walls.

X. Use suitable vibration isolation pads for vibrating equipment.

3.09 GROUNDING AND BONDING

A. Bond all new metallic cable shields and metallic supporting structures, in all equipment rooms and service entrances, including racks, frames, protectors, and cabinets to the existing telecommunications grounding busbar (TGB), according to the manufacturer’s specifications.

B. Do not make connections between the telecommunications busbar system and building electrical grounds, or other types of connections, without UCB approval.

C. Bond metallic surfaces of telecommunications hardware with #6 AWG grounding wire as straight as possible to the ground source.

D. Ensure that the grounding system is physically secured.

E. All grounding conductors leaving the ER and TRs shall be in a separate conduit from all communication cabling.

F. All grounding items shall be installed in complete compliance with Division 16 and NEC.

APPENDIX FOR EQUIPMENT SCHEDULE:

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<th>Line</th>
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<td>EZDP33FWS</td>
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<td>EZDP233GK</td>
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END OF SECTION 27 05 00
SECTION 27 05 28

PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 – GENERAL

1.01 RELATED DOCUMENTS
   A. Drawings, Contract Forms, and Conditions of the Contract, including Construction Manager/General Contractor (CM/GC) Agreement including Exhibits and other Division 1 Specification Sections, apply to this section.

1.02 SCOPE OF WORK
   A. Provide all services labor, materials, tools, and equipment required for the complete and proper installation of interior telecommunications pathways as called for in these specifications and related drawings.
   B. This section includes minimum requirements and installation methods for the following:
      a. IMC Conduit and Cable Tray Systems
      b. EMT Conduit and Cable Tray Systems
      c. Surface Metal Raceway Systems
      d. Wireless Access Boxes
      e. Educational Technology Cabinets for Classrooms and Lecture Halls

1.03 QUALITY ASSURANCE
   A. All installation work for the new interior telecommunications pathways shall be performed in a neat and workmanlike manner. All methods of construction that are not specifically described or indicated shall be subject to the control of UCB.
   B. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified is based on the acceptable manufacturers listed. Where “approved equal” is stated, equipment shall be equivalent in every way to that of the equipment specified and subject to approval of UCB based on submittals provided.
   C. Materials and work specified herein shall comply with the applicable requirements of:
      a. ANSI/NFPA 70 – National Electrical Code including, but not limited to, the following articles:
         i. 250 – Grounding
         ii. 300 – Wiring Methods
         iii. 314 – Outlet, Device, Pull, and Junction Boxes; Conduit Bodies; Fittings; and Manholes
         iv. 342 – Intermediate Metal Conduit: Type IMC
         v. 358 – Electrical Metallic Tubing: Type EMT
         vi. 386 – Surface Metal Raceways
         vii. 392 – Cable Trays
         viii. 770 – Optical Fiber Cables and Raceways
      b. ANSI/TIA-568-C.0 – Generic Telecommunications Cabling for Customer Premises
      c. ANSI/TIA-568-C.1 – Commercial Building Telecommunications Cabling Standard
      d. ANSI/TIA-569-B – Commercial Building Standard for Telecommunications Pathways and Spaces, including applicable addendum
      e. ANSI/TIA-606 – Administration Standard for Telecommunications Infrastructure of Commercial Buildings
      f. ANSI/TIA-607 – Commercial Building Grounding and Bonding Requirements for Telecommunications
      g. BICSI Telecommunications Distribution Methods Manual

1.04 SUBMITTALS
   A. As-built drawings

PART 2 – MATERIALS
2.01 EMT CONDUIT AND CABLE TRAY SYSTEMS
A. Electrical Metallic Tubing (EMT): Electro-galvanized steel tubing 3/4” and larger diameter per project requirements:
   a. Conduit joint couplings and connectors: steel double set screw indenter fittings
   b. Metal bushings for 3/4” and 1” conduit
   c. Insulated metallic bushings for 1-1/4” and larger conduit
   d. Insulated metallic bushings with grounding lugs as required
   e. Conduit sweeps: minimum 10 times the conduit inside diameter
   f. Include required conduit straps, and hangers, heavy-duty malleable iron or steel
   g. Perforated pipe strap, j-hooks, bridle rings, or wire hangers are not permitted
   h. LB fittings and plastic fittings are not permitted
   i. Nipple runs from one outlet box to another outlet box are not permitted
   j. Plastic cable ties are not permitted to support any cabling in any location

B. Outlet boxes: Galvanized steel sheet metal 4” x 4” x 2-1/8” deep minimum with single gang mud ring.
C. Pull-boxes: Minimum 14 gauge galvanized steel with screw fastened cover and trim for flush or surface mounting as required for project. Dimensions as required for project.
   a. Box extensions are prohibited for new construction however they are permitted on remodel work to extend existing installations.

D. Metal Flex Conduit (3/4”) and deep Cut-In Boxes for outlets in existing walls for remodel projects only.
E. Muletape: polyester or aramid line with a minimum pull tensile strength of 200 pounds for backbone.
F. Poly line: poly pull line with a minimum pull tensile strength of 200 pounds for horizontal.
G. Cable Trays in Ceiling Areas:
   a. Welded wire mesh cable system 12 standard size with future growth.
   b. Include components, and compatible fittings designed and manufactured by the cable tray manufacturer as required for a fully installed electrically continuous system.
   c. Include support kits, brackets, threaded rod hangers, lateral threaded rod braces, and other anchors and supports as required as specified in Section 270500.
H. Labels for conduit, pull-boxes, and cable trays: 1” x 2” yellow background with 3/8” lettering to read “TELECOM”.

2.02 SURFACE METAL RACEWAY SYSTEMS
A. Surface Metal Raceway Systems (SMRS):
   a. Surface Raceway: Steel Raceway with Ivory color finish
   b. Surface Raceway Parts and Fittings (SRPF):
   c. Surface Single gang box to mount faceplate with modular furniture (existing modular raceways shall be used only for pathway).
   d. Surface Single gang extension box to mount on surface raceways (the surface raceways shall be used only for pathway).
   e. Camera installation:
      i. 4” Octagon Box (see detail).
      ii. 6 3/8” Large round fixture box solid base (see detail).
   f. Include all parts and components: base and cover, compatible fittings, insulated bushings, and supports designed and manufactured by the raceway manufacturer as required for a complete installation.

2.03 OUTSIDE PATCH ANTENNA’S
A. Weatherproof 2 gang Electrical Box
   a. Die cast Aluminum
   b. Gray finish in color
   c. 5 – ¼ inch Thread
   d. 2 5/8 inch x 4 ½ inch x 4 ½ inch
B. Weatherproof 2 gang Electrical Box Cover
   a. Aluminum
   b. Gray finish in color

2.04 WIRELESS ACCESS BOXES
A. Wall-Mount Enclosure for Wireless Access Equipment
   a. Steel closure
   b. White finish in color
   c. Keyed lock
   d. Include components and compatible fittings from the manufacturer as required for a complete
      installation (Mounting bracket).

B. Ceiling Enclosure for Wireless Access Equipment
   a. Plenum-rated enclosure
   b. 2’ x 2’ x 2 ¼” box mounts in standard 2’ x 2’ or 2’ x 4’ ceiling tile
   c. Keyed lock
   d. Include equipment mounting plate and other components and compatible fittings from the
      manufacturer as required for a complete installation (Mounting bracket).

PART 3 - EXECUTION

3.01 INSPECTION
A. Examine areas and conditions under which the new interior telecommunications pathways are to be
   installed. Provide notification, in writing, of conditions detrimental to proper completion of the work.
B. Verify field measurements and pathway routing conditions are as shown on project drawings. Provide
   notification, in writing, of conditions deviating from drawings.
C. Beginning of telecommunications pathway installation indicates Contractor acceptance of existing
   conditions.
D. Post and comply with: CONSTRUCTION INSPECTION REPORT – VOICE AND DATA
   COMMUNICATIONS attached to Section 270100.

3.02 INSIDE CONDUIT AND CABLE TRAY INSTALLATION
A. Place new inside EMT conduit and cable tray systems as shown on the project drawings.
B. Perform installation of pathways as specified in Section 270500 including anchoring and supports,
   grounding and bonding, firestop, etc.
C. No section of conduit shall be longer than 30 m (100 ft) between pull points (e.g., outlet boxes,
   telecommunications closets, or pull-boxes).
D. The inside radius of a bend in conduit shall be at least 6 times the conduit internal diameter. Bends in
   the conduit shall not contain any kinks or other discontinuities that may have a detrimental effect on the cable
   sheath during cable pulling operations. Some cabling may require larger bends and shall comply with the
   manufactures and TIA requirements.
E. No section of conduit shall contain more than two 90° bends, or equivalent bends exceeding 180° total,
   between pull points. If there is a reverse (u-shaped) bend in the section, a pull-box shall be installed. Of
   the 180° offsets, saddles and kicks shall not exceed 30 degrees.
F. Provide pull-boxes as required to accommodate wire pulling, and code compliance as required due to field
   conditions for each project.
G. Install pull-boxes in readily accessible locations. Equipment, piping, ducts, and the like shall not block
   access to the boxes. Coordinate access doors as required to provide access to pull-boxes in hard ceilings
   and similar inaccessible areas.
H. Collector/distribution conduit shall be 25’ ± 5 between pull-boxes. Conduits and boxes shall be upsized per fill in area. Install the conduit collector/distribution system so that the electrical continuity of the system for the main feed is maintained.

I. Conduit, cable tray, and surface raceway shall be so installed, that no cable run shall exceed 290’ in length from the Telecommunications Room (TR) or Equipment Room (ER) to the farthest outlet. Where building conditions prohibit meeting this requirement, additional TRs or ERs may need to be provided.

J. Conduits terminating into cable trays shall be no more than 6” away from the cable tray.

K. Provide dedicated 3/4” for each telecommunications outlet to the nearest pull-box or cable tray. Where multiple outlets serve an area, a conduit feeder system shall be used based on the attached drawing: **TYPICAL TELECOMMUNICATION CONDUIT LAYOUTS.** The conduit feeder system design shall be documented in drawing form and shall be approved in writing by the UCB OIT department prior to installation.

L. Conduit for fire alarm cable shall be separate, dedicated 3/4” conduit for the entire distance from the outlet to the MDF room with 62.5/125 fiber

M. Minimum conduit size for telecommunications shall be 3/4”.

N. Stub out conduits into the TRs and ERs only enough to attach connector and bushings with grounding lugs except conduits shall extend a minimum of 6 inches above the finished floor.

O. The ends of the metallic conduit shall be reamed and bushed using:
   a. Metal bushings for 3/4” and 1” conduit stubs to cable trays
   b. Insulated metallic bushings for 1-1/4” conduit and larger
   c. Insulated metallic bushings with grounding lugs for conduit entering TRs and ERs

P. Cut ends of metallic conduit shall be filed to remove burs.

Q. Bond all metallic raceways (conduit, cable tray, etc.) entering the TRs and ERs to the TGB or TMGB in the same room with #6 AWG grounding wire as straight as possible.

R. Ceiling tile shall be removed as necessary for the conduit and cable tray installation and put back in place without damaging or dirtying any of the tiles or supporting framework. Ceiling tile shall be handled with clean hands so that no fingerprints or marks are left on the tiles. The contractor is responsible for the cost of repair or replacement of any damaged or dirtied tiles or ceiling hardware.

S. Support conduits above suspended ceilings from building structure by suitable straps, racks, or hangers. Supporting conduits from ceiling suspension wires is not permitted.

T. Provide conduit support within 18” of each termination, and a maximum of 7” between supports along conduit.

U. Support pull-boxes independently from building construction. Do not support from conduit.

V. Provide conduit expansion fittings with external grounding straps at building expansion joints.

W. Install new Muletape in all new conduits prior to pulling backbone cable. The Muletape shall extend three feet from each end of the conduit and shall be knotted and secured to remain in place.

X. Install new Poly line in all new conduits prior to pulling horizontal cable. The Poly line shall extend three feet from each end of the conduit and shall be knotted and secured to remain in place.

Y. Do not install conduit or cable tray adjacent to hot surfaces or in wet areas.

Z. Install metal flex conduit and deep cut-in boxes for outlets in existing walls for remodel projects only. Connect flex conduit to pull-box within 4’ of entering ceiling space from wall space. Flex conduit and deep cut-in boxes are not allowed in new construction.

AA. Conduit and cable tray sizes and routes and pull-box sizes and locations shall be coordinated with UCB OIT for each project.

BB. If it is necessary to burn holes through webs of beams or girders, receive written approval from UCB as to the location and size of the hole before proceeding with work and abide with UCB standards for this work. All holes shall be burned no larger than absolutely necessary.

CC. Support cable tray with manufacturers supports and/or using threaded, galvanized rod hangers with rods extended through support steel and double-nutted. Size support members within load rating of member
section and without visible deflection. Cut off excess threaded rod ends flush with the bottom of the double nut.

DD. Install cable tray level and straight to the extent possible.
EE. Where cable trays abut walls, supports shall be provided to walls.
FF. Provide cable tray supports at a minimum of 8’ on center and at all intersections and angles.
GG. A minimum of 12” headroom shall be provided above all cable trays.
HH. A minimum of 8” horizontal clearance shall be provided on at least one side of all cable trays.
II. All cable tray shall be installed in compliance with clearances specified in Section 271500.
JJ. Install the cable tray system so that the electrical continuity of the system is maintained.
KK. Provide body expansion connectors for cable trays at building expansion joints.
LL. Provide external grounding strap at expansion joints, sleeves, crossovers and other locations where cable tray continuity is interrupted.
MM. Support racks for telecommunications conduit and or cable tray must be dedicated for telecommunications pathways only. Multi-use suspension systems for plumbing and other piping along with electrical and telecommunications pathways are not permitted.
NN. Coordinate conduit and cable tray runs with other trades.
OO. Label all conduit and cable tray at both ends indicating TR, ER, outlet, or other location where conduit terminates and the length of the conduit. Label pull-boxes indicating destination of conduits entering and exiting.
PP. Label all conduit, pull-boxes, and cable tray with “Telecom” stickers at each end and every 75 feet.
QQ. Label conduits entering TRs and ERs in accordance with ANSI/TIA-606 – Administration Standard for Telecommunications Infrastructure of Commercial Buildings.
RR. Separate dedicated pathways (conduit, cable tray, etc.) shall be provided for backbone and horizontal telecommunications cabling. Cable trays shall be clearly divided between backbone and horizontal cabling.
SS. Cable trays shall not pass through any firewall or fire-rated walls or surfaces. Cable tray shall end before the firewall and transition to the EZ Path within six (6) inches of the firewall. The cable through the EZ Path shall not exceed 60% fill, so that and 40% future fill shall remain.
TT. Firestop all pathways and core drills through walls and floors as specified in Section 270500.

3.03 SURFACE METAL RACEWAY INSTALLATION

A. Place new surface metal raceway systems as shown on the project drawings.
B. For outlets in surface raceway, use single-gang extension box on the front of the raceway so jacks do not protrude into pathway as shown in the drawing attached at the end of this Section.
C. Perform installation of routing hardware as specified in Section 270500 including anchoring and supports, grounding and bonding, firestop, etc. Use anchors for attachment to surface. Use of adhesives is prohibited.
D. Collector/distribution surface raceway shall be 25’ ± 5 between pull-boxes. Surface raceway and boxes shall be upsized per fill in area.
E. Cut raceways square and ream ends to remove burs at raceway connections to outlets.
F. Install raceways parallel or perpendicular to building walls, floors and ceilings.
G. When installing through false ceiling, extend raceway above top of ceiling grid to a pull box feeder system or within 6” of the cable tray. Notch ceiling panel to size of raceway.
H. Coordinate raceway runs with other trades.
I. Ceiling tile shall be removed as necessary for the raceway installation and put back in place without damaging or dirtying any of the tiles or supporting framework. Ceiling tile shall be handled with clean hands so that no fingerprints or marks are left on the tiles. The contractor is responsible for the cost of repair or replacement of any damaged or dirtied tiles or ceiling hardware.
J. Upon request per project and daily installs, the contractor shall coordinate finish selection with the Department of Facilities Management prior to final design. All coordination and disposal cost shall be included in fixed-pricing or project bid.
K. Label all raceway covers on the inside with “Telecom” stickers at each end and every 75 feet. Identify all raceway with Telecommunications labeling as directed by UCB OIT.

3.04 TELECOMMUNICATIONS OUTLETS AND WIRELESS ACCESS ENCLOSURES
A. The locations of outlet boxes and wireless access enclosures shown on project drawings are approximate. The exact location of outlet boxes and enclosures shall be governed by structural conditions, obstructions, or other equipment.
   a. Unless otherwise noted, outlet boxes shall be located as follows (dimensions are above finished floor to center line of boxes):
      i. Standard telecommunications outlets: 1’6”
      ii. Wall-mount telephone outlets: 4’6”
      iii. ADA Wall mount telephone outlets: 4’0”
   b. All ADA standards shall be met when applicable.
   c. Adjust outlet box locations so that they will be symmetrically located and not interfere with other equipment.
   d. Where outlets of other types are adjacent, coordinate heights to be similar where possible.
   e. Where outlets are located on masonry walls, adjust box location to set in corner of block or brick.
   f. Back to back outlet boxes are not permitted. Separate boxes a minimum of 6” in standard walls and a minimum of 2’ in acoustical walls.
   g. Where conflicts are noted for outlet box locations, coordinate with UCB OIT and Facilities Management.
   h. Outlet box locations may be adjusted by UCB up to six (6) feet from the location shown on drawing with no additional cost to UCB.
B. Support outlet boxes independently from building construction. Do not support from conduit or raceways.
C. Install wall-mount and ceiling enclosures for wireless access equipment, including all accessories and firestop materials, in accordance with manufacturer’s specifications. When wireless wall boxes are installed on gypsum board (sheet rock) secure with toggle bolts. After ceiling boxes are installed per manufacturer’s specifications, secure with four self-tapping screw to the ceiling grid.
D. Provide EMT conduit 6” to 4” from the ceiling enclosures for wireless access equipment. The conduit shall not block access or removal of the surrounding ceiling tiles of the ceiling enclosure.
E. Provide EMT conduit connecting to wall-mount enclosures for wireless access equipment.
F. All wireless box installations shall comply with the “Wireless Security Box Instructions” attached to the end of this section.

3.05 OUTSIDE PATCH ANTENNA’S
A. Step one (see attachment for photo’s)
   a. Cut a notch on the bottom center of the cover to allow the cable to feed thru.
   b. Mount the 2-gang metal cover using the provided mounting screws.
   c. Mark the 4 holes for the Patch antenna to mount to the cover.
   d. Drill the 4 holes with a 1/8 inch drill bit.
B. Step two (see attachment for photo’s)
   a. Screw the Patch antenna to the cover using ½ inch #8 sheet metal screws.

3.06 AS-BUILT DRAWINGS
A. Mark the project drawings with notations reflecting any variations from the base specifications and drawings including as-built conduit routing.
B. Comply with CONSTRUCTION DRAWINGS AS-BUILT REQUIREMENTS attached to Section 270100.
## APPENDIX FOR EQUIPMENT SCHEDULE:

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<th>Description</th>
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<td>Wire mesh cable tray – Standard Bar Connector</td>
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<td>Wire mesh cable tray – Bend &amp; Intersection Bars</td>
<td>Cope</td>
<td>T-Bar</td>
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<td>6</td>
<td>Wire mesh cable tray – Kwik-Latch Assembly</td>
<td>Cope</td>
<td>CAT-GC</td>
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<td>7</td>
<td>Wire mesh cable tray – Trapeze Support Bracket</td>
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<td>Outside Patch antenna 2 gang box cover – gray</td>
<td>Bell</td>
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</table>

SMRS = Surface Metal Raceway Systems

SRPF = Surface Raceway Parts and Fittings

CPI = Chatsworth Products, Inc.

END OF SECTION 27 05 28
First step:

- Cut a notch on the bottom center of the cover to allow the cable to feed thru.
- Mount the 2-gang metal cover using the provided mounting screws.
- Mark the 4 holes for the Patch antenna to mount to the cover.
- Drill the 4 hole with a 1/8" drill bit.
Second step:
- Screw the Patch antenna to the cover using 3/8” #8 sheet metal screws
JCT BOX - MODULAR FURNITURE

SCALE: FULL
REMOVE CENTER KNOCK OUT AND MARK LOCATION ON FURNITURE PANEL

BACK PLATE OF HUBBELL BOX HBL5748IV

JCT BOX - FRONT VIEW W/O FACEPLATE

SCALE: FULL
WIREMOLD V5739 =
FIXTURE BOX/SOLID BASE
(CW AND WW)

NOTE: WIREMOLD V5739 BOXES USED
FOR WALL OR CEILING MOUNTS. MOUNT TO CONCRETE WITH LEAD ANCHORS.

FLUSH MOUNT DROP CEILING INSTALLATION -
RACO 8125 BOX (FCR)

FLUSH MOUNT WALL BOX INSTALLATION -
RACO 8125 BOX (FWR)
WIRELESS ACCESS POINT ENCLOSURE INSTALLATION INSTRUCTIONS FOR UNIVERSITY OF COLORADO AT BOULDER

This document is intended to provide installation guidelines and instructions for mounting Access Point enclosures at the University of Colorado Boulder Campus.

Max Lopez
Senior Wireless Engineer
University of Colorado at Boulder
Office of Information Technology
3645 Marine Street
Boulder, CO 80309
max.lopez@colorado.edu
ENCLOSURE PART LIST

PART #
OBERON 1032-00 - Wall mount/Hard Deck Ceiling Mount
OBERON 1064-00 - Grid Ceiling Mount

MANUFACTURER
Oberon Inc.
http://www.oberonwireless.com/

Orders are purchased through our Channel Partner:
Anixter
Jean Finnegan
Inside Sales
4505 Florence Street
Denver, CO 80238
tel: 303.574.2524
fax: 303.574.2635
jean.finnegan@anixter.com

BACKGROUND
OIT (Office of Information Technology) performed research, analysis, and testing with the Oberon enclosures, and have identified the aforementioned parts # to be optimal for accommodating the installation of Cisco 1140 Series Access Points. The Oberon 1032-00 wall mount/hard deck enclosure has been custom made for University of Colorado and is not an option for direct ordering from the Oberon website.

Installation of the Cisco 1140 Series Access Points should be ceiling mounted pointing down toward the floor whenever possible. Please keep in mind that wall installations should be only be used when a ceiling mount is not possible.

INSTALLATION INSTRUCTIONS
A list of diagrams follow, which will provide hardware dimensions and general installation instructions. For more detailed installation instructions, please contact the Office of Information Technology:

Donald Thomas
OIT Project Engineer
Donald.Thomas@colorado.edu
Direct: 303-735-6300
CEILING GRID MOUNT EXAMPLE
Oberon’s model 1032-00 “hard lid” or wall mount enclosure provides a secure, aesthetic, convenient mounting solution for smaller wireless access points from many vendors. This economical enclosure has a low profile impact resistant ABS dome so that wireless access points with integrated or non-detachable antennas can be secured in otherwise unsecured spaces. The product is designed to provide an unobtrusive mounting solution. Locks are “keyed-alike” to simplify moves, adds, and changes.

Specifications:
- Wireless access point enclosure designed to be surface mounted on “hard-lid” ceilings or walls.
- Economical solution for securing smaller wireless access points with integrated or non-detachable antennas
- Construction: 16 gauge, steel back-box, and impact resistant, RF transparent, ABS cover
- Locks keyed-alike
- Cover is UL listed (UL-94V5A)
- Size: 11” x 11” x 2.5” (total depth)

Model 1030-00 includes:
- (2) Keys for lock
- Universal mounting plate with mounting features for different vendors access points
- Mounting Instructions
- (4) # 6-32 x 3/16 Screws
- (4) # 6-32 x 3/16 Screw
OUTSIDE ACCESS POINT ANTENNA MOUNT (ONLY USE WITH CISCO 1242 AP’S)

FIGURE 1 - OUTDOOR WIRELESS BOX INSTALL DETAIL

*DRAWING IS TO BE USED AS A GUIDELINE FOR CONCEPTUAL PURPOSES ONLY. IT IS UP TO THE INSTALLER TO SPECIFY AND FOLLOW ANY CODE ISSUES SUCH AS WATER PROOFING OR FIRE RATING FOR EACH SPECIFIC PROJECT. CONSULT WITH OIT STAFF IF THERE ARE ANY QUESTIONS.

FIGURE 2 - OUTDOOR WIRELESS BOX ELEVATION EXAMPLE

*DRAWING IS TO BE USED AS A GUIDELINE FOR CONCEPTUAL PURPOSES ONLY. IT IS UP TO THE INSTALLER TO SPECIFY AND FOLLOW ANY CODE ISSUES SUCH AS WATER PROOFING OR FIRE RATING FOR EACH SPECIFIC PROJECT. CONSULT WITH OIT STAFF IF THERE ARE ANY QUESTIONS.
SECTION 27 05 43

EXTERIOR UNDERGROUND DUCTS AND RACEWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 – GENERAL

1.01 RELATED DOCUMENTS
A. Drawings, Contract Forms, and Conditions of the Contract, including Construction Manager/General Contractor (CM/GC) Agreement including Exhibits and other Division 1 Specification Sections, apply to this section
B. UCB Standards Sections:
   a. Section 01045 – Cutting and Patching
   b. Section 02200 – Earthwork
   c. Section 02221 – Trenching, Backfilling, Compacting
   d. Section 02513 – Asphalitic Concrete Paving
   e. Section 02520 – Portland Cement Concrete Paving
   f. Section 02580 – Pavement Marking
   g. Section 03100 – Concrete Formwork
   h. Section 03300 – Cast-In-Place Concrete

1.02 SCOPE OF WORK
A. Provide all services, labor, materials, tools, and equipment required for the complete and proper installation of exterior telecommunications pathways as called for in these specifications and related drawings.
B. This section includes minimum requirements and installation methods for the following:
   a. Cutting and Patching Asphalt and Concrete
   b. Trenching and Excavation
   c. Underground Conduit Systems
   d. Cable Routing Hardware
   e. Horizontal Directional Drilling – Also commonly referred to as Directional Boring or Guided Horizontal Boring

1.03 QUALITY ASSURANCE
A. All installation work for the new exterior telecommunications pathways shall be performed in a neat and workmanlike manner. All methods of construction that are not specifically described or indicated shall be subject to the control of UCB.
B. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified is based on the acceptable manufacturers listed. Where “approved equal” is stated, equipment shall be equivalent in every way to that of the equipment specified and subject to approval of UCB based on submittals provided.
C. Materials and work specified herein shall comply with the applicable requirements of:
   a. ANSI/NFPA 70 – National Electrical Code including, but not limited to, the following articles:
      i. 314 – Outlet, Device, Pull-Boxes; Conduit Bodies; Fittings; and Manholes
      ii. 344 – Rigid Metal Conduit: Type RMC
      iii. 352 – Rigid Nonmetallic Conduit: Type RNC
      iv. 358 – Electrical Metallic Tubing: Type EMT
      v. 384 – Strut-Type Channel Raceway
   c. NEMA Standards including, but not limited to:
      i. NEMA, RN1, 1986 PVC Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
ii. NEMA, TC3, 1982 PVC Fittings for use with Rigid PVC Conduit and Tubing
iii. NEMA, TC6, 1983 PVC and ABS Plastic Utilities Duct for Underground Installation
iv. NEMA, TC8, 1983 Extra Strength PVC Plastic Utilities Duct for Underground Installation
v. NEMA, TC9, 1983 Fitting for ABS and OVC Plastic Utilities Duct and Fittings for Underground Installation
vi. NEMA, TC10, 1983 PVC and ABS Plastic Communications Duct and Fittings for Underground Installation
d. UL Standards including, but not limited to:
   i. UL 6, 1981 Rigid Metal Electrical Conduit
   ii. UL 651 1981 Schedule 40 and 80 PVC Conduit
e. ANSI-C80.2, 1983 Specification for Rigid Steel Conduit, Enameled
f. ANSI/TIA-569-B – Commercial Building Standard for Telecommunications Pathways and Spaces
g. ANSI/TIA-607 – Commercial Building Grounding and Bonding Requirements for Telecommunications
h. ANSI/TIA-758-A – Customer Owned Outside Plant Telecommunications Cabling Standard (including all applicable addenda)
i. BICSI Telecommunications Distribution Methods Manual
j. BICSI Customer-Owned Outside Plant Manual
D. For horizontal directional drilling, the Contractor shall follow all procedural precautions necessary to ensure that the essential aspects of proper directional bore installation are adequately controlled.
E. Personnel for horizontal directional drilling shall be fully trained in their respective duties as part of the directional drilling crew and in safety.

1.04 SUBMITTALS
   A. As-built drawings

PART 2 – MATERIALS

2.01 TRENCH/BACKFILL MATERIALS
   A. Trenching and Excavation Backfill: Select fill materials as specified in Section 02221
   B. Concrete Slurry: Select Flow Fill as specified in Section 02221
   C. Concrete Pavement: Select concrete paving materials as specified in Section 02520
   D. Asphalt Pavement: Select asphaltic paving materials as specified in Section 02513

2.02 CONDUIT SYSTEM
   A. Non-Metallic Conduit:
      a. PVC plastic pipe, ASTM D1785, Schedule 40 or 80, Type PVC 1120
      b. 4” 45 Degree Fiberglass Bend: FRE Composite Inc., 30-4032 Elbow IPS
      c. 4” 90 Degree Fiberglass Bend: FRE Composite Inc., 30-4030 Elbow IPS
   B. Metallic Conduit: GRC with PVC coating (for building entrances, offsets and sweep bends) within 50 feet of the building protection.
   C. Conduit Joint Couplings:
      a. PVC non-metallic fittings must be installed with solvent applied couplings.
      b. An approved transition coupling shall be used to connect metal to plastic (PVC) conduits.
      c. Couplings may be threaded and/or glued to provide watertight seal at conduit junctions.
   D. Electrical Metallic Tubing (EMT): Electro-galvanized steel tubing 3/4” and larger diameter per project requirements for inside use only all outside use must have written approval from CU OIT.
      a. Conduit joint couplings and connectors: steel double set screw indenter fittings
      b. Metal bushings for 3/4” and 1” conduit
c. Insulated metallic bushings for 1-1/4” and larger conduit

d. Insulated metallic bushings with grounding lugs as required

e. Conduit sweeps: minimum 10 times the conduit inside diameter

f. Include required conduit straps, and hangers, heavy-duty malleable iron or steel. Perforated pipe strap or wire hangers are not permitted.

E. Inside Pull-Boxes: Reference Section 271800 for inside pull-boxes for conduit entering building.

F. Outside Pull-Box: Minimum 14 gauge galvanized steel with weatherproof locking cover and hardware for surface mounting as required for project. Dimensions as required for project.

G. Test mandrel shall be ½” smaller than inside conduit diameter and not less than 12 inches long.

H. Muletape: Polyester or aramid fiber.

I. Core Drill Seals for Outside Building Walls: Link-Seal waterproof assembly or equal. Manufactured by PSI/Thunderline/Link-Seal, 6525 Goforth Street, Houston, TX 77021.

J. Conduit Caulking Compound: Compounds for sealing conduit ducts shall have putty-like consistency workable with the hands at temperatures as low as 35 degrees Fahrenheit, shall not slump at a temperature of 300 degrees Fahrenheit, and shall not harden materially when exposed to the air. Compounds shall readily caulk or adhere to clean surfaces of plastic conduit, metallic conduits, or conduit coatings; concrete, masonry; any cable sheaths, jackets, covers, or insulation material, and the common metals. Compounds shall form a seal without dissolving, noticeable changing characteristics, or removing any of the ingredients. Compounds shall have no injurious effect on the hands of workers or upon materials.

K. Underground Plastic Line marker: Manufacturer’s standard permanent, continuous-printed polyethylene film tape with metallic core, intended for direct burial service; not less than 3” wide x 4 mils thick. Provide orange tape with black printing reading, “CAUTION TELEPHONE/DATA CABLE BELOW,” or similar.

L. Tracer Wire: Copper #6

M. Tracer Box: NEMA-3 4” x 4” weatherproof box.

N. Spacers for 4” Conduit: Intermediate Spacer and Base Spacer.

O. Handhole: 2’ x 3’ x minimum 18” deep communications vault constructed of precast concrete with a minimum thickness of 1.25 inches: The cover shall be either precast concrete, steel, or cast-iron.

P. Manhole: 6’-0” X 12’-0” X 7’-0” two-piece precast concrete communications vault equipped with 30” frame and cover, 3”, 6” and 12” grade rings as required. Including all necessary hardware: ladder, pulling-in irons, cable racks, “S” rack supports, steps, plastic conduit end bells, and lead tag for identification.

Q. Duct Plug 4”

R. End Bell 4”: Carlon E297N

S. Communication Drain Box: 2’ x 2’ inside dimension concrete block with 18” diameter lid for access from top and two (2) 1” PVC Schedule 8 pipes. Custom made per detail drawing attached at the end of this section

T. Squeege is moistened pea-sized gravel and sand mixture

2.03 CABLE ROUTING HARDWARE

A. Cable Rack with Support Hardware as Required:
   a. 18 Hole manhole rack
   b. Other Sizes as Required

B. Cable Rack Steps/Hooks:
   a. 4” Hook
   b. Other Sizes as Required

C. “S” Rack Supports

D. Step Lock Wedge

2.04 HORIZONTAL DIRECTIONAL DRILLING EQUIPMENT

A. The horizontal directional drilling equipment shall consist of a directional drilling rig of sufficient capacity to perform the bore, a guidance system to accurately guide boring operations, and trained and competent personnel to operate the system.
B. All equipment shall be in good, safe operating condition with sufficient supplies, materials and spare parts on hand to maintain the system in good working order for the duration of this project.

C. The directional drilling machine shall consist of a hydraulically powered system to drill into the ground at a variable angle.
   a. The machine shall be anchored to the ground to withstand the pulling, pushing and rotating pressure required to complete the boring.
   b. The hydraulic power system shall be self-contained with sufficient pressure and volume to power drilling operations.
   c. The hydraulic system shall be free of leaks.
   d. The drill head shall be steerable by changing it's rotation and shall provide the necessary cutting surfaces and drilling fluid jets.

D. The Guidance System shall be of a proven type and shall be set up and operated by personnel trained and experienced with this system.
   a. The Operator shall be aware of any magnetic anomalies and shall consider such influences in the operation of the guidance system if using a magnetic system.

PART 3 - EXECUTION

3.01 INSPECTION

A. Examine areas and conditions under which the new exterior telecommunications pathways are to be installed. Provide notification, in writing, of conditions detrimental to proper completion of the work.

B. Verify field measurements and pathway routing conditions are as shown on drawings. Provide notification, in writing, of conditions deviating from drawings.

C. Beginning of telecommunications pathway installation indicates Contractor acceptance of existing conditions.

D. Post and comply with: CONSTRUCTION INSPECTION REPORT – VOICE AND DATA COMMUNICATIONS attached to Section 270100.

3.02 TRENCHING AND BACKFILL

A. Perform all trenching and backfill for new underground conduit system placement as shown on the project drawings.

B. Perform pavement removal and replacement as specified in Sections 02221, 02513, and 02520.

C. Perform trenching, backfilling, and compaction as specified in Sections 02200 and 02221.

D. Perform pavement marking as required as specified in Section 02580.

E. All utilities to be located by contractor and exposed, if necessary, prior to construction. For locations on UCB campus right of way:
   a. Sewer, water, electric: 303-492-5522
   b. Telephone: 303-492-5522
   c. Gas, Public Service Company: 303-986-2800
   d. Utility Notification Center of Colorado: 1-800-922-1987

3.03 CONDUIT SYSTEM PLACEMENT

A. Place new conduit system including handholes and manholes as shown on the project drawings.

B. No pathway shall have more than 180 degrees of bends.

C. Nomenclature example for Conduit drawings: 2PC4"C
   a. 2 = 2 conduits
   b. P = Polyvinylchloride M = Metal
   c. C = Conduit
   d. 4" = 4" Inside diameter of conduits
   e. C = Schedule 40 or 80
D. Twelve inch (12") clearance from all utilities to be maintained. If not possible, conduit to be encased in concrete slurry (flow fill) where proper distance cannot be obtained.

E. Cross telecommunications conduit ducts below gas piping.

F. Trench, conduit, handhole and manhole details are shown on the project drawings. Detail drawings of the following Types 1, 2, 3, 4, and 5 are attached at the end of this section:
   a. Type 1: Typical Construction – Protection: All locations except bends and street crossings
   b. Type 2: Typical Construction – Protection: Street crossings – Schedule 80
   c. Type 3: Typical Construction – Protection: All bends and where specified
   d. Type 4: Typical Construction – Protection: 20’ each side of manholes
   e. Type 5: Typical Construction – Protection: 4-way duct bank

G. All conduits shall be thoroughly cleaned before laying or using.

H. During construction the ends of the conduits shall be plugged to prevent water washing mud into the conduits, manholes, or buildings. Particular care shall be taken to keep the conduits clean of concrete, dirt, or any other substance during the course of construction.

I. New and reopened trenches under asphalt roadways and parking lots must have concrete cap or be encased in concrete as required.

J. Support multiple conduits on preformed nonmetallic separators to provide not less than 1” spacing between exterior surfaces of conduit (Type 5). Spacing between separators shall be close enough to prevent sagging of conduits or breaking of couplings and watertight seals.

K. Squeegee sand is to be placed in the trench for 20’ on each side of the manholes (Type 4).

L. Conduits shall be securely anchored in place with nylon tie-downs to prevent movement during the placement of concrete slurry (flow fill), squeegee, and other backfill materials. Wire tie-downs are prohibited.

M. Seal all conduit junctions and fittings watertight prior to pour of concrete slurry (flow fill). Conduit couplings shall be made in accordance with the manufacturer’s recommendation for the particular type of conduit and coupling selected and as approved by UCB.

N. Unless otherwise noted on drawings, a minimum two foot (24") depth of cover is required above the top of all conduits.

O. Provide communication drain box in conduit six feet (6’) from building outside wall penetrations as shown in project drawings. Conduit inside drain box shall be perforated to allow water and gas to escape.

P. Transition to PVC coated GRC conduit five feet (5’) from building outside wall penetrations.

Q. For all offsets and sweep bends, provide fiberglass or PVC coated GRC.

R. All conduit bends are to be minimum 3’ radius or larger as noted on drawings.

S. Bury underground plastic line marker one foot (12") above the telecommunications conduit.

T. Bury #6 copper tracer wire directly above the telecommunications conduit and extend 4” into each manhole space. Extend 6” of tracer wire into tracer box on outside wall of building directly above conduit entry point.

U. Provide plastic conduit bell ends at each PVC conduit termination and for all conduit entering manholes.

V. Do not bore under concrete sidewalks, remove and replace sidewalks as necessary, or push a minimum 4” conduit, PVC schedule #40.

W. The new conduit shall extend through the wall into the building, tunnel, or crawl space a minimum of 4 inches.

X. Building, tunnel, and manhole coredrills must be sealed around conduits with UCB approved waterproof plugging compound.
   a. Seal openings around conduits that pass through inside building wall coredrills with UL listed foamed silicon elastomer compound.
   b. Seal openings around conduits that pass through outside building walls with a complete Link-Seal assembly or equal for a waterproof seal. Slope conduit away from building.
c. Seal openings around conduits that pass through manhole walls with foundation foam on the interior of the core and silicone sealer on the inside and outside of the core for a waterproof seal.

Y. Handholes shall be placed with the long dimension in line with the conduit run. The conduit shall enter opposite ends of the handhole on the short sides so that the handhole shall not be used as a 90 degree bend in cable installations.

Z. All conduits entering bottom of handhole shall be flush with the inside wall. Dirt shall be removed 6” below the bottom of conduits entering the handhole and pea-gravel shall be placed on the bottom to help water dissipate.

AA. The ends of the metallic conduit shall be reamed and bushed using:
   a. Insulated metallic bushings for 1-1/4” conduit and larger
   b. Insulated metallic bushings with grounding lugs for conduit entering TRs and ERs

BB. After conduit duct installation has been completed and concrete has set, pull “D” test mandrel through all new conduit ducts to verify duct integrity and insure smooth interior surfaces free from burrs or obstructions that might damage cable sheaths.

CC. Following mandrel testing, draw cylindrical wire brush with stiff bristles through each conduit to clean the conduit and remove any concrete, dirt or other obstructions.

DD. Stub out conduits into ERs, TRs, and cabinets only enough to attach connector and bushings with grounding lugs except conduits shall rise a minimum of 6 inches above the finished floor.

EE. Install new Muletape in all new conduit and extending three feet into each building space.

FF. Plug ends of the new conduit with watertight rubber conduit plugs, removable conduit caulking compound, or conduit caps to ensure foreign matter does not enter the buildings.

GG. Refer to EH&S report from UCB prior to cutting or drilling any surface.

### 3.04 CABLE ROUTING HARDWARE

A. Place new cable routing hardware in the tunnels and in crawl spaces beneath the building as required for the project and as shown on the drawings.

B. Perform installation of routing hardware as specified in Section 270500 including anchoring and supports, grounding and bonding, etc.

C. Place new ladder, pulling-in irons, cable racks, “S” rack supports, steps in new and existing manholes as required for backbone cable routing.

### 3.05 HORIZONTAL DIRECTIONAL DRILLING

A. UCB OIT shall be notified 48 hours in advance of starting horizontal directional drilling work. The directional drilling shall not begin until UCB OIT is present at the job site and agrees that proper preparations for the operation have been made.

B. No work shall commence until Traffic Control and Construction Permits from UCB and/or the City of Boulder are in place as applicable for the specific project.

C. Site Preparation
   a. Prior to any alterations to work site, the entry and exit points shall be marked.
   b. No alterations to the work site beyond what is required for operations shall be made.
   c. All activities shall be confined to designated work areas.

D. Drill Path Survey
   a. The entire drill path shall be accurately surveyed with entry and exit stakes placed in the appropriate locations within the areas indicated on drawings.
   b. If a magnetic guidance system is being used, the drill path will be surveyed for any surface geomagnetic variations or anomalies.

E. All applicable environmental regulations shall be adhered to.

F. Following drilling operations, the equipment will be de-mobilized and the worksite restored to its original condition. All excavations will be backfilled and compacted to 95% of original density. Landscaping will be restored to original site conditions.

### 3.06 SAFETY
A. The contractor must comply with UCB regulations for asbestos, lead, and confined spaces (contact EH&S 303-492-0215)

B. All applicable state, federal and local safety regulations shall be adhered to and all operations shall be conducted in a safe manner.

C. Guard manhole openings per NESC C-2-1997, 423.A:
   a. When covers of manholes, handholes, or vaults are removed, the opening shall be promptly protected with a barrier, temporary cover, or other suitable guard.

D. Test for gas in manholes and unventilated vaults per NESC C2-1997, 423.B and C, including, but not limited to:
   a. The atmosphere shall be tested for combustible or flammable gas(es) before entry.
   b. Where combustible or flammable gas(es) are detected, the work area shall be ventilated and made safe before entry.
   c. Unless forced continuous ventilation is provided, a test shall also be made for oxygen deficiency.
   d. Provision shall be made for adequate continuous supply of air. Note: The term adequate includes evaluation of both the quantity and quality of the air.
   e. Employees shall not smoke in manholes.
   f. Where open flames must be used in manholes or vaults, extra precautions shall be taken to ensure adequate ventilation.

E. All outside plant (OSP) construction shall be fenced off and holes covered off hours and when not active according to UCB Grounds, EH&S and Housing requirements.

3.07 AS-BUILT DRAWINGS
A. Mark the project drawings with notations reflecting any variations from the base specifications and drawings including as-built conduit routing.

B. Comply with Construction Drawings AS-BUILT Requirements attached to Section 270100.

APPENDIX FOR EQUIPMENT SCHEDULE:

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<td>ATT 612-84 Manhole</td>
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END OF SECTION 27 05 43
COMMUNICATION DRAIN BOX DETAIL

SCALE: 1" = 1'-0"

2 PVC SCHED. 8
ONE INCH PIPES

2" x 2" (INSIDE DIM)
MIN. CONCRETE BLOCK
WITH 18° Lid FOR
ACCESS FROM TOP

AS REQUIRED TO
PIPE DEPTH
MAINTAINED

2" PVC SCHED. 40
DRAIN LINE TO
EXISTING STORM
SEWER

GROUND LEVEL

CONDUIT PERFORATED
TO ALLOW WATER AND
GAS TO ESCAPE

SIDE VIEW

SIX 1" DRILLED
DRAIN HOLES IN
BOTTOM SIDES &
TOP OF PIPE
(TOTAL OF 24)

FRONT VIEW
COMMUNICATIONS DUCTING TRENCH TYPICAL
SPACING UNLESS NOTED OTHERWISE

NOTE: TYPICAL CONSTRUCTION —
PROTECTION ALL LOCATIONS EXCEPT
BENDS AND STREET CROSSINGS

SCALE: 1”=1’-0”
DETAIL — PAVEMENT RESTORATION

SCALE: 1” = 1′ - 0″
COMMUNICATIONS DUCTING TRENCH
TYPE 3

NOTE: TYPICAL CONSTRUCTION - PROTECTION ALL BENDS AND WHERE SPECIFIED

SCALE: 1"=1'-0"
COMMUNICATIONS DUCTING TRENCH
TYPE 4

NOTE: TYPICAL CONSTRUCTION - PROTECTION 20' EACH SIDE ALL MANHOLES

NATIVE SOIL
BACKFILL
COMPACTED

RESOD WHERE NECESSARY

TEL WARNING TAPE

2'-0"
MIN. COVER

APPROVED BACKFILL AND
COMPACTION

SQUEEZE (WET
SAND-GRAVEL
MIXTURE) 20" EACH
END OF MANHOLE

1'-0"
MIN. WIDTH

CONCRETE SLURRY

(4) 4" PVC CONDUIT

SCALE: 1"=1'-0"
COMMUNICATIONS DUCTING TRENCH
TYPE 5

NOTE: TYPICAL CONSTRUCTION — PROTECTION 4-WAY DUCT BANK

SCALE: 1"=1’-0"

#8 COPPER TRACER WIRE
CONCRETE SLURRY (FLOWFILL)
(4) 4" PVC CONDUIT
SEPARATOR
SECTION 27 08 00

COMMUNICATIONS SYSTEMS COMMISSIONING

PART 1 – GENERAL

1.01 RELATED DOCUMENTS
   A. Drawings, Contract Forms, and Conditions of the Contract, including Construction Manager/General Contractor (CM/GC) Agreement including Exhibits and other Division 1 Specification Sections, apply to this section.

1.02 EMERGENCY FACILITIES
   A. Maintain at all times free access to fire lanes and emergency and utility control facilities such as fire hydrants, fire alarm boxes, utility vaults, manholes, pull-boxes, etc.

1.03 SAFETY OF PERSONS AND PROPERTY
   A. Initiate, maintain, and supervise all safety precautions and programs in connection with the project work. Comply with all safety precautions and programs of UCB.

   B. Take all reasonable precautions for safety of, and provide reasonable protection to prevent damage, injury, or loss to:
      a. Personnel conducting project work and other persons who may be affected thereby; and
      b. Existing facilities, whether or not such facility is to be removed or relocated; and
      c. Project work and all materials and equipment to be incorporated therein, whether in storage or off site, under care, custody or control of Contractor or any subcontractors; and
      d. Installed equipment and existing construction; and
      e. Other property at the site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, fences, roadways, structures and utilities not designed for removal, relocation or replacement in the course of construction.

   C. Trucks and other equipment shall not drive on lawns, concrete sidewalks, or concrete curbs unless approved in writing by the UCB Project Manager. All lawns, shrubs, walks, irrigation equipment, tunnels, curbs, or other property damaged in such a manner by the Contractor shall be replaced or repaired in a timely manner by the Contractor to the satisfaction of UCB.

   D. Comply with all applicable laws, ordinances, rules, regulations, policies of UCB, and lawful orders of any public authority having jurisdiction for safety of persons or property to protect them from damage injury or loss.

   E. Assume responsibility for construction safety at all times and provide, as part of contract, all trench or building shoring, scaffolding, shielding, dust/fume protection, mechanical/electrical protection, special grounding, safety railings, barriers, and other safety features required to provide safe conditions for all workers and site visitors.

   F. Moderate public pedestrian traffic should be expected around all work locations. Ladders, scaffold, installation materials, and all other hazardous conditions must be fully protected at all times. Warning cones, barricades, warning tapes, etc. shall be used to warn and protect persons and property at all times in public corridors.

   G. Work shall not interfere with legal fire exits. Corridors, areas of egress, fire protection standpipes, hydrants, and exit stairs shall be maintained at all times.

   H. Comply with any and all code related and UCB specific safety requirements for work to be performed in confined spaces. The University requires appropriate safety training, physical examination and fit testing for employees working in confined spaces. This shall be provided to Contractor employees at the expense of the Contractor and at no cost to the University.

   I. Comply fully with National Electrical Safety Code NESC and UCB specific safety requirements for work in electrical high voltage power manholes. Only licensed electricians may perform work in electrical high
voltage power manholes. In addition, a UCB high voltage electrician escort is required to be on site throughout the time work is being conducted by contractors (including standing order electricians) in any high voltage power manholes or vaults.

1.04 LOCATION AND PROTECTION OF UTILITIES
   A. Notwithstanding any other provisions of the contract, Contractor shall be solely responsible for location and protection of any and all public lines and utility customer service lines in the work area.

1.05 VEHICULAR ACCESS AND PARKING
   A. Provide required parking permits for all construction vehicles furnished by the Contractor. Permits shall be purchased by the Contractor from the University Parking Management Office at 303-492-7384. Any cost to the Contractor for parking related items is not a billable charge.
   B. Park only in approved and authorized areas. UCB shall not pay the cost of parking tickets.

1.06 IDENTIFICATION
   A. All Contractor personnel shall be clearly identified by uniform and company badge with photo ID.
   B. Contractor may also be issued and required to wear UCB provided Contractor ID’s for required card access locations or identification. All owner provided Contractor ID’s must be returned upon completion of the project work.
   C. Equip all vehicles with signs identifying the Contractor company. All vehicles used on campus by Contractor personnel, whether owned by the employee or the Contractor shall have visible company identification on both sides of the vehicle. Magnetic signs are acceptable.

1.07 DELIVERY AND STORAGE
   A. Make provisions for the delivery and safe storage of all materials and equipment. Specific delivery and storage instructions to be coordinated between UCB and Contractor in advance.
   B. Mark materials and store in such manner as to be easily checked and inspected.
   C. Store all materials and equipment out of the weather and protected from damage, theft, and vandalism and assume complete responsibility for losses due to any cause. Store materials on dry base at least 6” above ground or floor and provide waterproof covering. Remove and provide special storage for items subject to moisture damage. Replace items stolen or damaged at no cost to UCB.
   D. Equipment or materials stored on site shall be stored so as not to interfere with other work, block passageways, or obstruct access/exits to buildings or facilities.
   E. Where materials are indicated to be furnished by other or by UCB for installation under this Division, make a complete and careful check of all materials delivered and furnish a receipt acknowledging acceptance of the delivery and condition of the materials delivered. After such acceptance, assume full responsibility for their safe-keeping until such time as the completed installation has been accepted.
   F. Use of trailers may be required. Coordinate with UCB for location of any required trailers.
   G. Contractor shall be responsible for all costs associated with materials and equipment delivery and storage.

1.08 SITE ACCESS AND COORDINATION WITH OCCUPANTS
   A. Contractor shall have access to site during normal business hours subject to any work restriction for the duration of the project.
   B. Perform work in a manner so as to minimize disruption to the ongoing day-to-day activities of the occupants of the facility.
   C. Notify UCB to schedule activities that may disrupt the occupants.
   D. There are areas of the building where access shall be restricted or regulated due to personnel safety. UCB shall identify such sensitive work areas in which advanced scheduling and admittance permission is required.

1.09 SITE RESTORAL AND CLEANUP
   A. Keep the building, premises and surrounding area free from accumulation of surplus, waste materials or rubbish caused by operations at all times.
B. Remove tools, equipment and scaffolding, and leave the area where the work has been done broom clean at the end of each workday. In the case of dispute, the University may remove all such items and charge the cost of such removal to the Contractor.

C. Before leaving each day, remove all surplus material, waste material, empty boxes, crates, and rubbish and transport rubbish to an on-site location designated by the University. All MAC work will not have an on-site location for material. Use of University dumpsters and trash cans is prohibited.

D. Keep clean all equipment and fixtures for the duration of the project.

E. Upon completion of work and before acceptance, remove from the site all surplus and discarded materials, temporary structures, tools, and debris. Surplus and waste materials removed from the site shall be disposed of in accordance with applicable laws and regulations.

F. Equipment shall be turned over to UCB in perfect, unblemished condition.

G. Replace, restore, or bring to original condition any damaged floors, ceilings, walls, furniture, grounds, pavement, etc., caused by Contractor personnel and operations. Restore damage or disfigurements and repair surfaces, including finish and/or paint, to match existing.

H. Upon completion of work and before acceptance, thoroughly clean the entire work area including all equipment and fixtures, both exposed surfaces and interiors. Final cleanup at job completion shall include:
   a. Exterior: In addition to items specified below, any new surfaces on exterior, concrete, metal, etc. shall be carefully and thoroughly cleaned.
   b. Hardware: Clean and polish all hardware and leave clean and free from paint, grease, dirt, etc.
   c. Electrical: Clean and polish all electric fixtures, including glassware, switchplates, etc. and leave clean and free from paint, grease, dirt, etc.
   d. Equipment: Carefully and thoroughly clean all items of equipment, mechanical, electrical, cabinets, ductwork, etc.
   e. Floors: Thoroughly clean all floors. Vacuum and clean all carpeting. Sweep all hard surface floors.

I. Leave the site in a clean, neat, and orderly condition at least equal to that which originally existed. All final cleanup of the exterior and interior of the building shall be done by the Contractor or by professional cleaners hired and paid for by the Contractor as required.

PART 2 – MATERIALS

2.01 THIS SECTION NOT USED.
   A.

PART 3 - EXECUTION

3.01 THIS SECTION NOT USED.
   A.

APPENDIX FOR EQUIPMENT SCHEDULE:

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SECTION 27 11 00
COMMUNICATIONS EQUIPMENT ROOM WORK

PART 1 – GENERAL

1.01 RELATED DOCUMENTS
A. Drawings, Contract Forms, and Conditions of the Contract, including Construction Manager/General Contractor (CM/GC) Agreement including Exhibits and other Division 1 Specification Sections, apply to this section

1.02 SCOPE OF WORK
A. Provide all services, labor, materials, tools, and equipment required for the complete and proper installation within the Telecommunications Rooms (TRs) and Equipment Rooms (ERs) as called for in these specifications and related drawings.
B. This section includes minimum requirements and installation methods for the following:
   a. Equipment Racks and Cable Routing Hardware
   b. Copper Termination Equipment
   c. Fiber Termination Equipment
   d. Grounding and Bonding

1.03 QUALITY ASSURANCE
A. All installation work in the TRs and the ERs shall be performed in a neat and workmanlike manner. All methods of construction that are not specifically described or indicated shall be subject to the control of UCB.
B. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified is based on the acceptable manufacturers listed. Where “approved equal” is stated, equipment shall be equivalent in every way to that of the equipment specified and subject to approval of UCB based on submittals provided.
C. Materials and work specified herein shall comply with the applicable requirements of:
   a. ANSI/NFPA 70 – National Electrical Code (NEC) Articles 250, 300, and 645
   b. ANSI/TIA-568-C.0 – Generic Telecommunications Cabling for Customer Premises
   c. ANSI/TIA-568-C.1 – Commercial Building Telecommunications Cabling Standard
   d. ANSI/TIA-568-B.2 – Commercial Building Telecommunications Cabling Standard – Part 2: Balanced Twisted-Pair Cabling Components, including applicable addendum
   e. ANSI/TIA-568-C.3 – Optical Fiber Cabling Components Standard
   f. ANSI/TIA-569-B – Commercial Building Standard for Telecommunications Pathways and Spaces
   g. ANSI/TIA-604 Series – Fiber Optic Connector Intermateability Standards
   h. ANSI/TIA-606 – Administration Standard for Telecommunications Infrastructure of Commercial Buildings
   i. ANSI/TIA-607 – Commercial Building Grounding and Bonding Requirements for Telecommunications
   j. BICSI Telecommunications Distribution Methods Manual
   k. FCC CFR 47 Part 68 – Connection of Terminal Equipment to the Telephone Network

1.04 DESIGN DOCUMENTATION - GUIDELINES FOR CONSULTANTS
In reference to telecommunications design work, the University requires the telecommunications design effort be substantially complete and included in the publication of the initial design documentation set. The design elements expected in each phase, as a minimum, are listed below. Don’t forget to make it very clear what is new construction and what is not when working in existing locations.
A. Schematic Design (SD) Phase
a. Legion or Symbol Schedule complete.
b. Site Plan complete.
c. Specifications will change little and need to be complete for updates.
d. Floor plans shall include outlet locations with numbers for each location (at SD phase the numbers can be XX to indicate numbers will be added on a future phase). Once a number is assigned it shall never change for any reason, a deletion will not change any of the other numbers to keep the numbers consecutive.
e. Riser drawings shall be provided to indicate that the design group understands the project may include OSP OIT copper, OSP Qwest with protection and OIT copper voice, OIT copper utility, copper Qwest to each IDF location.
f. Riser drawing shall be provided to indicate that the design group understands the project may include OSP OIT Multimode(62.5/125) and Singlemode fiber, and then OIT riser Multimode(50/125), Singlemode fiber to each IDF location.
g. Riser drawing shall be provided to indicate the conduits for OSP and risers to include size and quantity.
h. The rack layout is standard for CU OIT and shall be complete at SD phase for review and update. The number of racks may change due to the number of outlets which is acceptable.
i. The MDF voice wall is normally an issue to work through so a wall detail to indicate stacked protectors feed from the bottom at least four high with a 1/2 D-ring route above the protectors at a height of no more than 6 feet 3 inches all the way across the 66 block run. The next row is 66 blocks stacked 6 high with no gaps feed from the bottom with voice riser cable that will be terminated on the left side first all the way down to the bottom of the sixth block then back to the top and terminated on the right side all the way down to the bottom of the sixth block before terminating on the second row and so on. Then a gap is left for future voice riser and the next row is 66 blocks stacked 6 high with no gaps feed from the bottom with utility riser cable that will be terminated on the left side first all the way down to the bottom of the sixth block then back to the top and terminated on the right side all the way down to the bottom of the sixth block before terminating on the second row and so on.
j. In the MDF on a shorter wall the Qwest protectors are setup like the CU OIT as well as riser however we need one row of six 66 blocks between the protectors and the riser for horizontal station cables that will be terminated on the left side first all the way down to the sixth block on the outside pins only than down the right side of the 66 block on the outside pins only.
k. A note shall be added to the rack detail that “the voice shall be terminated with only one pair per port skipping the 25th pair of each group and the utility shall be terminated with four pair per port skipping the 25th pair of each group. See the patch panel labels for more direction from the CU OIT Project manager.”
l. Cable tray and conduit pathways shall be complete.
m. Details need to be complete – cable tray, ladder rack, outlet box, Ccure, drain box, etc.

B. Design Development (DD) Phase

a. All rooms should be nailed down by now so the Terminal sheets with the floor layout, rack layout, and wall layouts shall be complete to include but not limited to:
   i. The ladder racking in each TR.
   ii. The copper and fiber cable routing with the location of the 20 foot coils on the fiber cables shown on the room layout.
   iii. The relay rack locations with the front and back labeled. These shall be next to the wall and working from left to right.
   iv. All grounding detail.
   v. The wall details shall be confirmed for which walls and all numbering added.
b. The outlets need to be numbered if not complete on SD phase.
c. Fine tune any specification needs.
d. Add conduit in location with Gypsum ceilings.
e. Confirm we have enough panels and racks for the number of outlets to be installed.

C. Construction Document (CD) Phase
   a. This phase shall only be used for final clean-up
   b. When complete email all T dwg CAD files to CU OIT CAD. This is not the As-built files and after construction an As-built set needs to be sent to CU OIT CAD as well.

1.05 ARCHITECTURAL REQUIREMENTS
A. New Telecommunications Rooms (TRs) and Equipment Rooms (ERs) shall be designed in compliance with the space, electrical, and environmental requirements of ANSI/TIA-569-A – Commercial Building Standard for Telecommunications Pathways and Spaces. Smaller spaces or enclosures shall not be acceptable without prior written approval from UCB OIT.
B. The locations for all TRs and ERs shall be designed to be within a 150’ radius of all areas to be served with the understanding to maintain ANSI/TIA distance standards for telecommunications cabling.
C. Corridor access with the door to swing out is required for all new TRs and ERs, which shall comply with common area access requirements. No other rooms shall lead directly to or from the TR or ER.
D. All walls of the TRs and ERs will be covered with rigidly fixed ¾” A-C fire-resistant or non-combustible plywood backboard, void free, 8’ high, painted with two coats of light colored fire retardant paint.
E. TRs and Telecom ERs shall be open to the structure above (no suspended ceiling).
F. The floor, walls and ceiling of the TRs and ERs will be sealed to reduce dust. The floor shall be sealed concrete.
G. The communication TRs and ERs cannot be shared with other departments or purposes including, but not limited to, custodial, access services, electrical, mechanical, storage, etc.
H. Equipment not related to the support of the TR or ER (e.g., piping, ductwork, pneumatic piping, electrical equipment, plumbing, etc.) should not be installed in, pass through, or enter the room.
I. No equipment, hardware, piping, etc. shall be added in or near any TR or ER that will change the temperature or humidity of these rooms without written agreement from UCB OIT department prior to design and installation.
J. The MDF room shall be enlarged to allow future UPS floor space in the footprint. Empty conduits are to be installed running from the UPS location to each data closet. Ensure sufficient wall space is available for future electrical breaker panels that will feed all communication rooms.
K. New TRs and ERs shall not be adjacent to any electrical room or room containing a transformer or motors. Electrical power systems in or adjacent to the TRs and ERs should be configured such that their electromagnetic fields do not interfere with telecom cabling or equipment.
L. Communication as-built files shall be a part of the final punch list and not complete until UCB OIT receives the final as-built cad files (final payment shall be held).

1.06 ELECTRICAL REQUIREMENTS
A. New Telecommunications Rooms (TRs) and Equipment Rooms (ERs) shall be designed in compliance with the space, electrical, and environmental requirements of ANSI/TIA-569-A – Commercial Building Standard for Telecommunications Pathways and Spaces. Smaller spaces or enclosures shall not be acceptable without prior written approval from UCB OIT.
B. The communication TRs and ERs cannot be shared with other departments or purposes including, but not limited to, custodial, access services, electrical, mechanical, storage, etc.
C. Equipment not related to the support of the TR or ER (e.g., piping, ductwork, pneumatic piping, electrical equipment, plumbing, etc.) should not be installed in, pass through, or enter the room.
D. No equipment, hardware, piping, etc. shall be added in or near any TR or ER that will change the temperature or humidity of these rooms without written agreement from UCB OIT department prior to design and installation.
E. Power for all TRs and ERs in the building will be provided by a separate supply circuit terminated on its own electrical panel with an isolated ground. This electrical panel shall be located in the room with the MDF. If the building is equipped with a standby power generator, the panel serving the TRs and ERs shall be connected to the standby power generator.

F. The MDF room shall be enlarged to allow future UPS floor space in the footprint. Empty conduits are to be installed running from the UPS location to each data closet. Ensure sufficient wall space is available for future electrical breaker panels that will feed all communication rooms.

G. Power for telecommunications and data network equipment in the TRs and ERs should be provided by one (1) double duplex outlet with a dedicated 120VAC, 20A circuit and one (1) L530R outlet with a dedicated 120VAC, 30A circuit located 30 inches behind the relay rack on the wall. In addition, convenience duplex power outlets should be placed at 6 foot intervals on the walls.

H. Lighting in the TRs and ERs should be a minimum of 500 lx (50 foot candles) measured 1 m (3 ft) above the finished floor, mounted 2600 mm (8.5 ft) minimum above the finished floor. Lighting fixtures should not be powered from the same electrical distribution panel as the telecom or data equipment in the room.

I. New TRs and ERs shall not be adjacent to any electrical room or room containing a transformer or motors. Electrical power systems in or adjacent to the TRs and ERs should be configured such that their electromagnetic fields do not interfere with telecom cabling or equipment.

J. Communication cable trays shall be installed in the corridors only with no Sprinklers above the cable tray.

K. A minimum of two 4 inch conduits shall be installed in all gypsum ceilings greater than 3 feet wide and at all corners that are gypsum.

1.07 PLUMBING REQUIREMENTS

A. The communication TRs and ERs cannot be shared with other departments or purposes including, but not limited to, custodial, access services, electrical, mechanical, storage, etc.

B. Equipment not related to the support of the TR or ER (e.g., piping, ductwork, pneumatic piping, electrical equipment, plumbing, etc.) should not be installed in, pass through, or enter the room.

C. No liquid piping, dry liquid piping, drains or steam piping shall pass through or within the walls of any TRs or ERs with the exception of fire safety systems.

D. No equipment, hardware, piping, etc. shall be added in or near any TR or ER that will change the temperature or humidity of these rooms without written agreement from UCB OIT department prior to design and installation.

E. Communication cable trays shall be installed in the corridors only with no Sprinklers above the cable tray.

1.08 MECHANICAL REQUIREMENTS

A. The communication TRs and ERs cannot be shared with other departments or purposes including, but not limited to, custodial, access services, electrical, mechanical, storage, etc.

B. Equipment not related to the support of the TR or ER (e.g., piping, ductwork, pneumatic piping, electrical equipment, plumbing, etc.) should not be installed in, pass through, or enter the room.

C. No liquid piping, dry liquid piping, or steam piping shall pass through or within the walls of any TRs or ERs with the exception of fire safety systems.

D. No equipment, hardware, piping, etc. shall be added in or near any TR or ER that will change the temperature or humidity of these rooms without written agreement from UCB OIT department prior to design and installation.

E. The temperature and humidity in the TRs and ERs should be controlled to provide continuous operating ranges of 64°F to 75°F with 30% to 55% relative humidity. A positive pressure differential with respect to surrounding areas should be provided. If a standby power source is available in the building, the HVAC system serving the TRs and ERs should be connected to the standby power. HVAC loads will depend on the equipment in these rooms. The equipment list and associated loads will be available upon request from the UCB OIT Networking group.

F. All AC units, VAV and Fan Coil Units shall be located outside the TRs and ERs with only duct work entering the room unless written approval has been given from the UCB OIT department.
G. No liquid piping, dry liquid piping, drains or steam piping shall pass through or within the walls of any TRs or ERs with the exception of fire safety systems.

1.09 COMMUNICATIONS REQUIREMENTS

A. New Telecommunications Rooms (TRs) and Equipment Rooms (ERs) shall be designed in compliance with the space, electrical, and environmental requirements of ANSI/TIA-569-A – Commercial Building Standard for Telecommunications Pathways and Spaces. Smaller spaces or enclosures shall not be acceptable without prior written approval from UCB OIT.

B. The locations for all TRs and ERs shall be designed to be within a 150’ radius of all areas to be served with the understanding to maintain ANSI/TIA distance standards for telecommunications cabling.

C. All walls of the TRs and ERs will be covered with rigidly fixed ¾” A-C fire-resistant or non-combustible plywood backboard, void free, 8’ high, painted with two coats of light colored fire retardant paint.

D. The communication TRs and ERs cannot be shared with other departments or purposes including, but not limited to, custodial, access services, electrical, mechanical, storage, etc.

E. Equipment not related to the support of the TR or ER (e.g., piping, ductwork, pneumatic piping, electrical equipment, plumbing, etc.) should not be installed in, pass through, or enter the room.

F. No equipment, hardware, piping, etc. shall be added in or near any TR or ER that will change the temperature or humidity of these rooms without written agreement from UCB OIT department prior to design and installation.

G. The MDF room shall be enlarged to allow future UPS floor space in the footprint. Empty conduits are to be installed running from the UPS location to each data closet. Ensure sufficient wall space is available for future electrical breaker panels that will feed all communication rooms.

H. New TRs and ERs shall not be adjacent to any electrical room or room containing a transformer or motors. Electrical power systems in or adjacent to the TRs and ERs should be configured such that their electromagnetic fields do not interfere with telecom cabling or equipment.

I. All CAD design shall comply with the CAD standards document attached at the end of this section. The UCB OIT supplied prints shall be used for design on all projects with updates for each project. The communication design team is responsible for completing the T-5 at CD phase.

J. The UCB OIT standards shall be used for all projects. Items that do not apply to the project can be “strikethrough” and additional information add shall be in the color of red. These specifications shall be email to UCB OIT for all phases of the project including but not limited to SD, DD and CD.

K. The AS-BUILT files shall be the responsibility of the Communication Consulting company to complete not the contractors responsibly. All AS-BUILT files shall be turned into OIT per these standards.

L. Building designs shall be Star topology with no intermediate cross connect point. All voice, utility, fiber and Qwest shall terminate from the building MDF to a TR.

M. The complete design shall be mailed to UCB OIT on a compact disc or USB drive no later than three weeks following UCB comments.

N. Communication as-built files shall be a part of the final punch list and not complete until UCB OIT receives the final as-built cad files (final payment shall be held).

O. A minimum of two 4 inch conduits shall be installed in all gypsum ceilings greater than 3 feet wide and at all corners that are gypsum.

P. The communication design team shall support and help in the coordination of all of the UCB OIT design team requirements in this section.

Q. Include TR and ER dividing line labeled on both T files and ET files for correct pathway installation.

PART 2 – MATERIALS

2.01 EQUIPMENT AND MATERIALS MINIMUM REQUIREMENTS

A. Floor-Mount Equipment Rack
   a. Standard 19” rack mounting space
b. 84” high with 44 rack spaces (1 rack space = 1-3/4”)
c. EIA-310-D standard 5/8” 5/8” 1/2” hole pattern
d. EIA channel width of 3” with double-sided 12/24 tapped screw holes
e. Lightweight high strength aluminum construction with clear finish
f. 15” deep base with four (4) ¾” bolt down holes and equipped with hardware for permanent mounting on concrete floor
g. Rack installation kit
h. Dust covers for the base off all racks.

B. Vertical Rack Cable Management (for new installations)
   a. 84” high
   b. Slack Loop Storage Organizer, Extended (2”) Mounting Bracket
c. Cable Retainer

C. Rack Cable Management and Accessories
   a. Interbay Cable Organizer
   b. Screw-Mount, Reusable Cable Ties
c. Back Wire Manager: 2” Clear Narrow Cable Ring or 4” Doublewide Cable Ring (for remodel projects)
d. Blank Filler Panel, 1, 2, or 4 Rack Units

D. Power Strips
   a. Standard 19” rack-mount power strip with 10 outlets and 10’ cord

E. Ladder Cable Runway
   a. Tube steel painted Gray with cross members welded at 12” intervals:
      i. 6” Wide, 9’ 11-1/2” Length: CPI 10250-106
      ii. 12” Wide, 9’ 11-1/2” Length: CPI 10250-112
      iii. 24” Wide, 9’ 11-1/2” Length: CPI 10250-124
   b. Include support kits, brackets, splice kits, end caps, etc. as required for complete installation.

F. Plywood Backboard: ¾” A-C fire-resistant or non-combustible plywood backboard, void free, 8’ high, painted with two coats of light colored fire retardant paint.

G. ½ D-Rings and D-Rings wall-mount nominal 2” 4” or 6” as required.

H. Velcro cable ties for cable routing and management as required.

2.02 COPPER TERMINATION EQUIPMENT
A. Category 3 – For Renovations Match Existing and for Additions use 66-type connecting blocks and brackets:
   a. 66 block punch down 66M1-50 style
   b. 89 bracket
   c. 66M cover
   d. Bridge clips
B. Patch Panel: 48-Port Rack Mount Panel
C. Panel for Backbone (Tie) Cable
D. Panel for Utility Cable
E. Building Entrance Protector
   a. 66 block punch to 66 block punch with 5 pin heat coil input.
   b. 66 block punch and 25 foot stub with 5 pin heat coil input.
F. Building Entrance Protector Gas Tube and 4 ohm with 5 pin Heat Coils.

2.03 FIBER TERMINATION EQUIPMENT
A. Rack-Mount Lightguide Termination Shelf for Backbone Cable:
   a. 72-Strand Capacity 4U Fiber Fixed Shelf
   b. ST Panel for 4U Fiber Shelf
   c. SC Panel for 4U Fiber Shelf
B. Combination Shelf for Fiber Terminations:
   a. 24-Strand Capacity 1U Fiber Sliding Shelf for Cartridges
   b. Cartridge 6ST OptiSPEED Beige 62.5/125
   c. Cartridge 6SC LazerSPEED Aqua 50/125
   d. Cartridge 6ST TeraSPEED Blue Single mode
C. ST Multimode Coupling with Hex Mounting Nut for 62.5/125
D. ST Singlemode Coupling with Hex Mounting Nut
E. SC Multimode Duplex Coupling for Laser Optimized 50/125:

2.04 PATCH CORDS
A. Copper Category 5e, various lengths as required for project:
   a. Colored Blue for Voice in TR and ER (NO BOOT)
   b. Colored Blue for Voice in MDF for all voice from PBX port to Riser pair (NO BOOT)
   c. Colored Black for Data in TR and ER (NO BOOT)
   d. Desktop Mounting Cord Colored Black for Data at Outlet Location (NO BOOT)
   e. Special Circuit Cord Colored Yellow for Circuits other than Voice or Data in TR and ER (NO BOOT)
B. Copper Category 6e, various lengths as required for project:
   a. Colored Black for Data in TR and ER
   b. Desktop Mounting Cord Colored Black for Data at Outlet Location
C. Voice Patch Cable from Patch Panel to 66 Blocks (solid not stranded):
   a. Colored Blue for Voice in TR and ER (Special Order)
D. Special Circuit Patch Cable from Patch Panel to 66 Blocks (solid not stranded):
   a. Special Circuit Colored Yellow for Circuits other than Voice or Data in TR and ER (Special Order)
E. Copper Category 6A, various lengths as required for project:
   a. Colored White for Data in TR and ER (OIT written approval only).

2.05 GROUNDING AND BONDING
A. #4 and #6 AWG wire suitable for grounding application.
B. All connectors and clamps shall be mechanical type made of silicon bronze.
C. Terminals shall be solderless compression type, copper long-barrel NEMA two bolt.
D. Telecommunications Bonding Backbone (TBB): Minimum No. 6 AWG insulated copper conductor.
E. Telecommunications Grounding Busbar (TGB): Minimum 6 mm thick x 50 mm wide predrilled copper busbar with standard NEMA bolt hole sizing and spacing
F. All grounding equipment shall be UL listed for that purpose.

PART 3 - EXECUTION
3.01 EQUIPMENT RACKS AND CABLE ROUTING HARDWARE IN TELECOMMUNICATIONS ROOMS
A. The Telecommunications Rooms (TRs) and Equipment Rooms (ERs) may be equipped with some existing hardware, such as plywood backboards, grounding bus bars, equipment racks, ladder cable runway, horizontal and vertical cable management, and copper and fiber termination equipment. Existing hardware already be in place will be shown on the project drawings.
B. Examine TRs and ERs and verify conditions are as shown on project drawings. Provide notification in writing of conditions deviating from drawings or detrimental to proper completion of the work.
C. Beginning of installation in the TRs and ERs indicates Contractor acceptance existing conditions.
D. Install new equipment racks with vertical and horizontal cable management in the TRs and ERs as required for project and as shown on drawings. Letter designation for racks and equipment shall be placed as shown in the rack layout at the end of this Section and in the panel details at the end of Section 271700. All
equipment racks shall be securely anchored to the concrete floor using minimum 3/8” hardware or as specified by rack manufacturer.

E. Install new ladder cable runway for cable routing in the TRs and ERs as required for project and as shown on drawings. All ladder cable runway shall be securely anchored to the walls with support kits and brackets as specified by manufacturer. Secure equipment racks to ladder cable runway with all-thread covered with EMT conduit sleeve.

F. Install plywood backboard on the walls in the TRs and ERs as required for the project and as shown on drawings. All plywood backboard shall be securely anchored to the walls.

G. Install D-rings on plywood backboard for cable routing in the TRs and ERs as required for the project and as shown on drawings.

H. All new cables shall be supported using ladder cable runway, D-rings, and cable management hardware and shall be neatly dressed-out in the TRs and ERs.

I. Clamp all new cables at the entrance to the TRs and ERs for strain relief.

J. Provide coils on all new fiber cables terminated in the TRs and ERs per the project drawings to control excess fiber lengths. TRs and ERs without coils shall be marks “No fiber coil” on the drawings.

K. Bind fiber cable coils in four places with separation of 90 degrees and anchor to wall with cable ties within four feet of cable entrance. Do not install cable coils on cable or equipment racks. D-rings shall not be used to support the fiber coils.

L. Firestop all sleeves and conduit openings after the cable installation is complete.

M. All building MDFs require one wall-mount telephone outlet on the plywood backboard.

N. The hardware layout in the racks shall follow the UCB standard format from top to bottom and left to right as shown in the typical rack layout drawings.

O. Equipment placement shall be coordinated with UCB OIT staff.

P. Data patch cords being installed to ports on equipment must not cross the center of the port section on the equipment.

Q. Patch cords being installed to jacks on patch panels must not cross the center of the patch panel.

R. Patch cords from equipment ports on one side of the rack to jack patch panel positions on the other side of the rack must route to the vertical manager, up to the top, and over and down the vertical manager on the other side of the rack, so that the patch cords do not cross the center of the patch panel or the center of the port section on the equipment.

S. Patch cords may be installed from equipment ports to jacks on patch panels when the ports and jacks are on the same side of the centerline.

T. A small drip loop is required for trouble shooting and tracing patch cords.

U. Refer to the drawings attached at the end of this section for patch cord routing.

V. All horizontal and patch cables leaving the relay rack shall have Velcro cable ties placed on the bundle every 8 to 12 inches within the ER and TR’s.

### 3.02 COPPER TERMINATION EQUIPMENT

- Some copper termination equipment may already be in place in existing TRs and ERs and will be shown on the project drawings.

- Mount new 66M1-50 blocks on 89B brackets for backbone (tie), utility, and horizontal telephone cables directly on plywood backboard in the TRs and ERs as required for the project and as shown on drawings. Add bridge clips, cross-connects, and patch cords for all voice installs in immediate communication room prior to final testing for projects and after testing for daily installs and place new clear covers after cable termination and labeling.

- Mount new patch panels for Category 5e and Category 6 horizontal cables in the floor-mounted equipment racks in the TRs and ERs as required for the project and as shown on drawings.

- Mount new patch panels for copper backbone (tie) and utility cables in the floor-mounted equipment racks in the TRs and ERs as required for the project and as shown on drawings.
E. Label all copper terminations according to UCB campus standards. The one-page Copper Termination sheet will be provided by UCB OIT and installed by the Contractor. Additional labels needed will be supplied and installed by the Contractor. Replacement sheets will be provided to the Contractor at an additional cost.

F. Provide the copper patch cords for each new horizontal cable to UCB OIT three (3) weeks prior to final acceptance. The patch cords will be installed in the ERs and TRs by UCB personnel. The patch cords will be of adequate length to fit the rack layout without excessive loops. Coordinate the proportion of (data) versus (voice) patch cords with UCB OIT prior to ordering the cords.

G. Provide one desktop mounting cord for each cable in the B, D and F position on the faceplate to UCB OIT three (3) weeks prior to final acceptance. The mounting cords will be installed by UCB personnel. The quantity, color, and length of desktop mounting cords will be specified on a per-project basis.

H. The voice patch cords from the patch panel to the 66 block shall be installed prior to testing but not tested through for all projects. These voice patch cables are supplied and installed by the Contractor. The Contractor shall submit the pair count with the jack number for as-built documents at 3 weeks and 1 week prior to occupancy or as specified per project. One end of these voice patch cords is plugged into the patch panel and the other end is punched down. Krone and 110 will also need to include voice patching per project or jack install instruction.

3.03 FIBER TERMINATION EQUIPMENT

A. Some fiber termination equipment may already be in place in existing TRs and ERs and will be shown on the project drawings.

B. Mount new fiber termination shelves in the floor-mounted equipment racks in the TRs and ERs as required for the project and as shown on drawings.

C. Label all fiber enclosures according to UCB campus standards. Fiber schematic sheets and Fiber Termination labels will be provided by UCB OIT and installed by the Contractor. Replacement sheets and labels will be provided to the Contractor at an additional cost.

D. Place dust covers on all ST couplings prior to final acceptance.

E. Paint panels for singlemode fiber terminations yellow according to UCB campus standards.

3.04 GROUNDING AND BONDING

A. Mount new TGBs on plywood backboard in TRs as shown on project drawings. The location for the TGBs shall be coordinated with UCB OIT.

B. Mount new TMGB on plywood backboard in main ER as shown on project drawings. The location for the TMGB shall be coordinated with UCB OIT.

C. Connect new TBB the TMGB in the ER to the TGBs in the TRs as shown on project drawings. Connect the TBB to the TMGB and TGBs in accordance with TIA-607 and NEC. All grounding conductors leaving the ER and TRs shall be in a separate conduit from all communication cabling.

D. Bond all metallic surfaces of new racks, ladder cable runway, and equipment in the TRs and ERs to the TGB or TMGB in the same room with #6 AWG grounding wire as straight as possible.

E. Bond all metallic raceways (conduit, cable tray, etc.) entering the TRs and ERs to the TGB or TMGB in the same room with #6 AWG grounding wire as straight as possible.

F. All grounding items shall be installed in complete compliance with Division 16 – Electrical (or CSI 2004 Division 26 - Electrical) and NEC.

APPENDIX FOR EQUIPMENT SCHEDULE:

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<td>Patch Cord for Data in Black at TR and at the outlet 6e</td>
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xx = the length of the patch cord in the size of 03, 04, 05, 06, 07, 08, 09, 10, 11, 12, 13, 14 and 15.

x = the length of the patch cord in the size of 1.5, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12.

END OF SECTION 27 11 00
UCB OIT Telecom
CAD Standards Guideline

For

Documentation and Construction Projects

Revision – November 28, 2011
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1. INTRODUCTION

This document was produced by the University of Colorado at Boulder, OIT Telecom CAD Department (UCB OIT Telecom CAD Dept.) in April of 2004 and has been revised in May of 2011.

The purpose of this document is to serve as a tight specification for producing and delivering CAD drawings for facility documentation projects and construction projects. The guidelines are intended to ensure the successful use and control of CAD systems and data throughout the UCB OIT Telecom CAD Dept.

Before a project can be closed out and final payment from the UCB OIT Telecom Dept. rendered, all specified materials must be submitted to the appropriate UCB OIT Telecom CAD Dept. project manager or representative in accordance with production standards and special instructions described throughout this document.

A signed copy of the CAD Quality Assurance Checklist found in section 2.B.7 of this document must also be submitted with CAD drawings being delivered during the closeout phase of projects. When a CAD Quality Assurance Checklist has been signed and submitted, the vendor (architect, engineer, contractor, etc.) is assuring that all materials adhere to the standards and guidelines set forth in this document.

The layering standard outlined herein is a slightly modified version of the 1997 American Institute of Architects CAD Layer Guidelines. However, please note that the UCB OIT Telecom CAD Dept. follows its own guidelines for naming and organizing CAD files, instead of following the 1997 AIA recommendations in these areas.

The UCB OIT Telecom Division Standards mentioned in this document refer to the Telecommunication Project Standards found at http://www.colorado.edu/facilitiesmanagement/pdc/construction/standards/index.html.

Please direct any questions or comments about this document to the UCB OIT Telecom CAD Dept. client representative at the address below.

University of Colorado at Boulder
OIT Telecom, CAD Dept.
1045 18th St., 313 UCB
Boulder, CO 80309

Attn:
OIT Telecom – CAD Department
Kevin Gzym, CAD Coordinator
Telephone: 303-492-3855
E-mail: Kevin.Gzym@colorado.edu
2. CAD DRAWING PRODUCTION

A. FILE FORMAT AND SETUP

1. FILES PROVIDED BY UCB OIT TELECOM CAD DEPT.
   a) Consultants shall contact the UCB OIT Telecom CAD Dept. at the beginning of the project to be provided with a CD containing all necessary AutoCAD blocks, LISP files, Script Files, base drawings, building numbers and codes, etc.

2. ELECTRONIC FILE FORMAT
   a) Facility documentation drawings and construction project drawings must be submitted to the UCB OIT Telecom CAD Dept. in full compliance with AutoCAD software (file extension = .DWG). The following AutoCAD file formats are acceptable:
      (1) AutoCAD 2010* – DWG format only
      *Due to AutoCAD issues the UCB OIT CAD Dept. must save drawings to version 2010 and previous versions will not coincide with information provided by OIT.

3. SCALE AND UNITS
   a) All CAD drawing models should be drafted to scale at full scale.
   b) Imperial (Architectural in AutoCAD) units shall be the standard system of measurement (exception: Decimal for OSP).
   c) The base unit shall be inches (exception: feet for OSP).

4. TOLERANCES
   a) For Facility Documentation Drawings
      (1) Typically it is required that exterior building dimensions recorded within CAD drawings must reconcile to within 1 inch of actual building dimensions as measured in the field, and interior building dimensions must reconcile to within 1/2 inch of actual field dimensions. However, individual project specifications may vary. Please confirm dimension error tolerances for each project with your UCB OIT Telecom CAD Dept. client representative.
   b) For Construction Drawings
      (1) Tolerances for construction drawings are implicit within professional service contracts.

5. TEXT
   a) All non-attributed text on UCB OIT Telecom CAD Dept. CAD drawings shall be created using only the Mtext command.
   b) All text on UCB OIT Telecom CAD Dept. CAD drawings shall use only the ROMANS font supplied with AutoCAD's font library. The CAD files submitted shall be plotable without modification.
   c) Text size must be legible and appropriate to the graphic information presented and the intended plotted scale of the drawing (See Appendix 3.A. Figure 1, Dimscale Chart for
UCB OIT Telecom CAD Dept.). Text must be in all upper case letters throughout a drawing.

d) Text usually should not touch other graphic objects, and must be placed with enough space around it to be legible when the drawing is plotted and reproduced.

e) Text may be placed at an angle. It must be readable from the bottom or right edges of the plotted sheet. Generally text should be placed at an angle of 0° or 90°. Text may be placed along (above or below) another element at an angle other than 0° or 90°.

f) Dimensions, labels, notes and drawing titles, when requested as part of the project, shall match existing height on printed drawings.

6. BLOCKS

a) The UCB OIT Telecom CAD Dept. is currently requiring the use of block definitions provided by this department (See Section 2.A.). However, when additional blocks must be created, the UCB OIT Telecom CAD Dept. requires that the following general rules be employed:

(1) All entities within a block must be created on layer 0

7. TITLE BLOCKS

a) Each CAD file submitted to the UCB OIT Telecom CAD Dept. should have only one title block. The title block should be placed in paper space, with its insertion point inserted at a coordinate location of (0,0,0), and at a scale of 1. The cut size of the paper should be 24”x36”. Depending on the purpose of the drawing, facility documentation or construction, the drawing’s title block should contain certain essential information that the UCB OIT Telecom CAD Dept. needs, to store and retrieve each drawing in its library.

(1) Title Blocks for Facility Documentation Drawings

(a) A generic UCB OIT Telecom CAD Dept. title block template is available for use.

(2) Title Blocks for Construction Drawings

(a) Consulting architects and engineers may use their own title blocks. At minimum, these title blocks should contain all of the information listed below.

(3) Project Information:

(a) Firm Name - representing the drawing author
(b) Project Name - as specified by the UCB OIT Telecom CAD Dept.
(c) Building Number - as specified by the UCB OIT Telecom CAD Dept.
(d) Building Name - specify only if the project name does not include this information already, and the project is building specific
(e) Project Number - assigned by the UCB OIT Telecom CAD Dept

(4) Drawing Information:

(a) • Drawing Title - indicating the drawing content, e.g. floor plan, section, detail, etc.
(b) • Drawing Number
(c) • Date of Drawing - original drawing date including significant revision dates
8. MODEL SPACE AND PAPER SPACE

a) The UCB OIT Telecom CAD Dept. requires that each CAD file submitted as a project deliverable contain only one title block in paper space which references the building model contained in model space. Additional models related to the same building are allowed and shall be shown through the use of multiple viewports in paperspace.

b) In addition:

   1) Label scaled details with the appropriate scale on the detail title in model space.
   2) Show detail through viewport zoomed to the appropriate scale in paper space.
   3) Do not place or draw model-related blocks, tags and objects in paper space.
   4) Draw all model space objects at full scale, and to scale.

9. EXTERNAL REFERENCE FILES (XREFS)

a) The UCB OIT Telecom CAD Dept. will not accept the submission of any CAD drawing deliverable which contains references to external source drawing files created outside of the UCB OIT Telecom CAD Dept. All externally referenced data sources that were used during the CAD drawing production phase, unless created by the UCB OIT Telecom CAD Dept., should be inserted and retained as a block within a single drawing file, including the title block, upon project completion and prior to drawing delivery to the UCB OIT Telecom CAD Dept. External references shall not be “bound” to drawings. The resulting self-contained drawing file is an acceptable deliverable to the UCB OIT Telecom CAD Dept.

10. DRAWING COMPOSITION

a) All AutoCAD drawings shall be purged of empty, unused, or non-essential drawing data prior to submittal to The UCB OIT Telecom CAD Dept. This includes all unused layers, linetypes, blocks, fonts and entities.

b) AutoCAD drawings shall not contain multiple overlaid lines or lines with multiple segments unless the overlaid lines or adjacent line segments are assigned to different layers.

c) Blocks should not be exploded.

d) Drawings should be left in paperspace and zoomed extents.

e) The menu should be set to ACAD.

11. ANNOTATION

a) Annotation can be placed in either model space or paper space. Annotations related to model data, such as dimensions, notes, drawing titles, legends and callouts must be included in the model space where they are easier to coordinate and revise.

b) Other annotations, such as sheet-specific notes, are more convenient to work with when placed on the drawing sheet in paper space.

c) Leaders shall extend from the vertical midpoint of the top line of the annotation and point to the object being described. Leaders can extend from the right or left side of the annotation. Leaders shall be placed on the same layer as the annotation for the object.
12. DIMENSIONS

a) All dimensions shown in the project submittals shall be fully associative. Dimension definition points should be located with an appropriate Object Snap (End Point, Mid Point, etc.) or otherwise located precisely on the project geometry. Manual input of dimension text or otherwise over-riding the actual dimensions is NOT acceptable in submittals to the UCB OIT Telecom CAD Dept.

13. LAYERING

a) The UCB OIT Telecom CAD Dept. has adopted most of the layer name and use rules recommended by the CAD Layer Guidelines published in 1997 by the American Institute of Architects (AIA CAD Layer Guidelines NCS Version 2). AIA recommendations, which have been adopted by the UCB OIT Telecom CAD Dept. are included in this section. Where noted, the UCB OIT Telecom CAD Dept. has supplemented the AIA guidelines with its own rules and standards, as necessary. A copy of the current National CAD Standards may be obtained from http://www.buildingsmartalliance.org/ncs/.

(1) STANDARD LAYER LISTING

This section contains a partial list of AIA recommended layers to be used when producing facility documentation drawings, construction drawings, fiber schematics and Outside Plant (OSP) drawings for the UCB OIT Telecom CAD Dept.

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# OIT Telecom CAD Standards

**Revision – 11-28-11**

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<td>(replace ???? with Owner</td>
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<td>Phantom</td>
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<td>T-00-000</td>
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*Sheet Abbreviations*

- All – All Drawing Types
- As Req. – As required
- DET – Detail Sheet
- JK – Jack Map
- MH – Manhole Drawing
- OSP – Outside Plant Drawing
- SCHM – Schematics (Fiber)
- TR – Terminal Sheets

**Owner Abbreviations for Alt-Owner Jacks/Fiber:**
- ANET – Alliance Network
- CARD – Card Readers
(3) **Layer Name Formatting**

As recommended by the 1997 AIA CAD Layer Guidelines, layer names may be as short as six characters (discipline code + major group) or as long as sixteen characters (discipline code + major group + minor group + status). Here are four examples of acceptable formula variations:

- **# 1** T-COND = discipline code + major group
- **# 2** T-CABL-FIBR = discipline code + major group + minor group
- **# 3** T-SCHM-FUTR = discipline code + major group + status code
- **# 4** T-SCHM-FIBR-FUTR = discipline code + major group + minor group + status

(4) **Attributes**

(a) **Linetypes**

The default linetype of each layer is typically CONTINUOUS unless otherwise specified. Drawing entities shall assume the linetype property of the layer on which they reside. This means that the linetype of individual entities shall be assigned ‘by layer’ as opposed to ‘by entity.’

(b) **Colors**

The UCB OIT Telecom CAD Dept. recommends the use of specific colors for core layers and annotation layers (see the previous section regarding the definition of core layers). Drawing entities shall assume the color property of the layer on which they reside. This means that the color of individual entities shall be assigned ‘by layer’ as opposed to ‘by entity.’

(c) **Pen Weight**

The following chart shows pen weight assignments, which should maximize the printed clarity of drawings conforming to the color assignments of the UCB OIT Telecom CAD Dept.’s core layers.

<table>
<thead>
<tr>
<th>Pen #</th>
<th>Color</th>
<th>Weight</th>
<th>Core drawing elements (including, but not limited to):</th>
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<tr>
<td>1</td>
<td>red</td>
<td>.010 in</td>
<td>Emergency Phone</td>
</tr>
<tr>
<td>2</td>
<td>yellow</td>
<td>.010 in</td>
<td>Racks, Cable Management</td>
</tr>
<tr>
<td>3</td>
<td>green</td>
<td>.010 in</td>
<td>Jacks (alternate ownership), Notes, Dimensions</td>
</tr>
<tr>
<td>4</td>
<td>cyan</td>
<td>.010 in</td>
<td>Copper Cable/Equip, Room Numbers, Building,</td>
</tr>
<tr>
<td>5</td>
<td>blue</td>
<td>.010 in</td>
<td>Innerduct</td>
</tr>
<tr>
<td>6</td>
<td>magenta</td>
<td>.010 in</td>
<td>Fiber (OSP, Terminal Sheets)</td>
</tr>
<tr>
<td>7</td>
<td>white</td>
<td>.010 in</td>
<td>Title Block, Fiber Strands (fiber schematics)</td>
</tr>
<tr>
<td>20</td>
<td></td>
<td>.010 in</td>
<td>Building Demo</td>
</tr>
<tr>
<td>40</td>
<td></td>
<td>.010 in</td>
<td>Conduit</td>
</tr>
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</table>
14. FILL AND HATCH PATTERNS

a) Limit excessive use of hatch patterns to avoid unnecessarily large files. All consultants are responsible for keeping files sizes within reasonable limits. A solid hatch shall be created by only using AutoCAD “SOLID” hatch pattern. Using dense hatch patterns to create solid fill shall not be permitted in the drawing set.

15. AUTOCAD DRAWING SUPPORT FILES

a) Drawings created using non-standard AutoCAD fonts, linetypes and hatch patterns can result in content discrepancies in the delivered drawing set. To ensure the integrity of the drawing set, and minimize potential problems:

(1) Only native AutoCAD fonts, linetypes and hatch patterns shall be used. These are standard support features installed as part of a standard AutoCAD installation.

(2) Postscript fonts shall not be used.

16. FILE NAME CONVENTIONS

a) As explained in the section entitled Model Space and Paper Space, the UCB OIT Telecom CAD Dept. requires that each CAD file submitted as a project deliverable, contain only one major drawing model with one title block (i.e. one building plan, etc.). This policy allows each CAD file produced for either a facility documentation project or a construction project to be named according to the conventions outlined below

(1) Naming Facility Documentation Drawings (primary method):

(a) CAD files produced by Preferred CAD Vendors, which typically contain drawings of existing facility conditions should be named according to the following examples:

EXAMPLES:
wlrd_327_1f.dwg = building + first floor 1f
tcom_210_1b.dwg = building + basement 1b
fib_144.dwg = fiber schematic for cable 144
fib_144_2.dwg = fiber schematic for cable 144, sheet 2
stad_378_tr_1b23.dwg = terminal sheet for Stadium, Room 1B23

(2) Building ID Code:
(a) The standard UCB OIT Telecom CAD Dept. building identification code assigned by UCB Facilities Management is normally a four (4) alpha character code. The standard building identification codes that pertain to your project can be found on the CD mentioned in section 2.A.1.a.

(3) Floor ID Code:
(a) The standard floor identification code follows a two digit numbering system. Floors above or at grade are numbered sequentially in ascending order, starting with 1f, 2f, 3f, etc. Floors that are below grade are numbered in descending order, starting with 1b (basement), 2b, (sub-basement), 3b, etc.
17. STANDARD SHEET SIZES AND FORMATS
   a) All sheet sizes are to be limited to three standard formats. Required sheet size is specific to each project and is under the discretion of the University. They are as follows:
      (1) A Sized Plot 8 1/2” x 11”
      (2) B Sized Plot 11” x 17”
      (3) D Sized Plot 24” x 36” (preferred format)

18. RASTER GRAPHICS
   a) Raster files shall not be used to represent the project geometry, e.g. building plans or other drawings shall not be scanned and inserted as raster files. Raster files may be used for the incorporation of existing condition photos or similar applications. Raster files included in a drawing shall be placed on layer T-RSTR.

19. CAD FILE TRANSMITTAL
   a) The content of electronic drawings must match the delivered original hard copy set as closely as possible, if not exactly. To ensure the integrity of the electronic drawing set upon delivery to The UCB OIT Telecom CAD Dept.:
      (1) Ensure the drawings adhere to the guidelines presented in this document.
      (2) Include a transmittal sheet (electronic and hard copy) with all submittals indicating the UCB OIT Telecom CAD Dept. project number, project name and complete listing of all materials submitted, including filenames and sheet numbers for each item included in the submittal. This ensures the completeness of the drawing set and assists in archival procedures.
      (3) Include hard copy prints of all drawing submittals per UCB OIT Telecom Division Standards
      (http://www.colorado.edu/facilitiesmanagement/pdc/construction/standards/index.html)
      (4) Submit AutoCAD .PC3 plot configuration files whenever necessary.
      (5) Submit AutoCAD files (See section 2.A.2.a.) and other electronic format files on CD-ROM formatted for Windows. All files are to be copied directly to CD-ROM. No compression or archive utilities are allowed.
      (6) Electronic data deliverables are required with all major submittals.

20. CD-ROM LABELING
   a) All CDs are to be labeled as follows:
      (1) CAMPUS: Campus for which the project is intended. Specify satellite location if applicable.
      (2) DATE: The date when the submittal was delivered to the campus for final acceptance.
      (3) PROJECT: Title of the project.
      (4) SUBMITTAL: Project submittal phase (i.e. 50% schematic etc.)
      (5) BLDG NUMBERS: Building number identified by the campus specific to the project.
      (6) AUTOCAD VERSION: AutoCAD version.
      (7) WINDOWS VERSION: Windows version.
      (8) COMPANY: Name of consultant to the campus.
      (9) PHONE NUMBER: Phone number of consultant.
      (10)CD-ROM: CR-ROM Number. Label as CD-ROM x of y. When only a single CD is used for the submittal, label as CD-ROM 1 of 1
21. DOCUMENTATION

a) The delivered CAD drawing files must be accompanied by the documentation described below. This information must cover all CAD files delivered to the UCB OIT Telecom CAD Dept.
   (1) A list of any extended discipline codes, non-standard drawing type codes, and user defined codes that are used in the CAD file names.
   (2) A list of approved exceptions to the standard layer structure (a single exception list is acceptable if all files conform to the list.
   (3) A list of any deviations from the standards, with reference to the written approval obtained for those deviations that required prior approval.
   (4) A description of any third party products that have been used with the drawings and reference to written approval for their use is required. This is necessary if the CAD application software:
      (a) Affects the UCB OIT Telecom CAD Dept.’s ability to review or edit the drawings.
      (b) Requires the UCB OIT Telecom CAD Dept. to own a license to the software to work with the CAD files without violating the software’s copyrights.

22. SOFTWARE AND SOFTWARE LICENSES

a) The UCB OIT Telecom CAD Dept. requires that the delivered CAD files be usable without any additional software licenses or installation

B. OIT CAD DEPARTMENT PROCEDURES

1. REQUESTING CAD DATA FROM THE UCB OIT TELECOM CAD DEPT.

a) Consultants may request copies of existing CAD data for University facilities. CAD Data is provided for the convenience of the recipient only. This data has been gathered from a variety of sources and it may or may not conform to University of Colorado at Boulder standards. The data may be incomplete, or may not accurately reflect current facility conditions. The UCB OIT Telecom CAD Dept. makes no representation as to the data’s completeness or accuracy. Consultants should also acknowledge that CAD data appears to be extremely accurate because it has been generated with a computer, and that the accurate appearance of drawings does not guarantee that they truly represent existing conditions. CAD data submitted by consultants to the UCB OIT Telecom CAD Dept. must be accurate and must conform to the current CAD standards, even if reference data provided by the UCB OIT Telecom CAD Dept. was inaccurate or did not conform to the standards.

b) Acquisition of Electronic (Outside Plant (OSP) Map) Data: All rights reserved. Map data provided by Facilities Management CAD Office is intended for the sole use of the contractor to satisfy obligations to the University of Colorado construction contracts. The map information may include copyright Electronic Spatial Data from Boulder County and/or the City of Boulder and may not be copied, duplicated, or redistributed in any way, in whole or in part, without expressed written consent by Boulder County and/or City of Boulder. Agreement of “Electronic Data Limitations and Conditions of Use” must
be entered into by and between the University of Colorado and consultant prior to release of above mentioned electronic data.

2. SUBMITTAL REQUIREMENTS

a) All AutoCAD drawings forwarded to the UCB OIT Telecom CAD Dept. shall be submitted in a timely fashion, coinciding with the needs of the project and The UCB OIT Telecom CAD Dept. staff. The delivery of AutoCAD documentation during various project stages shall be timed appropriately to ensure that the UCB OIT Telecom CAD Dept. ultimately receives the most accurate information available. The receipt of electronic AutoCAD drawings alone does not alleviate the responsibility of the Consultant for providing hard copy documentation to the UCB OIT Telecom CAD Dept.

b) The following documentation shall be delivered to the UCB OIT Telecom CAD Dept. at the following project milestones:

(1) Construction:
   (a) The UCB OIT Telecom CAD Dept. requires a complete set of Construction Documents in AutoCAD and hard copy format when the project enters the construction phase. The number of hard copy sets required will vary depending on the project. Contact UCB OIT Telecom CAD Dept. client representative for quantity of hard copy sets required for the project.

(2) Completion:
   (a) When the project has been completed, the Consultant shall submit a complete set of As-built documents in AutoCAD electronic and hardcopy formats to the UCB OIT Telecom CAD Dept.

   (b) Refer to the construction specifications for further detail in regards to “Construction Drawings As-built Requirements”. http://www.colorado.edu/facilitiesmanagement/pdc/construction/standards/index.html.

3. SUBMITTAL SCHEDULE

a) The final submittal of as-built CAD data should be made after project construction is complete and facilities have been occupied. In addition, the UCB OIT Telecom CAD Dept. may require sample submittals at key milestones in the development of the CAD drawings, specifications and data in accordance with the contract and/or UCB OIT Telecom Division Standards. Sample submittals are not intended to be a burden on the Consultant, and typically will involve a very limited number of drawings. Digital media submittals, as a minimum, shall be provided at the first and final submittal milestones. Providing digital media at the first submittal milestone will allow the UCB OIT Telecom CAD Dept. to verify that the data structures being used by the Consultant conform to the CAD data standards and are readily usable on the UCB OIT Telecom CAD Dept. CAD systems.

4. VALIDATION OF DELIVERED MATERIALS

a) The UCB OIT Telecom CAD Dept. will validate the CAD data and other materials submitted by consultants. If submittals do not conform to the UCB OIT Telecom CAD Standards Guidelines, the UCB OIT Telecom CAD Dept. may return the materials to the Consultant. The Consultant is responsible for revising the materials to make them
conform to the UCB OIT Telecom CAD Standards Guidelines.

b) The UCB OIT Telecom CAD Dept. recommends the use of the eTransmit command in AutoCAD to create a .zip file containing all drawings, associated x-refs, pen settings files, etc. to be included in the submittal to the UCB OIT Telecom CAD Dept.

5. COMMUNICATION ABOUT THE CAD STANDARDS

a) These CAD Standards will be most effective for the UCB OIT Telecom CAD Dept. and most usable for consultants if there is communication between consultants and the University Owner's Representative. Consultants should ask questions about the CAD data standards before beginning work. Direct questions to the UCB OIT Telecom CAD Dept. Concerns regarding the impact of the CAD standards on a particular project must be discussed with the Owner's Representative. Consultant's questions are valuable because they help the UCB OIT Telecom CAD Dept. understand the real-world conditions of each project's design and construction process. Questions will raise issues that will result in better CAD standards.

6. SUGGESTIONS FOR THE STANDARDS

a) The content of the manual is intended to be neither static nor all-inclusive and thus will be updated and enhanced as appropriate. Suggestions for improvements are encouraged so that subsequent updates reflect the needs of the University. Submit suggestions, as well as any pertinent new information, which would enhance these standards, to the UCB OIT Telecom CAD Dept. client representative.
7. CAD QUALITY ASSURANCE CHECKLIST

CAD drawings delivered upon closeout of project must be accompanied by submission of the following checklist. When a checklist has been signed and submitted, the vendor (architect, engineer, contractor, etc.) is assuring that all materials adhere to the standards and guidelines set forth in this document.

CHECKLIST –

File Format and Setup
- Electronic File Format
- Scale and Units
- Tolerances
- Text
- Blocks
- Title blocks
- Model Space and Paper Space
- External Reference Files (XREFs)
- Drawing Composition
- Annotation
- Dimensions
- Layering
- Fill and Hatch Patterns
- AutoCAD Drawing Support Files
- File Name Conventions
- Standard Sheet Sizes and Formats
- Raster Graphics
- Cad File Transmittal
- CD Rom Labeling
- Documentation
- Software and Software Licenses

Name of Accountable Vendor Representative (please print) ________________________________

Signature of Accountable Vendor Representative______________________________________

Phone Number _________________________________________________________________

E-mail ________________________________________________________________________

Date __________________________________________________________________________
3. APPENDIX

A. Figure 1 - Dimscale Chart for UCB OIT Telecom CAD Dept.

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Plotted Text height (inches) x Dimscale = Actual (CAD) text height
Dimscale is the number of drawing scale units in a foot

B. Figure 2 - Record Document Jack Abbreviations

Note: These abbreviations are intended for record documents and may need to be modified for construction drawings.
C. Figure 3 – New Jacks - Phase 1

1. Design, Prints and T5 Jack Form

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D. Figure 4 - New Jacks – Phase 2

1. Final Jack Testing - Final Jack Prints and T5 Jack Form

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Note: Added jacks are to be placed at the end of the T5 and patch panel, do not fill in open gaps.
E. Figure 5 - New Jacks – Phase 3

1. Final CAD As-Built.
F. Figure 6 - Sample Terminal Room Footprint
g. Figure 7 - Sample Cable Layout
H. Figure 8 - Sample Rack Detail

Note: This drawing is an example of an existing terminal condition and is not to be construed as an approved rack standard.
I. Figure 9 - Sample Wall Detail
J. Figure 10 - Sample Fiber Sheet
K. Figure 11 - Sample Outside Plant Drawing
SECTION 27 13 00

BACKBONE CABLING REQUIREMENTS

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

A. Drawings, Contract Forms, and Conditions of the Contract, including Construction Manager/General Contractor (CM/GC) Agreement including Exhibits and other Division 1 Specification Sections, apply to this section

1.02 SCOPE OF WORK

A. Provide all services labor, materials, tools, and equipment required for the complete and proper installation, splicing, and termination of new backbone cabling as called for in these specifications and related drawings.

B. This section includes minimum requirements and installation methods for the following:
   a. Copper Backbone Cabling
   b. Copper Splices
   c. Fiber Optic Backbone Cabling
   d. Fiber Splices
   e. Fiber Connectors
   f. Coaxial Backbone Cabling

1.03 QUALITY ASSURANCE

A. All backbone cable installation, splicing, and termination shall be performed in a neat and workmanlike manner. All methods of construction that are not specifically described or indicated shall be subject to the control of UCB.

B. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified is based on the acceptable manufacturers listed. Where “approved equal” is stated, equipment shall be equivalent in every way to that of the equipment specified and subject to approval of UCB based on submittals provided.

C. Materials and work specified herein shall comply with the applicable requirements of:
   a. ANSI/NFPA 70 – National Electrical Code (NEC) Articles 250, 300, 645, and 770
   c. ANSI/TIA-568-C.0 – Generic Telecommunications Cabling for Customer Premises
   d. ANSI/TIA-568-C.1 – Commercial Building Telecommunications Cabling Standard
   e. ANSI/TIA-568-C.3 – Optical Fiber Cabling Components Standard
   f. ANSI/TIA-569-B – Commercial Building Standard for Telecommunications Pathways and Spaces
   g. ANSI/TIA-598-C – Optical Fiber Cable Color Coding
   h. ANSI/TIA-604-3 – FOCIS 3 Fiber Optic Connector Intermateability Standard
   i. ANSI/TIA-606 – Administration Standard for Telecommunications Infrastructure of Commercial Buildings
   j. ANSI/TIA-607 – Commercial Building Grounding and Bonding Requirements for Telecommunications
   k. ANSI/TIA-758-A – Customer Owned Outside Plant Telecommunications Cabling Standard (including all applicable addenda)
   l. ANSI/ICEA S-87-640 – Fiber Optic Outside Plant Communications Cable
   m. BICSI Telecommunications Distribution Methods Manual
   n. BICSI Customer-Owned Outside Plant Manual

1.04 SUBMITTALS
A. As-built drawings

PART 2 – MATERIALS

2.01 INSIDE COPPER BACKBONE CABLING

A. Riser Rated Non-Plenum (CMR) Category 3 UTP, 24 AWG
   a. 25-Pair
   b. 50-Pair
   c. 100-Pair
   d. 200-Pair
   e. 300-Pair
   f. 400-Pair

B. Riser Rated Plenum (CMP) Category 3 UTP, 24 AWG
   a. 25-Pair
   b. 50-Pair
   c. 100-Pair
   d. 200-Pair
   e. 300-Pair
   f. 400-Pair

2.02 OUTSIDE PLANT (OSP) COPPER TWISTED-PAIR BACKBONE CABLING

A. ASP Filled Core for Buried Installations, 24 AWG
   a. 25-Pair
   b. 50-Pair
   c. 100-Pair
   d. 200-Pair
   e. 300-Pair
   f. 400-Pair
   g. 600-Pair
   h. 900-Pair
   i. 1200-Pair

2.03 COPPER SPLICES

A. Splice Closure System for use in manholes and tunnels: 2-Type System
   a. 2-Type Cover
   b. 2-Type Endplate
   c. Washer Cutter Tool Kit

B. Splice Closure System for inside ER and TR’s: Split Sleeve Vault & Riser
   a. Split Sleeve for 200 Pair
   b. Split Sleeve for 600 Pair

C. Provide all required hardware and kits for field splicing in splice closures and for sealing and mounting the closures.

D. 710 Splice Module – 25 pair splice connector straight/filled with solid cap

2.04 INSIDE FIBER OPTIC BACKBONE CABLING

A. Single-Mode 8.3/125 Fiber Optic Cable
   a. 2-Strand Riser-Rated (OFNR)
   b. 2-Strand Plenum-Rated (OFNP)
   c. 12-Strand Riser-Rated (OFNR)
   d. 12-Strand Plenum-Rated (OFNP)
   e. 24-Strand Riser-Rated (OFNR)
   f. 24-Strand Plenum-Rated (OFNP)
B. Multi-Mode 62.5/125 Fiber Optic Cable – For Fire Alarm circuits and Existing terminals Only – Coordinated with UCB OIT
   a. 2-Strand Riser-Rated (OFNR)
   b. 2-Strand Plenum-Rated (OFNP)
   c. 12-Strand Riser-Rated (OFNR)
   d. 12-Strand Plenum-Rated (OFNP)
   e. 24-Strand Riser-Rated (OFNR)
   f. 24-Strand Plenum-Rated (OFNP)
C. Multi-Mode Laser Optimized 50/125 Fiber Optic Cable
   a. 12-Strand Riser-Rated (OFNR)
   b. 12-Strand Plenum-Rated (OFNP)
   c. 24-Strand Riser-Rated (OFNR)
   d. 24-Strand Plenum-Rated (OFNP)

2.05 OUTSIDE PLANT FIBER OPTIC CABLE
A. Singlemode 8.3/125 TeraSpeed Outside Plant Fiber Optic Cable
   a. 6-Strand Dielectric.
   b. 12-Strand Dielectric.
   c. 24-Strand Dielectric.
   d. 36-Strand Dielectric.
   e. 72-Strand Dielectric.
   f. 96-Strand Dielectric.
B. Multimode 62.5/125 OptiSpeed Outside Plant Fiber Optic Cable – Coordinated with UCB OIT
   a. 6-Strand Dielectric.
   b. 12-Strand Dielectric.
   c. 24-Strand Dielectric.
   d. 36-Strand Dielectric.
   e. 72-Strand Dielectric.
   f. 96-Strand Dielectric.
C. Multimode Laser Optimized 50/125 LazrSpeed Outside Plant Fiber Optic Cable – For approval only – Coordinate with UCB OIT
   a. 6-Strand Dielectric.
   b. 12-Strand Dielectric.
   c. 24-Strand Dielectric.
   d. 36-Strand Dielectric.
   e. 72-Strand Dielectric.
   f. 96-Strand Dielectric.

2.06 FIBER SPLICES
A. Splice Closure:
   a. Fiber Optic Splice Closure.
   b. Fiber Optic Splice Closure fully equipped with cable addition kit.
   c. Fiber Optic Splice Tray and all required accessories for a complete installation.
B. Provide all required hardware and kits for field fusion splicing in splice closures and for sealing and mounting the closures.

2.07 FIBER CONNECTORS
A. Multimode ST II Connector 0.9/2.4/3.0 mm for 62.5/125.
B. Singlemode ST II Connector 0.9/2.4/3.0 mm.
C. Laser Optimized Multimode SC Connector 0.9 mm: for buffered fiber
D. Laser Optimized Multimode SC Connector 3.0 mm.
E. Direct Termination Kit for Outside Plant Cable.
F. Other consumables and kits as required for field termination of fiber optic cable on connectors.

2.08 INSIDE COAXIAL BACKBONE CABBING
All coaxial backbone cable shall be 0.500 non-flooded cable. Campus tunnel systems are used for coaxial backbone pathways. The tunnels are considered environmentally controlled environments, so coaxial cables with built-in flooding compounds are not required. Plenum rated cable is only to be used where and when required. Type RG-11 coaxial cable shall not be permitted in this application.

A. Riser Rated Non-Plenum (CMR or CATVR) .500 non-flooded cable
   Times Fiber T10500J.
B. Riser Rated Plenum (CMP or CATVP) .500 non-flooded cable
   Commscope P3 500 JCAP.

2.09 COAXIAL DEVICES AND EQUIPMENT
A. Amplifiers
   All amplifiers that are to be tied into the CATV backbone are to be manufactured by Motorola.
   a. “BLE” model shall be used for single output designs
   b. “MB” model for multiple output designs
   c. Forward Passband 52 MHz – 870 MHz (or greater)
   d. Return Passband 5- 40 MHz
B. Optical Nodes connected to CATV backbone and provisioned with 60VAC power
   Optical Nodes connecting to the CATV backbone that are provisioned with 60VAC power are to be equipped as follows:
   a. 1 GHz Compact Optical Node
   b. Forward Passband 47 MHz – 1003 MHz
   c. Return Passband 5- 85 MHz
C. Optical Nodes separate from the CATV backbone
   Optical Nodes that are separate from the CATV backbone and are used to feed a cable plant isolated to a single building, the following shall apply:
   a. Optical Node
   b. Minimum gain: 40dB
   c. Return transmitter: 1mW, high-gain transmitter
D. Passive Devices for Coaxial Backbone
   All passive equipment that is tied into the CATV backbone are to be manufactured by Motorola.
   a. Splitters and directional couplers shall be “SSP” model, with a minimum passband upper frequency of 750MHz
   b. Taps shall be “FFT” model, with a minimum passband upper frequency of 750MHz
E. Connectors for Coaxial Backbone
   a. Gilbert brand connectors are recommended

2.10 BACKBONE CABLE INSTALLATION MATERIALS, EQUIPMENT, AND TOOLS
A. Furnish all required materials, equipment, and tools necessary to properly complete the backbone cabling system installation including, but not limited to: tools for pulling, splicing, and terminating the cables, mounting hardware, cable ties, bolts, anchors, clamps, hangers, kits of consumables, lubricants, communication devices, stands for cable reels, cable wenches, etc.
B. Muletape: Polyester or aramid fiber.
C. Conduit Caulking Compound: Compounds for sealing conduit ducts shall have putty-like consistency workable with the hands at temperatures as low as 35 degrees Fahrenheit, shall not slump at a temperature of 300 degrees Fahrenheit, and shall not harden materially when exposed to the air. Compounds shall readily caulk or adhere to clean surfaces of plastic conduit, metallic conduits, or conduit coatings; concrete, masonry; any cable sheaths, jackets, covers, or insulation material, and the common metals. Compounds
shall form a seal without dissolving, noticeable changing characteristics, or removing any of the ingredients. Compounds shall have no injurious effect on the hands of workers or upon materials.

D. Cable Ties
   a. Inside
   b. Metallic Ties for Tunnels and Crawl Spaces: to Unistrut Racking

E. Cable Tags: ID Kit
F. “Caution Fiber” Tags: Scotchlite

PART 3 - EXECUTION

3.01 INSPECTION
A. Examine areas and conditions under which backbone cable is to be installed. Provide notification, in writing, of conditions detrimental to proper completion of the work.
B. Verify field measurements and cable routing and termination conditions are as shown on drawings. Provide notification, in writing, of conditions deviating from drawings.
C. Beginning of backbone cable installation indicates Contractor acceptance of existing conditions.
D. Post and comply with: CONSTRUCTION INSPECTION REPORT – VOICE AND DATA COMMUNICATIONS attached to Section 270100.

3.02 BACKBONE CABLING INSTALLATION
A. Perform all backbone cable installation in conformance with manufacturer’s installation guidelines.
B. Ensure that maximum pulling tensions of specified cables are not exceeded and cable bends maintain the proper radius during placement.
C. Failure to follow appropriate guidelines for cable installation will require the Contractor to provide, in a timely fashion, the additional material and labor necessary to rectify the situation. This shall apply to any and all damages sustained to the cables during installation.
D. Field verify all cable measurements and install all backbone cables in such a matter as to avoid any and all mid-span splices. No mid-span splices are allowed except as specified and shown on project drawings.
E. Pull new Muletape through all conduit while pulling new backbone cable.
F. The Contractor shall be responsible for all damage to the cable during placement.
G. Do not roll or store cable reels without an appropriate underlay.
H. Clamp all new backbone cables at the entrance facilities for strain relief.
I. Backbone telecommunications cabling shall be placed in dedicated pathways separate from horizontal and other cabling.
J. Backbone cables and splice cases installed in tunnels, crawl spaces and manholes shall be strapped to the cable racks using stainless steel ties.
K. Terminate cables so as not to pull tight on terminating equipment.
L. Ensure that all splice closures are properly sealed for protection of the cable and splices.
M. Neatly and permanently label all backbone cables with the cable number at both ends and at all splice locations.
N. Firestop all sleeves and conduit openings after the cable installation is complete.
O. Plug ends of conduit entering buildings with watertight conduit caulking compound after cable installation is complete to ensure foreign matter does not enter the buildings.
P. Test, label, and document the final backbone cable installation, including cable footages, on the as-built drawings. Standard UCB test sheets and labels can be picked up by contacting the UCB OIT Construction Supervisor at 303-492-8033.

3.03 COPPER UTP BACKBONE CABLE
A. Install copper UTP backbone cabling through conduit, tunnel, and crawl spaces, manholes and other pathways as shown on the drawings.
B. Terminate cable pairs on 66M1-50 connecting blocks in each ERs and TR as shown on the project drawings and following the industry standard color code sequence.

C. Terminate voice backbone (tie) cable pairs on 96-port panels in ERs and TRs as shown on the project drawings. Terminate one pair on each port. Each 25-pair binder group shall have the first 24 pairs terminated on 24 ports in the panel and the 25th pair in each binder group shall remain unterminated.

D. Terminate utility cable pairs on 48-port panels in ERs and TRs as shown on the project drawings. Terminate four pairs on each port. Each 25-pair binder group shall have the first 24 pairs terminated on 6 ports in the panel and the 25th pair in each binder group shall remain unterminated.

3.04 FIBER BACKBONE CABLE

A. Install fiber optic backbone cable through conduit, tunnel, crawl spaces, manholes and other pathways as shown on the drawings.

B. Install service coils with length of 20 feet, and a diameter of 18 inches, at each end of all new backbone fiber optic cables to control excess cable lengths before terminating fiber strands. Do not leave cable slack on walls or ladder racks.

C. Bind fiber cable service coils in four places with separation of 90 degrees and anchor to wall with screw type Panduit – “Tak-Ty Hook & Loop Cable Tie Mounts” or screw type Hubbell – “Velcro Brand Saddle Cable Ties” within five feet of cable entrance per the drawings. Do not install cable coils on cable or equipment racks. Each fiber cable coil shall be Velcro individually for ease of maintenance and repair work. D-rings shall not be used to support the fiber coils.

D. Install fiber connectors in the ERs and TRs as shown on the project drawings.

E. Perform termination of multimode fiber strands on ST II and SC connectors with loss ≦ 0.5 dB at 850 nm.

F. Perform termination of singlemode fiber strands on ST II and SC connectors with loss ≦ 0.2 dB at 1310 nm.

G. Terminate fiber strands on connectors and in termination equipment (shelves and panels) as specified in manufacturer’s color code sequence.

H. Do not terminate, splice or cut off “DEAD” cable strands. Neatly coil these unterminated strands inside the shelves or panels with the proper bend radius to protect them for future termination or splicing.

I. Perform fusion splices for multimode and singlemode fiber strands at each splice location with strand numbering as indicated on the drawings.

J. Perform fusion splices for singlemode fiber strands with splice loss ≦ 0.2 dB at 1310 nm.

K. Perform fusion splices for multimode fiber strands with splice loss ≦ 0.3 dB at 850 nm.

L. Place “Caution Fiber” tags at all coils and every 50’ along the cable route.

3.05 SAFETY

A. The contractor must comply with UCB regulations for asbestos, lead, and confined spaces (contact EH&S 303-492-0215)

B. Guard manhole openings per NESC C-2-1997, 423.A:

   a. When covers of manholes, handholes, or vaults are removed, the opening shall be promptly protected with a barrier, temporary cover, or other suitable guard.

C. Test for gas in manholes and unventilated vaults per NESC C2-1997, 423.B and C, including, but not limited to:

   a. The atmosphere shall be tested for combustible or flammable gas(es) before entry.
   b. Where combustible or flammable gas(es) are detected, the work area shall be ventilated and made safe before entry.
   c. Unless forced continuous ventilation is provided, a test shall also be made for oxygen deficiency.
   d. Provision shall be made for adequate continuous supply of air. Note: The term adequate includes evaluation of both the quantity and quality of the air.
   e. Employees shall not smoke in manholes.
   f. Where open flames must be used in manholes or vaults, extra precautions shall be taken to ensure adequate ventilation.
3.06 AS-BUILT DRAWINGS

A. Mark the project drawings with notations reflecting actual cable lengths and any variations from the base specifications and drawings including as-built cable routing.

B. Comply with “Construction Drawings AS-BUILT Requirements” attached to Section 270100.

APPENDIX FOR EQUIPMENT SCHEDULE:

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<td>Washer Cutter Tool Kit</td>
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<td>Splice closure for inside ER &amp; TR’s – Split sleeve 200 pr</td>
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<td>KBS3-175-1</td>
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<td>Splice closure for inside ER &amp; TR’s – Split sleeve 600 pr</td>
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<td>KBS5-100-6</td>
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<td>710 Splice Module – 25 pair splice connector</td>
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<td>3M710-SC1-25</td>
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<td>Inside 62.5/125 Fiber Non-Plenum Riser (OFNR) – 12 Strands Mat. ID = 700009384</td>
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<td>Inside 50/125 Fiber Plenum Riser (OFNP) – 24 Strands Mat. ID = 760018689</td>
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<td>3M</td>
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<td>65</td>
<td>Multimode ST II Connector 62.5/125 Mat. ID 700004328</td>
<td>Systimax</td>
<td>MFC-STU / (MFC-STU-30)</td>
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<td>Singlemode ST II Connector Mat. ID 700011067</td>
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<td>Laser Optimized Multimode SC Connector 0.9 mm: Mat. ID 760007070</td>
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<td>Laser Optimized Multimode SC Connector 3.0 mm: Mat. ID 760007047</td>
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<td>Direct Termination Kit for Outside Plant Cable: Mat. ID 700006117</td>
<td>Systimax</td>
<td>D-181755</td>
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<td>Riser Rated Non-Plenum (CMR or CATVR) .500 non-flooded cable</td>
<td>Times Fiber</td>
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<td>71</td>
<td>Riser Rated Plenum (CMP or CATVP) .500 non-flooded cable</td>
<td>Commscope</td>
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<td>1 GHz Compact Optical Nodes connected to CATV backbone</td>
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<td>73</td>
<td>Optical Nodes separate from the CATV backbone</td>
<td>ATX</td>
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<td>74</td>
<td>Connectors for Coaxial Backbone</td>
<td>Gilbert brand</td>
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<td>Cable Ties for CATV - TM3S8-C mount with PLT4S-CO tie</td>
<td>Panduit</td>
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<td>75</td>
<td>Cable Ties for CATV - TM3S8-C mount with PLT4S-CO tie</td>
<td>Panduit</td>
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<td>Metallic Ties for Tunnels and Crawl Spaces for CATV</td>
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<td>Cable Tags.</td>
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<td>“Caution Fiber” Tags.</td>
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END OF SECTION 27 13 00
SECTION 27 15 00
HORIZONTAL CABLING REQUIREMENTS

PART 1 – GENERAL

1.01 RELATED DOCUMENTS
   A. Drawings, Contract Forms, and Conditions of the Contract, including Construction Manager/General Contractor (CM/GC) Agreement including Exhibits and other Division 1 Specification Sections, apply to this section

1.02 SCOPE OF WORK
   A. Provide all services, labor, materials, tools, and equipment required for the complete and proper installation and termination of new horizontal “station” cabling as called for in these specifications and related drawings.
   B. The horizontal portion of the telecommunications cabling system extends from the work area telecommunications outlet to the termination in the Telecommunications Room (TR) or Equipment Room (ER).
   C. This section includes minimum requirements and installation methods for the following:
      a. Copper Horizontal Cabling
      b. Fiber Optic Horizontal Cabling
      c. Work Area Faceplates
      d. Copper Modular Jacks
      e. Fiber Modular Jacks and Connectors
      f. Coaxial Horizontal (Drop) Cabling

1.03 UCB WIRELESS DESIGN GUIDELINES / NEW CONSTRUCTION BUILDINGS
   A. University of Colorado Boulder Campus new construction buildings will include Project IT funds to engage an 802.11 wireless engineering vendor to perform 802.11 RSSI 3-D modeling to determine Access Point (AP) placement and radio frequency propagation based on the modeling software and proposed building design blueprints. Vendor will be proficient in the use of Motorola designed “Enterprise Planner” modeling software. The modeling software will provide 3-D multi-floor results. The vendor will be supplied with the latest version CAD drawings for the new construction building to be used in the modeling process. OIT Operations’ preferred vendor for this application is Polycom or Acuvant. The vendor will provide as a deliverable a full report from the modeling engagement including Access Point location placement, RSSI with heat maps detailing wireless data rates, SIR interference heat maps, and channel and power plan for each building floor. The report will include all heat maps, material lists and executive summary detailing the parameters used for the modeling setup. The report will be submitted with a minimum two hard copies and on electronic CD. OIT Operations will review the finished report before Architect/Contractor engages cable plant design to accommodate AP placement. For questions related to this document please call (303) 735-7000, or Ext 57000 using a campus based telephone.

1.04 QUALITY ASSURANCE
   A. All horizontal “station” cable installation and termination shall be performed in a neat and workmanlike manner. All methods of construction that are not specifically described or indicated shall be subject to the control of UCB.
   B. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified is based on the acceptable manufacturers listed. Where “approved equal” is stated, equipment shall be equivalent in every way to that of the equipment specified and subject to approval of UCB based on submittals provided.
   C. Materials and work specified herein shall comply with the applicable requirements of:
      a. ANSI/NFPA 70 – National Electrical Code including, but not limited to, the following articles:
i. 300 – Wiring Methods
ii. 645 – Information Technology Equipment
iii. 725 – Class 1, Class 2, and Class 3 Remote Control, Signaling, and Power-Limited Circuits
iv. 770 – Optical Fiber Cables and Raceways
v. 800 – Communications Circuits

b. ANSI/TIA-568-C.0 – Generic Telecommunications Cabling for Customer Premises
c. ANSI/TIA-568-C.1 – Commercial Building Telecommunications Cabling Standard
d. ANSI/TIA-568-B.2 – Commercial Building Telecommunications Cabling Standard – Part 2: Balanced Twisted-Pair Cabling Components, including applicable addendum
e. ANSI/TIA-568-C.3 – Optical Fiber Cabling Components Standard
f. ANSI/TIA-569-B – Commercial Building Standard for Telecommunications Pathways and Spaces
g. ANSI/TIA-604 Series – Fiber Optic Connector Intermateability Standard
h. ANSI/TIA-606 – Administration Standard for Telecommunications Infrastructure of Commercial Buildings

i. ANSI/ICEA S-83-596 – Fiber Optic Premises Distribution Cable
j. BICSI Telecommunications Distribution Methods Manual

1.05 SUBMITTALS

A. As-built drawings (as required per Section 270100 or per attached document “Construction Drawings AS-BUILT Requirements”)

PART 2 – MATERIALS

2.01 COPPER HORIZONTAL CABLING

A. Category 5e, 4-Pair UTP Cabling – For New Installations and Additions/Renovations – Coordinated with UCB OIT
   a. Inside Rated (CM), Blue Sheath Color.
   b. Plenum Rated (CMP), Blue Sheath Color.

B. Category 6 AdvanceNet, 4-Pair Horizontal Cabling – For New Installations by approval from UCB OIT
   a. Inside Rated (CM), Green Sheath Color.
   b. Plenum Rated (CMP), Lime Sheath Color.

C. For Housing Only:
   Category 6 LAN, 4-pair Horizontal Cabling – For New installations with Ccure reader, Video Cameras, Fire, and Health & Safety
   a. Inside Rated (CM), Red Sheath Color.
   b. Plenum Rated (CMP), Red Sheath Color.

D. Category 6A, 4-Pair UTP Cabling – For special data installation by approval from UCB OIT
   a. Inside Rated (CM), White Sheath Color.
   b. Plenum Rated (CMP), White Sheath Color.

2.02 FIBER OPTIC HORIZONTAL CABLING

A. Multimode (50/125) 2-Strand Inside Distribution Cable for Fire Alarm and Andover
   a. Laser Optimized multi-mode, graded-index optical fiber waveguide in accordance with TIA-492AAAC
   b. Core Diameter: 50 ± 2 µm
   c. Cladding Diameter: 125 ± 1.0 µm
   d. Minimum Bandwidth Information Transmission Capacity for Overfilled Launch: 500 MHz-km at 850 nm and 500 MHz-km at 1300 nm
e. Minimum Bandwidth Information Transmission Capacity for LASER Launch using Differential Mode Delay (DMD): 700 MHz-km at 850 nm
f. Maximum fiber loss: 3.5 dB/km @ 850 nm and 1.5 dB/km @ 1300 nm
g. Specifically designed and Manufacturer guaranteed for 10 Gbps Ethernet performance for 150 m distances using serial 850 nm electronics.
h. Riser Rated (OFNR).
i. Plenum Rated (OFNP).

B. Multimode (62.5/125) 2-Strand Inside Distribution Cable
   a. Riser Rated (OFNR): OptiSPEED PVC
   b. Plenum Rated (OFNP): OptiSPEED

2.03 COAXIAL HORIZONTAL CABLING AND CONNECTORS
A. Coaxial RG-6
   a. Inside Rated (CM or CATV).
   b. Plenum Rated (CMP or CATVP).
   c. Connectors used for terminations shall be:
      Thomas and Betts Snap-N-Seal or Stirling SPL – other 360-degree true radial compression connectors will be accepted providing that they meet industry standards. Hex-crimp connectors will not be accepted.

2.04 WORK AREA FACEPLATES
A. Hubbell Modular Flush-Mount Faceplates – For New Installations
   a. Single gang with 6 jack openings (holes)
   b. Designed for use with modular jacks specified
   c. Flat with slots to cover screws and to house white labels and covers
   d. Electrical Ivory color
   e. White color (limited building installations to match existing)
B. Hubbell Blank Covers for Faceplates – For New Installations
   a. Designed to fit jack opening in modular faceplate
   b. Electrical Ivory color
   c. White color (limited building installations to match existing)
C. Surface Housing for Wireless Access Boxes
   a. One-Port for modular outlet jack, Office White Color.
D. Wall Phone Faceplates
   a. Stainless Steel Recessed Plate.
E. Floorbox Outlet Frame.
F. Floorbox Outlet Faceplate (to be used with outlet frame).

2.05 COPPER MODULAR JACKS
A. Category 3, 8-Position, 8-Conductor Jack – For replacement to Match Existing – Coordinated with UCB OIT
   a. T568B wiring
   b. Supports minimum of 750 plug insertions
   c. Designed to fit opening in modular faceplate
   d. Electrical Ivory color
B. Category 5e, 8-Position, 8-Conductor Jack – For New Installations and Additions/Renovations to Match Existing – Coordinated with UCB OIT
   a. Designed to support applications up to 1 Gbps
   b. T568B wiring
   c. Supports minimum of 750 plug insertions
   d. Designed to fit opening in modular faceplate
   e. Gray color for typical voice and data.
f. Green color for all Labs as approved from UCB OIT
C. Category 6A, 8-Position, 8-Conductor Jack – For Special installations as approved from UCB OIT.
   a. Designed to support applications up to 10 Gbps
   b. T568B wiring
   c. Designed to fit opening in modular faceplate
   d. Blue color
D. Category 6A, 8-Position, 8-Conductor Jack – For Special installations as approved from UCB OIT.
   a. Designated to support applications up to 10Gbps
   b. T568B wiring
   c. Designed to fit opening in modular faceplate
   d. White color for special data.

2.06 FIBER ADAPTERS AND CONNECTORS FOR OUTLETS
   A. Multimode SC modular adapter (coupling) to fit faceplate for fiber jacks
   B. Laser Optimized Multimode SC Connector 0.9 mm: for buffered fiber, plus other consumables and kits as required for field termination of fiber optic cable on connectors

2.07 INSTALLATION MATERIALS, EQUIPMENT, AND TOOLS
   A. Furnish all required materials, equipment, and tools necessary to properly complete the horizontal copper, CATV coaxial and fiber optic cabling system installation including, but not limited to: tools for pulling and terminating the cables, mounting hardware, cable ties, bolts, anchors, clamps, hangers, kits of consumables, lubricants, communication devices, stands for cable reels, cable wenches, etc.
   B. Poly line: poly pull line with a minimum pull tensile strength of 200 pounds.

PART 3 - EXECUTION

3.01 INSPECTION
   A. Examine areas and conditions under which horizontal cable is to be installed. Provide notification, in writing, of conditions detrimental to proper completion of the work.
   B. Verify cable routing and termination conditions are as shown on drawings. Provide notification, in writing, of conditions deviating from drawings.
   C. Beginning of horizontal cable installation indicates Contractor acceptance of existing conditions.
   D. Post and comply with: CONSTRUCTION INSPECTION REPORT – VOICE AND DATA COMMUNICATIONS attached to Section 270100.

3.02 HORIZONTAL CABLE INSTALLATION
   A. Install faceplates and copper and fiber jacks at each work area outlet location as indicated on the project drawings. Place the jacks in the faceplates beginning with position A and placing the copper jacks before the CATV coaxial and/or fiber adapter jacks. Place blank covers in the unused openings on each faceplate.
   B. All faceplates shall have a minimum of two cables and jacks with the exception of wall plates (have one drop), wireless access points (have one drop), and Housing dorm rooms (have three drops).
   C. Faceplates shall be secured with mechanical fasteners. Adhesive fasteners shall not be allowed.
   D. Install one surface housing and one Category 5e jack in each wall/hard deck wireless access box.
   E. Install one surface housing and one Category 5e jack outside each ceiling wireless access box with 12 inches of exposed cable outside the conduit.
   F. Install copper and fiber optic horizontal cable from each work area outlet location indicated on the drawings to the nearest TR or ER as indicated on the project drawings.
   G. Perform all horizontal cable installation in conformance with manufacturer’s installation guidelines.
   H. Ensure that maximum pulling tensions of specified cables are not exceeded and cable bends maintain the proper radius during placement.
   I. For outlet locations in walls, floor, and overhead, the horizontal cable distribution design uses conduit or surface raceway to the outlet location with conduit, surface raceway, and/or cable tray in the ceiling space
to the TR or ER. Coordinate as necessary with electrical contractor for placement of horizontal cable pathways and outlet boxes.

J. Horizontal telecommunications cabling shall be placed in dedicated pathways separate from backbone and other cabling.

K. All horizontal cabling terminating within a single faceplate must be routed to and terminated in the same ER or TR.

L. Install new Poly line in all conduits while pulling in new horizontal cables.

M. Ceiling tile shall be removed as necessary for the cable installation and put back in place without damaging or dirtying any of the tiles or supporting framework. Ceiling tile shall be handled with clean hands so that no fingerprints or marks are left on the tiles. The contractor is responsible for the cost of repair or replacement of any damaged or dirtied tiles or ceiling hardware.

N. For cable penetration of ceiling tiles, the holes must be placed along the ceiling tile edge.

O. All cables in the ceiling space:
   a. shall be supported in conduit or in the cable tray and shall not droop or hang outside of cable tray;
   b. shall not be run “wild” (unsupported by conduit or cable tray) for distances greater than six inches;
   c. shall not be attached to the suspended ceiling structure or laid directly on the ceiling grid as a means of support;
   d. shall not be supported by or attached by any means to fire sprinkler heads or delivery systems, any environmental sensor, or the exterior of any conduit or raceway;
   e. shall be routed at right angles to the electrical power circuits where the cable is not enclosed in conduit or in cable tray.

P. Where specifically allowed by UCB OIT, cable hangers shall be specifically designed and installed for the purpose of supporting telecommunications cables. The hangers shall be attached to the building structure and framework at a maximum of five-foot intervals. Existing bridle rings may be left in place to support existing cables that are not removed. Bridle rings shall not be used to support new cables.

Q. All cables in the ceiling space and cable tray shall be bundled with plenum rated Velcro cable ties snug, but not deforming the cable geometry. Cable bundles shall have no more than 32 cables per bundle.

R. The total length of any horizontal station cable from the jack location to the termination block shall not exceed 90 meters.

S. Maintain the following clearances from EMI sources:
   a. Unshielded power lines or equipment less than or equal to 5 kVA near cable in open or non-metal pathway: 12”
   b. Unshielded power lines or equipment greater than 5 kVA near cable in open or non-metal pathway: 24”
   c. Unshielded power lines or equipment less than or equal to 5 kVA near cable in grounded metal pathway: 6”
   d. Unshielded power lines or equipment greater than 5 kVA near cable in grounded metal pathway: 12”
   e. Power lines enclosed in grounded metal conduit less than or equal to 5 kVA near cable in grounded metal pathway: 3”
   f. Power lines enclosed in grounded metal conduit greater than 5 kVA near cable in grounded metal pathway: 6”
   g. Fluorescent fixtures near cable in open or non-metal pathway: 12”
   h. Fluorescent fixtures near cable in grounded metal conduit: 6”
   i. Motors or transformers near cable in non-metal pathway: 48”
   j. Motors or transformers near cable in grounded metal pathway: 36”

T. Manage slack to avoid excess cable or kinking.

U. Cable shall not be exposed along route.

V. Do not splice or bridge tap the cable.
W. All cables shall be tied and dressed neatly with a minimum bend radius of 10 times the cable diameter. Provide necessary hardware to maintain proper bend radius at corners.

X. All cables shall be firmly held in place. Fastenings and supports shall be adequate to support loads with ample safety factors.

Y. All ladders used for cable installation shall be padded on both ends and shall be carried by two people when moved within the building.

Z. Failure to follow appropriate guidelines for cable installation will require the Contractor to provide, in a timely fashion, the additional material and labor necessary to rectify the situation. This shall apply to any and all damages sustained to the cables during installation.

AA. The Contractor shall be responsible for all damage to the cable during placement.

BB. Cables with jackets that are chaffed or burned exposing internal conductor insulation or have any bare copper (shiners) shall be replaced.

CC. Do not roll or store cable reels without an appropriate underlay.

DD. Neatly and permanently label all horizontal cables with the cable number at both ends.

EE. Firestop all sleeves and conduit openings after the cable installation is complete.

FF. Test, label, and document final horizontal cable installation including outlet numbering on as-built drawings.

GG. Remove existing cable and terminations that will no longer be used as specified and shown on project drawings. Coordinate as necessary with electrical contractor for removal of existing horizontal cable pathways and outlet boxes.

HH. All wireless box installations shall comply with the “Wireless Security Box Instructions” attached to the end of Section 270528.

3.03 COPPER CABLE TERMINATION

A. At the work area outlet, terminate all pairs of the each copper horizontal cable on the jack with TIA T568B pin-pair assignments.

B. Terminate all pairs of each copper horizontal cable on patch panels or new 66-type connecting blocks with only 3 pair terminated in most existing terminals on 66-type connects. Match existing termination practice for 66-type installation unless prints note differently.

C. All cables shall be terminated so as not to pull tight on the terminating equipment.

D. Do not untwist cable pairs more than 0.5 inches when terminating.

3.04 INSIDE FIBER OPTIC HORIZONTAL CABLELING

A. Perform termination of multimode horizontal fiber strands on SC connectors at each end with loss \( \leq 0.5 \) dB at 850 nm.

B. At the work area outlet, place two SC connectors with terminated fiber cable strands in the two SC adapter jacks in the faceplate.

C. In the TR or ER, place the two SC connectors with terminated fiber cable strands in the SC adapters in the termination shelf.

D. All cables shall be terminated so as not to pull tight on the terminating equipment.

3.05 COAXIAL HORIZONTAL CABLELING

A. All drops are to be home-run from the distribution tap to the face plate with no drop splitters or amplifiers to be used. Variations of this requirement requires express written approval from the UCB CATV group.

B. Drop connectors shall be compression type as listed in the previous section “Part 2 - Products” above. “Hex-crimp” connectors are not allowed.

C. Connector type is to be determined by the cable type being terminated.

3.06 AS-BUILT DRAWINGS

A. Mark the project drawings with notations reflecting actual cable outlet numbering and any variations from the base specifications and drawings.

B. Comply with Construction Drawings AS-BUILT Requirements attached to Section 270100.
## APPENDIX FOR EQUIPMENT SCHEDULE:

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<thead>
<tr>
<th>Line</th>
<th>Description</th>
<th>Manufacturer</th>
<th>Part Number</th>
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<tr>
<td>1</td>
<td>Category 5e, 200MHz 4-Pr UTP Ca-Inside Rated</td>
<td>Mohawk</td>
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<td>Category 5e, 200MHz 4-Pr UTP Ca-Plenum Rated</td>
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<td>Category 6, 650MHz 4-Pr Horizontal Ca –Inside Rated</td>
<td>Mohawk</td>
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<td>Mohawk</td>
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<td>Systimax</td>
<td>R-002-DS-5M-FSUAQ</td>
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<td>Systimax</td>
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<td>Coaxial RG-6 – Inside Rated</td>
<td>Times Fiber</td>
<td>2360V</td>
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<td>12</td>
<td>Coaxial RG-6 – Plenum Rated</td>
<td>Commscope</td>
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<td>6 gang Modular Flush-Mount Faceplates – electric ivory</td>
<td>Hubbell</td>
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<td>6 gang Modular Flush-Mount Faceplates – white</td>
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<td>IFP16W</td>
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<td>Blank Covers for Faceplates – electric ivory</td>
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<td>F-connector Faceplate pass-through – electric ivory</td>
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<td>SFFEX</td>
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<td>F-connector Faceplate pass-through – white</td>
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<td>SFFWX</td>
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<td>Surface Housing for Wireless Access Boxes</td>
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<td>Wall Phone Faceplates – Stainless steel</td>
<td>Hubbell</td>
<td>P630SR11GJ8</td>
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<td>Floorbox Outlet Frame</td>
<td>Hubbell</td>
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<td>Floorbox Outlet Faceplate (to be used with outlet frame)</td>
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<td>Category 3, 8-Position, 8-Conductor Jack</td>
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<td>HXJ5EGY</td>
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<td>HXJ5EGN</td>
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<td>Multimode SC modular adapter (coupling)</td>
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<td>Laser Optimized Multimode SC Connector 0.9 mm</td>
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<td>P6201A-Z-125</td>
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<td>Category 6A, 4-Pair UTP Cabling – Plenum Rated</td>
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END OF SECTION 27 15 00
SECTION 27 17 00
TESTING, IDENTIFICATION AND ADMINISTRATION

PART 1 – GENERAL

1.01 RELATED DOCUMENTS
   A. Drawings, Contract Forms, and Conditions of the Contract, including Construction Manager/General
      Contractor (CM/GC) Agreement including Exhibits and other Division 1 Specification Sections, apply to
      this section

1.02 SCOPE OF WORK
   A. Provide all services, labor, materials, tools, and equipment required for complete and proper testing,
      certification, identification, and administration of the installed telecommunications cabling as called for in
      these specifications and related drawings.
   B. This section includes minimum requirements and installation methods for the following:
      a. Copper Cable Testing and Testers
      b. Fiber Optic Cable Testing and Testers
      c. Labels and Labeling
      d. Documentation

1.03 QUALITY ASSURANCE
   A. All testing procedures and testers shall comply with applicable requirements of:
      a. ANSI/TIA-568-C.0 – Generic Telecommunications Cabling for Customer Premises
      b. ANSI/TIA-568-C.1 – Commercial Building Telecommunications Cabling Standard
      c. ANSI/TIA-568-B.2 – Commercial Building Telecommunications Cabling Standard – Part 2:
         Balanced Twisted-Pair Cabling Components, including applicable addendum
      d. ANSI/TIA-568-C.3 – Optical Fiber Cabling Components Standard
      e. TIA-455 Series – Fiber Optic Test Procedures
      f. TIA-526 Series – Optic Fiber Systems Test Procedures
      g. TSB 140-04 – Additional Guidelines for Field-Testing Length, Loss and Polarity of Optical Fiber
         Cabling Systems
   B. Identification and administration work shall comply with applicable requirements of:
      a. ANSI/TIA-568-C.0 – Generic Telecommunications Cabling for Customer Premises
      b. ANSI/TIA-568-C.1 – Commercial Building Telecommunications Cabling Standard
      c. ANSI/TIA-568-B.2 – Commercial Building Telecommunications Cabling Standard – Part 2:
         Balanced Twisted-Pair Cabling Components, including applicable addendum
      d. ANSI/TIA-568-C.3 – Optical Fiber Cabling Components Standard
      e. ANSI/TIA-569-A – Commercial Building Standard for Telecommunications Pathways and
         Spaces
      f. ANSI/TIA-598-A – Optical Fiber Cable Color Coding
      g. ANSI/TIA-606 – Administration Standard for Telecommunications Infrastructure of Commercial
         Buildings
      h. BICSI Telecommunications Distribution Methods Manual
      i. UCB OIT Standards for Identification and Administration

1.04 SUBMITTALS
   A. Test reports (including fiber pre-test sheets)
   B. As-built drawings
   C. The Consultant shall submit the proposed outlet numbers, using the T-5 template provided by OIT, for
      review and approval prior to construction.

PART 2 – MATERIALS
2.01 COPPER CABLE TESTERS
A. Test equipment and field test instruments shall meet requirements for ANSI/TIA-568-B.2 Annex B and Annex I.
B. Physical interface shall be modular RJ-45 connector and a serial port with DB-9 connector.
C. Store test results including date stamp of tests and UCB jack designator for each tested link.
D. Print test results in report form when connected to a PC.
E. Have auto-testing to determine if cable meets requirements of ANSI/TIA-568-B.2 Annex B and Annex I, 10Base-T, Fast Ethernet, Gigabit Ethernet, and ATM standards.
F. Measure NEXT for all pair combinations and Attenuation on all pairs from 1.0 to 350 MHz.

2.02 OPTICAL FIBER CABLE TESTERS
A. Field test instruments for multimode fiber cabling shall meet the requirements of ANSI/TIA/EIA-526-14-A.
B. Field test instruments for singlemode fiber cabling shall meet the requirements of ANSI/TIA/EIA-526-7.
C. Multimode Light Source
   a. Meet the launch requirements of ANSI/TIA-455-78B achieved within the field test equipment or by use of an external mandrel wrap (as described in clause 6.4 of ANSI/TIA-568-C.0) with a Category 1 light source.
   b. Provide stabilized 850 nm and 1300 nm +/- 20 nm wavelength LED light source
   c. Spectral width of sources shall be \( \leq 50 \) nm of 850 nm wavelengths and \( \leq 140 \) nm for 1300 nm wavelengths
   d. Output of light source shall be 8 MW for 62.5 or 50 \( \mu \)m core optical fiber as appropriate
   e. Output stability +/- 0.40 dB from 0 to 50 degrees C
   f. Long term output stability +/- 0.10 dB at 25 degrees C
   g. Connector types shall include: ST and SC
D. Singlemode Light Source
   a. Provide stabilized 1310 nm and 1500 nm +/- 20 nm wavelength Laser light source
   b. Output stability +/- 0.40 dB from 0 to 50 degrees C
   c. Long term output stability +/- 0.10 dB at 25 degrees C
   d. Connector types shall be ST
E. Optical Power Meter
   a. Calibrated against National Institute of Standards and Technology (NIST) standard.
   b. Provide 850 nm, and 1300 nm +/- 20 nm selectable wavelength test capability
   c. Measurement range from 10 to –60 dBm
   d. Accuracy +/- 5% at 0 to 50 dBm
   e. Accuracy +/- 10% 10 to 0 dBm and –50 to –60 dBm
   f. Resolution 0.01 dB
   g. Connector types shall include: ST and SC
F. Optical Time Domain Reflectometer (OTDR)
   a. Dual selectable wavelength: 850/1300 nm for multimode
   b. Dual selectable wavelength: 1310/1550 nm for singlemode
   c. Selectable Cable Index of Refraction
   d. Visual fault locator for continuity checks and dead zone fault location
   e. Front display and printer connection for hard-copy documentation
   f. Equipped with launch jumper cable of sufficient length to offset entry “dead zone”
   g. Connector types shall include: ST and SC

2.03 LABELS
A. Faceplate labels shall be printed and supplied by the Contractor with a Dymo Electronic Labelmaker 5000 or equivalent with prior approval from UCB OIT.
B. The one page Copper Termination sheet and Fiber Termination Labels will be provided by UCB OIT and installed by the Contractor. All additional labels needed shall be supplied and installed by the Contractor. Replacement sheets and labels will be provided to the Contractor at an additional cost.

C. Labels for cable marking: vinyl substrate with a white printing area and a clear “tail” that self laminates the printed area when wrapped around the cable. If cable jacket is white, provide cable label with printing area that is any other color than white, preferably orange or yellow - so that the labels are easily distinguishable.

D. Pre-printed labels shall meet legibility, defacement, exposure and adhesion requirements of UL 969.

E. Hand written labels are not allowed.

F. Cable ID tags

PART 3 - EXECUTION

3.01 COPPER CABLE TESTING

A. Test 100% of installed backbone copper cabling for:
   a. Wire Map
   b. Length

B. Perform the following Permanent Link tests for 100% of installed copper horizontal cabling as described in ANSI/TIA-568-C.1, Section 6.3 and ANSI/TIA-568-B.2, Annex E:
   a. Wire Map
   b. Length
   c. Insertion Loss
   d. Pair-To-Pair NEXT Loss
   e. Propagation Delay
   f. Delay Skew

C. Perform the following Permanent Link tests for 100% of installed Category 5e and Category 6 horizontal copper cabling as described in ANSI/TIA-568-C.0, Section 6.3 and ANSI/TIA-568-B.2 Annex E:
   a. PSNEXT Loss
   b. Pair-To-Pair ELFEXT
   c. PSELFEXT
   d. Return Loss

D. Cross-connects from horizontal to backbone cabling will not be in place for these tests.

E. The wire map test shall verify pair to pin termination at each end and check for connectivity errors. The wire map shall indicate the following for each of the eight conductors:
   a. Continuity to the remote end
   b. Shorts between any two or more conductors
   c. Reversed pairs
   d. Split pairs
   e. Transposed pairs
   f. Any other miswiring

F. The maximum length of the permanent link for horizontal cable shall be 90 meters. Shorten any cable runs as required at no additional cost to UCB.

G. Replace and or repair cable and terminations as necessary to assure 100% passing performance specifications.

H. Final testing shall be scheduled and conducted in the presence of the UCB OIT representative as specified in Section 270100.

I. Submit electronic and printed test results reports for each copper cabling permanent link to UCB before project is closed.

3.02 OPTICAL FIBER CABLE TESTING
A. Test all fiber optic cable strands for continuity and performance before and after the cables are pulled and terminated.
B. Test link attenuation of all installed multimode fiber optic strands after splicing and termination in accordance with ANSI/TIA-568-C.0, Section 6.4 and Annex E, and TSB-140.
   a. One direction with an optical light source and an optical power meter.
   b. Test at two wavelengths to account for attenuation differences due to wavelength:
      i. 850 nm and 1300 nm for multimode strands
      ii. 1310 nm and 1550 nm for singlemode strands
   c. Test multimode strands in accordance with TIA-526-14-A, Method B, One Reference Jumper.
   d. For multimode strands, wrap reference jumper around mandrel to remove high-order mode transient losses as specified in ANSI/TIA-568-C.0, Section 6.4, Table 3.
   e. Test Singlemode strands in accordance with TIA-526-7, Method A.1, One Reference Jumper.
   f. The total attenuation budget for each fiber cable length (end-to-end) shall equal the allowed attenuation for the fiber (0.2 dB per km times the length in km) plus the attenuation for each splice and connector. For example, a cable length of 3 km with 1 splice and 2 connectors would have an attenuation budget of (3 km x 0.2 dB/km) + (2 x 0.2 dB) = 1.2 dB.
C. Test all installed fiber optic strands after splicing and termination with an OTDR (Optical Time-Domain Reflectometer) per TIA-455-61 and TSB-140:
   a. End-to-end bi-directional signature trace with fault finding, connection point reflections, fiber bend, pressure point locations, etc.
   b. One wavelength, 1300 nm for multimode strands.
   c. One wavelength, 1550 nm for singlemode strands.
   d. Multimode fiber connector losses ≤ 0.5 dB at 850 nm
   e. Singlemode fiber connector losses ≤ 0.2 dB at 1310 nm
   f. Multimode fiber splice losses ≤ 0.3 dB at 850 nm
   g. Singlemode fiber splice losses ≤ 0.2 dB at 1310 nm
   h. Localized attenuation shall not exceed 0.5 dB at any point
D. Fibers that are broken or damaged shall be replaced at no cost to UCB and replaced fiber optic cables shall be re-tested.
E. Final testing shall be scheduled and conducted in the presence of the UCB OIT representative as specified in Section 270100, 1.7. Complete and submit the fiber pre-test sheet prior to scheduling the final testing. The fiber pre-test sheet is attached to the end of this Section.
F. Submit electronic and printed OTDR test results reports for each fiber optic cable strand to UCB before project is closed.

3.03 HORIZONTAL CABLE IDENTIFICATION AND LABELING:
A. Neatly and permanently label all copper and fiber optic cables with the cable number at both ends.
B. The UCB standard outlet numbering plan to be used for labeling faceplates, 66-blocks, patch panels, and fiber terminations is described in the attached document Labeling and Testing.
C. The identification and labeling for all copper and fiber optic cables and TR/ER terminations shall be clearly labeled and approved by UCB OIT 3 weeks prior to customer move occupancy.

3.04 AS-BUILT DRAWINGS
A. Mark the project drawings with notations reflecting any variations from the base specifications and drawings including as-built numbering for the outlets on the floorplans.
B. Comply with Construction Drawings AS-BUILT Requirements attached to Section 270100.
APPENDIX FOR EQUIPMENT SCHEDULE:

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<thead>
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END OF SECTION 27 17 00
Labeling and Testing

**Base:** The base section is just an introduction of the numbering of work-area outlets at the UCB (University of Colorado at Boulder). Although UCB numbers the work-area outlets in the database and expects this on the “Jack Position Sheet,” not all information is always applied (i.e. on work-area outlet). The numbering will include:

1) Communication room number.
2) Block or rack & panel. For CATV, this will indicate distribution tap number by showing tap number followed by the suffix “tv”. – See attachment 1.
3) Position on the block or panel.
4) Work-area jack associated to the outlet letters A through F.
5) Medium.
   a. C3 = category 3
   b. 5E = category 5e
   c. C6 = category 6 – 550 MHz
   d. 6E= category 6e - 650 MHz
   e. 6A= Augmented category 6 - 750 MHz
   f. TV = cable television
   g. M5 = multimode 50/125 micron.
   h. M6 = multimode 62.5/125 micron.
   i. S = singlemode
6) Block or rack & panel.
7) Position on the block or panel.
8) Ownership information for specific types of outlets when applicable.

*See Attachment #1 for sample.*

Note numbers 1, 2, and 3 are all the same per each jack within an outlet for A through F.

**Work-Area Outlet:** The work-area outlet number will include:

1) Ownership information if applicable
2) Communication room number.
3) Block or rack & panel.
4) Position on the block or panel.

This information is taken from the station wire in the A position of the work-area outlet and this is the only number on the work-area outlet (i.e. 210 – 1 – 2 or 210-1D-20).
Labeling and Testing

See Attachment #2 for sample.

Note: *Use Dymo Electronic Labelmaker 5000 (or equivalent) to print labels.
*Hand-written labels are not allowed.

66 Block: The 66 blocks have the following labeling:

**Used for all Location**

1) The left ear of each 66 block will be labeled with the block and wiring field letter designation (i.e. A1 or B1, A2 or B2). The ‘1’ or ‘2’ indicates the block number & ‘A’ indicates voice field Cat 3 & ‘B’ would indicate data field Cat 3. Other tags may be ‘U’ for utility and ‘T’ for tie.

**Used in Main Location with category 3**

2) On the left side of a 66 block in the MAIN, the station blocks are labeled with the first pair (w/b) of all station wire and the communication room number. An ‘L’ is used in the block and position to indicate the left side (i.e. 1L-1A), “RM” for room, and the room number the work-area outlet is located in. Work all the way down the left side 1L-1A to 1L-8A, 2L-1A to 2L-8A, etc., before starting the right side. If a Cat 3 cable does not go to the A position on the work-area outlet then label the 66 block appropriately (i.e. 1L-1A, 1L-1B, 1L-1C, 1L-1D, etc.).

**Used in Main Location with category 3**

3) On the right side of the 66 blocks in the MAIN, the station cable blocks are labeled the same but using R in the block and position to indicate the right side and the work-area jack position [A-F] (i.e. 1R-1A), “RM” for room and the room number the work-area outlet is located in. Work all the way down the right side 1R-1A to 1R-8A, 2R-1A to 2R-8A, etc. Again, if a Cat 3 cable does not go to the A position on the work-area outlet then label the 66 block appropriately (i.e. 1R-1A, 1R-1B, 1R-1C, 1R-1D, etc.).

**Used in Main Location with category 3 and in TR (Telecommunications Room) for category 3 riser with category 6 on patch panels (known as jack is a jack).**

4) All riser cable will have the riser count on the block for the correct cable pair number, starting with the first pair number and every third pair (i.e. 1, 4, 7, 10, 13, 16, 19 and 22). Count will start on the top left working down towards the bottom and then to the right side of the first block and down towards the bottom of each row.
Labeling and Testing

See Attachment #3 for sample.

Used in TR Location with category 3

1) The left ear of each 66 block will be labeled with the block and wiring field letter designation (i.e. A1 or B1, A2 or B2). The ‘1’ or ‘2’ indicates the block number & ‘A’ indicates voice field Cat 3 & ‘B’ would indicate data field Cat 3. Other tags may be ‘U’ for utility and ‘T’ for tie).

Used in TR Location with category 3

2) All riser cable is punched down only on the left side and will have the riser count on the block for the correct cable pair number starting with the first pair number & every third pair afterwards (i.e. 1, 4, 7, 10, 13, 16, 19, and 22).

Used in TR Location with category 3

3) On the right side of the 66 blocks the station cables are labeled at the first pair (w/b) of all station wires with the communication room. The block number and the position and the jack position [A-F] (i.e. 1 – 1A), “RM” for room & the room number the work-area outlet is located in. Work from top to bottom and from left to right. If a Cat 3 cable does not go to the A position on the work-area outlet then label the 66 block appropriately (i.e. 1-1A, 1-1B, 1-1C, 1-1D, etc.).

Used in TR (Telecommunications Room) for category 3 riser with category 6 on patch panels (known as jack is a jack).

4) All riser cable will have the riser count on the block for the correct cable pair number, starting with the first pair number and every third pair (i.e. 1, 4, 7, 10, 13, 16, 19 and 22). Count will start on the top left working down towards the bottom and then to the right side of the first block and down towards the bottom of each row.

See Attachment #4 for sample.

Patch Panel:  Patch panels are numbered by the number that is on the work-area outlet followed by the jack association letter, but the communication room number is not on the patch panels. Each panel is labeled with:

1) A letter that reflects its position on the rack.

2) The block or rack and panel of the station cable that is in the A position of the work-area outlet.
Labeling and Testing

3) The position on block or panel of the station cable that is in the A position of the work-area outlet.

4) The letter designation of the jack where this station wire lands in the work-area outlet (i.e. A – F).

5) The “RM” with the room number that the work-area outlet is located in.

See Attachment #5 for sample.

Note: *Use Dymo Electronic Label-maker 5000 (or equivalent) to print labels.

*Hand-written labels are not allowed.

Krone Block: Krone blocks should be numbered and terminated left to right per block and left to right per rack. The numbering is similar to the patch panel layout.

300-Pair 4-Pair Color Coded Kit

1) The cable ID and pair count is listed for each pair.

8 Pair Ultim8 Blocks

1) Each block is labeled with the block number and the Riser ID with the pair count on the top label of the 8 pair Ultim8 blocks.

2) Label each 8 pair Ultim8 block on the front of the top row, as follows:
   a) Block or rack and panel of the station cable that is in the A position of the work-area outlet.
   b) Position on block or panel of the station cable that is in the A position of the work-area outlet.
   c) The letter designation of the jack where this station wire lands in the work-area outlet (i.e. A – F).
   d) “RM” with the room number that the work-area outlet is located in.

See Attachment #6 for sample.

(All labels for Krone sold separately!)

110 Block: 110 Blocks are numbered per 100 pair on the square next to the first row of each 100 pair.

See Attachment #8 for sample.

1) Jack ID numbering is similar to the patch panel
   a) Each station cable will get all 4-pairs terminated and will be labeled Block #, Position # 1-6 per row and up to 24 per block, and room # jack is in the “A” position.
Labeling and Testing

b) If a cable is added to an existing outlet, the cable ID in the TR will need to reflect the faceplate “A” position and faceplate position being added. Example: 1-1B, 1-1C, 1-1D, 1-1E or 1-1F.

2) Riser or tie cable shall be labeled every 5th pair and marking the first pair of each 25 pair group.

See Attachment #9 for sample.

3) When 110 hardware is used, jacks are not dedicated to a riser count. A cross connect is necessary to connect from a riser pair to a jack.

Jack Position Sheets: All projects need to include an as-built Jack Position Sheet, to be given to the OIT Telecom project manager. The Jack Position sheet will need to include the numbers assigned to it from the print, the room number from the prints and all fields of data for each station wire (i.e. 177 – 1 – 1 AC3 – 1 – 1

177 – 1 – 1 BC6 – 1D – 2).

The electronic file of T-5 template.xls is the required Jack Position Sheet to be used and should be received from OIT department prior to construction.

See Attachment #7 for sample.

Protectors: The cable count and pairs are labeled on each protector (i.e. 11, 1 – 100 broken out for each protector).

Riser Copper Sheet: The MAIN will have a master list for all the riser pairs and each TR will have the riser count for that room. This is a 24” x 36” CAD print known as the Copper Sheet.

All Cables: All exposed cables need to be labeled with cable type, cable ID, and count before & after every splice, when leaving or entering the building & in communication rooms, tunnels, and all man holes or hand holes.

CATV coax label: The labeling on the coax in the terminal room at the distribution tap needs to be printed as a two- line label. Line 1 will show jack number, followed by room number (where jack is located). Line 2 will show CATV tap information.

Example: 135 – 1D – 8 Rm 271

135 – 1tv-1
Labeling and Testing

JACK NUMBERING PLAN

OUTLET # DATABASE INFORMATION ONLY
- *135-1D-8A5E
- *135-1D-8B5E-1A-16
- *135-1D-8CTV-1Tv-1
- *135-1D-8D
- *135-1D-8E5M-1D-22
- *135-1D-8F5M-1D-23

CLOSET

BLOCK OR RACK & PANEL

BLOCK OR PANEL POS.

OUTLET POSITION

MEDIA TYPE

BLOCK OR RACK & PANEL

BLOCK OR PANEL POSITION

* OWNERSHIP INFORMATION = THE LABELING OF OUTLETS FOR ALLIANCE NETWORK, LABS AND QWEST JACKS SHALL INCLUDE THE FOLLOWING PREFIXES BEFORE THE CLOSET NUMBER ON THE OUTLET:

AN = ALLIANCE NETWORK

LN = LABS

QW = QWEST

ATTACHMENT #1

jkplan-08.dwg
Labeling and Testing

TYPICAL JACK EXAMPLES

PHONE JACK LABELING INFORMATION - THE LABELING OR OUTLET FOR
RECEIVED NETWORK LINKS ARE DEPENDENT SHALL INCLUDE THE
NETWORK NAME, LINK ID THE LINK NUMBER ON THE OUTLET.
- = ALLIANcE NETWORK
LP = LAN
PR = PON
- = DEPEND

TELEPHONE PRODUCTION FACEPLATE

NOT TO SCALE

TELEPHONE FACEPLATE DRAWING NOTES

1. THE PLAN COVER THIS ALL TELEPHONE JACKS, PHONE JACKS ARE
HIM POSITIONED TO RECEIVE A TELEPHONE ROUTING NUMBER AND
RECEIVED PREPARED FOR THE PRODUCTION TO BE CHANGED.

2. WHEN THE ROUTER IS CHANGED THE TERMINAL EQUIPMENT IS LABELED
WITH THE ROUTER NAME THE FACEPLATE POSITION EXAMPLE: 10-11-14 3-14-14 11-14.

3. FACADES SHALL BE LABELED PER STANDARD NUMBER ON
PLACED PER SITE TO SHOW THAT THE FACADE NUMBER IS
CHANGING EXAMPLE: 100-100-1-1 1 120-10-1.

ATTACHMENT #2

jkplan-09.dwg
Labeling and Testing

EXAMPLE: The position is used for a wall jack.

EXAMPLE: The position is used for a card reader.

EXAMPLE: The position is not used when single data cabling is installed.

EXAMPLE: The position is not used when single data cabling is installed.

This is an Example of how to lay the block so that the pendant is not located in single voice cable.

EXAMPLE: The position is used for a card reader.
Labeling and Testing

KRONE

FIRST PAIR ON BLOCK
LAST PAIR AND TOTAL COUNT FOR BLOCK

BLOCK 1 XXX
XXXXXXXXXXXX

XXX

B. PAIR ULTIM8 BLOCKS
NOT TO SCALE

300 PAIR 4 PAIR COLOR CODED KIT
NOT TO SCALE

ATTACHMENT #6
Information Provided
## Labeling and Testing

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Labeling and Testing

110 BLOCK JACK LABELING EXAMPLE.

ATTACHMENT #8
110 BLOCK JACK LABELING EXAMPLE
Labeling and Testing

110 BLOCK RISER/TIE CABLE LABELING EXAMPLE.

ATTACHMENT #9

110 BLOCK RISER-TIE LABELING EXAMPLE.dwg
Labeling and Testing

Prior to Test, Check List

1. For all new fiber installs:
   a. Fiber labels
   b. Numbers on 10A/1000ST panels
   c. Single mode panels painted \textit{YELLOW}
   d. Racks, shelves and panels properly lettered
   e. Coils permanently mounted
   f. Floor cleaned-up and trash emptied

2. Testing day:
   a. Keys for terminals
   b. Communication devices for testing purposes
   c. Working test equipment
   d. Two knowledgeable testers & OIT Rep.

Note: If all above mentioned items are not completed, you are not ready to test.
Labeling and Testing

Check List (Fiber)

1. For all fiber upgrades and installs:
   a. Place all labels in terminals affected
   b. Label racks, shelves and patch panels correctly
   c. Place cable tags as specified in this document
   d. Place numbers to the left on the 1000 ST panels
   e. Place coupler grooves to the top when installing
   f. Single Mode panels ONLY to be painted YELLOW
   g. Mount fiber coils permanently per print
   h. Clean terminal and empty trash

2. Test Day Bring:
   a. Keys for the terminals
   b. Communication devises for testing purposes
   c. Working test equipment
   d. Two knowledgeable testers and an OIT Rep will meet you at the location

NOTE: If all the above-mentioned items are not completed, you are not ready to test!
Labeling and Testing

**Check List (Copper)**

1. For all copper upgrades and installs:
   a. Place all new copper sheets in terminals affected
   b. Label racks, shelves and patch panels correctly
   c. Place clear plastic covers on all 66 blocks
   d. 66 blocks numbered correctly
   e. Clean terminal and empty trash
   f. Pre-test completed?

2. Test Day Bring:
   a. Keys for the terminals
   b. Communication devises for testing purposes
   c. Working test equipment
   d. Two knowledgeable testers and an OIT Rep will meet you at the location

NOTE: If all the above-mentioned items are not completed, you are not ready to test!
# Labeling and Testing

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**Comments:**

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**Specifications for Single Mode Fiber:** .2 per ST; .2 per km; .2 per splice

**Specifications for Multi Mode Fiber:** .5 per ST; .5 per km; .5 per splice

**Specifications for Single Mode Riser Fiber:** 1.0

**Specifications for Multi Mode Riser Fiber:** 2.0
SECTION 27 20 00
DATA COMMUNICATIONS

PART 1 – GENERAL

1.01 RELATED DOCUMENTS
A. Drawings, Contract Forms, and Conditions of the Contract, including Construction Manager/General Contractor (CM/GC) Agreement including Exhibits and other Division 1 Specification Sections, apply to this section.

1.02 SCOPE OF WORK
A. The work covered by this Division consists of furnishing all services, accessories, connectors, supports, electrical protection, equipment, tools, setup, preparation, labor, supervision, incidentals, transportation, storage, and related items and appurtenances, and performing all operations necessary to complete the Data Communications system work as indicated in the project drawings and specified herein. UCB Information Technology Services will supply the Data Communications devices required for this project.
B. It is the intent and purpose of this specification to have, upon completion of the project, a “turn-key” Data Communications system that is designed, built, coordinated and integrated as necessary with the existing telecommunications infrastructure (e.g. existing data network elements) and complete and operable in all respects. Completely install, connect, and test all systems, equipment, devices, etc., shown or noted or required to final connections and leave ready for satisfactory operation. Provide any minor items omitted from the design, but obviously necessary to accomplish the above intent.
C. All work shall be conducted in coordination with the UCB Information Technology Services and other building trades.
D. All data communication system designs for UCB buildings on and off campus must be approved by the UCB OIT department for standard and design structure. Any design outside of these standards must be approved and include a written agreement for the design from the UCB OIT department.
E. The project supplies funds for the networking equipment and the equipment is owner supplied. The equipment consists of routers, firewalls, switches, and access points.

1.03 QUALITY ASSURANCE, REGULATIONS AND CODE COMPLIANCE
A. All installation work shall be performed in a neat and workmanlike manner. All methods of construction that are not specifically described or indicated shall be subject to the control of UCB.
B. Materials and work specified herein shall comply with the applicable requirements of:
a. ANSI/NFPA 70 – National Electrical Code (NEC) Articles 250, 300, and 645
b. ANSI/TIA-568-C.0 – Generic Telecommunications Cabling for Customer Premises
c. ANSI/TIA-568-C.1 – Commercial Building Telecommunications Cabling Standard
d. ANSI/TIA-568-B.2 – Commercial Building Telecommunications Cabling Standard – Part 2: Balanced Twisted-Pair Cabling Components, including applicable addendum
e. ANSI/TIA-568-C.3 – Optical Fiber Cabling Components Standard
f. ANSI/TIA-569-B – Commercial Building Standard for Telecommunications Pathways and Spaces
g. ANSI/TIA-604 Series – Fiber Optic Connector Intermateability Standards
h. ANSI/TIA-606 – Administration Standard for Telecommunications Infrastructure of Commercial Buildings
i. Americans with Disabilities Act (ADA)
j. UCB Standards
C. References to regulations, codes, and standards mean the latest edition, amendment and revisions to the regulations, codes and standards in effect on the date of the Contract Documents.
D. All work and materials shall conform to and be installed, inspected, and tested in accordance with the governing rules and regulations of federal, state, and local government agencies.
E. All modifications required by the referenced codes, rules, regulations, and authorities shall be made by the Contractor without additional charge to UCB.
F. Report immediately to UCB OIT personnel and/or the Consultant/Engineer, in writing, any part of the data communications design which does not conform to the requirements of these codes or regulations, or otherwise be held responsible to provide and install material which will comply with these codes and regulations.
G. Applicable codes and ordinances and local interpretations take precedence when they conflict with or are more stringent than the data communications design. Drawings and specifications take precedence where design is more stringent than codes and ordinances.

PART 2 – MATERIALS

The project supplies funds for the data communications equipment and the equipment is owner supplied. The data communications equipment consists of routers, firewalls, switches, and access points. All other materials necessary for the installation of the data communications system are to be provided by the Contractor.

2.01 EQUIPMENT AND MATERIALS MINIMUM REQUIREMENTS
A. All materials and equipment shall be new, free from defects, installed in accordance with manufacturer’s current published recommendations in a neat manner and in accordance with standard practices of the industry.
B. Where no specific material, apparatus, or appliance is mentioned, any standard, first-class product made by reputable manufacturer regularly engaged in the production of such material may be used providing it conforms to the contract requirements and meets the approval of UCB OIT Personnel and/or the Consultant/Engineer.
C. Materials shall meet or exceed the following minimum requirements:
   a. Where applicable, all materials and equipment shall bear the label and listing of UL. Application and installation of all listed equipment and materials shall be in accordance with such labeling and listing.
   b. Equipment shall meet all applicable FCC regulations.
   c. Electrical equipment and systems shall meet UL standards and requirements of the NEC. This listing requirement applies to the entire assembly. Any modifications to equipment to suit the intent of the specifications shall be performed in accordance with these requirements.
   d. Materials and equipment shall bear the manufacturer’s name or trademark and model/serial number permanently marked.

2.02 CABLES
A. All UTP cable inside the building shall be UL listed and marked type CM, CMR, or CMP and shall be installed in accordance with NEC articles 300-22, 800-49, 800-50, 800-51, 800-52, and 800-53.
B. All fiber optic cable inside the building shall be UL listed and marked type OFN, OFNR, or OFNP and shall be installed in accordance with NEC articles 300-22, 770-49, 770-50, 770-51, 770-52, and 770-53.

2.03 COMPATIBILITY OF RELATED EQUIPMENT
A. Equipment and materials installed shall be compatible in all respects with other items being furnished and with existing items so that a complete and fully operational system will result.

2.04 SPECIAL TOOLS AND KITS
A. The Contractor shall furnish any special installation equipment, tools, or kits necessary to properly complete the data communications system installation. This may include, but is not limited to, tools for
pulling, splicing, terminating, and testing the cables, communication devices, stands for cable reels, cable
wenches, assembly and adjustment devices, etc.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS
A. The approximate locations of existing and new telecommunications outlets, cabling and equipment will be
indicated on the project drawings; however, the drawings may not give complete information for the
specific work location. Contractor is responsible to field verify existing outlets and cabling prior to
submitting quote. Determine the exact location after thoroughly examining the general building plans and
by actual measurements before and during construction, subject to the approval of UCB and/or the
Consultant/Engineer.
B. Before construction work commences, visit the site and identify the exact routing for all data
communications cable pathways and equipment placement. Verify all dimensions, locating the work and
its relation to existing work, all existing conditions and their relation to the work and all man made
obstructions and conditions, etc. affecting the completion and proper execution of the work as indicated in
the project drawings and specifications.
C. If core drills are required, the exact core locations shall be identified and coordinated with the UCB
Asbestos Management plan as necessary.
D. All equipment locations shall be coordinated with UCB, other trades and existing conditions to eliminate
interference with required clearances for equipment maintenance and inspections.
E. Install data communications cabling and equipment to facilitate maintenance and repair or replacement of
equipment components. Provide easy, safe and code mandated clearances at equipment racks and
enclosures, and other equipment requiring maintenance and operation. Coordinate with UCB exact
location and mounting height of all equipment in finished areas, such as equipment racks, termination
equipment, communication and electrical devices. As much as practical, connect equipment for ease of
disconnecting, with a minimum of interference with other installations.
F. Coordinate ordering and installation of all materials and equipment with long lead times or having major
impact on work by other trades so as not to delay the job or impact the schedule. Coordinate delivery of
UCB provided Data Network Equipment.
G. Provide all scaffolding, rigging, hoisting and services necessary for delivery, installation, and erection of
materials, equipment, and apparatus furnished into the premises. These items shall be removed from
premises when no longer required. With the exception of UCB provided Data Network Equipment
provided as part of this project, use of University owned supplies and equipment is prohibited.

3.02 WORKMANSHIP
A. All labor must be thoroughly competent and skilled, and all work shall be executed in strict accordance
with the best practice of the trades.
B. Good workmanship and appearance shall be considered of equal importance with Data Communication
systems operation. Lack of quality workmanship shall be considered sufficient reason for rejection of a
system in part or in its entirety. Carefully lay out all work in advance and install in a neat and workmanlike
manner in accordance with recognized good practices and standards. Provide workmen who are skilled in
their craft and a competent Project Manager who will be on the job at all times.

APPENDIX FOR EQUIPMENT SCHEDULE:

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<th>Line</th>
<th>Description</th>
<th>Manufacturer</th>
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SECTION 274000
CLASSROOMS AND EDUCATIONAL TECHNOLOGY

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings, Contract Forms, and Conditions of the Contract, including Construction Manager/General Contractor (CM/GC) Agreement including Exhibits and other Division 1 Specification Sections, apply to this section.

1.2 SCOPE OF WORK

A. Provide all services, labor, materials, tools, and equipment required for the complete and proper installation within the Classrooms and Lecture Halls as called for in these specifications and related drawings.

B. Work includes, but is not limited to, the following:
   1. Educational Technology Equipment Cabinet with Mounting Accessories
   2. Configuration of classrooms and lecture halls with respect to UCB OIT space planning guidelines.
   3. Placement of and additions to interior telecommunications pathways including conduit between technology interface points within the classroom, including display devices, remote control panels, integrated lighting panels, audio amplifiers, loudspeakers, lecterns, etc.
   4. Installation and termination of audio, video, data and control cabling to connect the various educational technology components.
   5. Testing, identification, and administration for the classroom educational technology systems.
   6. Grounding and Bonding

C. All work shall be conducted in coordination with the UCB OIT Information Technology Services and other building trades.

D. The work covered by this Division consists of furnishing all materials, accessories, connectors, supports, electrical protection, equipment, tools, setup, preparation, labor, supervision, incidentals, transportation, storage, and related items and appurtenances, and performing all operations necessary to complete the educational technology system work as indicated in the project drawings and specified herein. It is the intent and purpose of this specification to have, upon completion of the project, a “turn-key” educational technology system within each specified classroom that is designed, built, coordinated and integrated as necessary with the existing telecommunications infrastructure (e.g. data network and/or cable television hookups) and complete and operable in all respects. Completely install, connect, and test all systems, equipment, devices, etc., shown or noted or required to final connections and leave ready for satisfactory operation. Provide any minor items omitted from the design, but obviously necessary to accomplish the above intent.

E. All Educational Technology system designs for UCB buildings on and off campus must be approved by the UCB OIT department for standard and design structure. Any design outside of these standards must be approved and include a written agreement for the design from the UCB OIT department.

1.3 QUALITY ASSURANCE, REGULATIONS AND CODE COMPLIANCE
A. All installation work in the classrooms and lecture halls shall be performed in a neat and workmanlike manner. All methods of construction that are not specifically described or indicated shall be subject to the control of UCB OIT.

B. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified is based on the acceptable manufacturers listed. Where “approved equal” is stated, equipment shall be equivalent in every way to that of the equipment specified and subject to approval of UCB OIT based on submittals provided.

C. Materials and work specified herein shall comply with the applicable requirements of:
1. ANSI/NFPA 70 – National Electrical Code (NEC) Articles 250, 300, and 645
2. ANSI/TIA-568-C.0 – Generic Telecommunications Cabling for Customer Premises
3. ANSI/TIA-568-C.1 – Commercial Building Telecommunications Cabling Standard
4. ANSI/TIA-568-B.2 – Commercial Building Telecommunications Cabling Standard – Part 2: Balanced Twisted-Pair Cabling Components, including applicable addendum
5. ANSI/TIA-568-C.3 – Optical Fiber Cabling Components Standard
6. ANSI/TIA-569-B – Commercial Building Standard for Telecommunications Pathways and Spaces
7. ANSI/TIA-604 Series – Fiber Optic Connector Intermateability Standards
8. ANSI/TIA-606 – Administration Standard for Telecommunications Infrastructure of Commercial Buildings
9. FCC CFR 47 Part 68 – Connection of Terminal Equipment to the Telephone Network
10. Americans with Disabilities Act (ADA)
11. UCB OIT Standards

D. References to regulations, codes, and standards mean the latest edition, amendment and revisions to the regulations, codes and standards in effect on the date of the Contract Documents.

E. All work and materials shall conform to and be installed, inspected, and tested in accordance with the governing rules and regulations of federal, state, and local government agencies.

F. All modifications required by the referenced codes, rules, regulations, and authorities shall be made by the Contractor without additional charge to UCB OIT.

G. Report immediately to UCB OIT personnel and/or the Consultant/Engineer, in writing, any part of the Educational Technology design which does not conform to the requirements of these codes or regulations, or otherwise be held responsible to provide and install material which will comply with these codes and regulations.

H. Applicable codes and ordinances and local interpretations take precedence when they conflict with or are more stringent than the telecommunications design. Drawings and specifications take precedence where design is more stringent than codes and ordinances.

1.4 CLASSROOM CONFIGURATION & CONSTRUCTION CONSIDERATIONS - GUIDELINES FOR CONSULTANTS
These guidelines communicate fundamental classroom design concepts to be used by administrators, architects and contractors. These design guidelines include architectural considerations as well as technology requirements. Emphasis will be placed on ease of use of the
teaching space, including simple user interfaces for educational technology control points, effective sight lines between student seating areas and display devices, and clear signage. This section describes general guidelines to be applied to all teaching spaces, but each classroom within the work scope will require individual interpretation. All classroom designs shall be submitted for approval to UCB OIT representatives prior to commencement of work.

A. CLASSROOM ORIENTATION
While square classrooms are preferred, many rectangular classrooms have been constructed and there is a question of long & skinny versus wide & shallow orientation. Technical professionals often choose long & skinny for narrower viewing angles to screens, but faculty usually request wide & shallow to keep the teacher closer to the students and provide a larger front wall for more board space & multiple screens. Media designs have to be functional in either layout.

B. SEATING CAPACITY
While interpretation of standards varies, the maximum number of loose tablet-arm chairs that can be accommodated in a college classroom can be approximated by taking the total square footage of the room, subtract 100 sq. ft. for teaching area then divide by 15 sq. ft. per student. A computer classroom often requires 30 to 35 sq. ft. per person.

In computer classrooms a 36” wide work surface is minimum for one person, 42”- 48” is preferred. The height of the work surface should allow the keyboard to be at a comfortable level (29”-31”). Classrooms with only one entrance/exit door are limited to a maximum of 49 occupants. Fixed seating generally increases the capacity of a classroom. When seats are fixed, as little as 12 square feet per student may be required by code.

C. PRESENTATION SPACE & FLOORS
Since classrooms and lecture halls will continue to be used for traditional instruction, the front center of the room needs to accommodate chalkboards or whiteboards, data projectors, screens, as well as walking space for pacing professors, and open space for displays and experiments. It is important in classrooms with a computer at each student station that the room layout encourages the presenter to walk around the perimeter of the room to all students. Avoid raised platforms in the front of classrooms so faculty can easily interact with students. Consider raised/access floors in computer classrooms for flexible connectivity & cable management. Carpeting absorbs unwanted sounds such as chairs being moved or feet being shuffled. Allow adequate space in the front of rooms so projected images can be clearly seen from any seating position.

For traditional 4:3 aspect ratio projectors, a general rule of thumb for placement is the projector mount should be placed out in the room approximately twice the width of the target screen. For example, a screen that is 6 feet wide would accompany a projector mounted approximately 12 feet out from the screen.

For wide-aspect 16:9 or 16:10 projectors that formula is slightly different, and mounting designs for both screen(s) and projector(s) should be reviewed by UCB OIT.

D. LIGHTING ISSUES (ACTIVE AND PASSIVE)
It is critical to prevent ambient room light from washing out projected screen images. During projection, room light should be bright enough (30-40 foot candles) for student interaction and note taking. Sufficient light is needed at the computer lectern and on the white board, but light sources must be controlled to minimize washout of the projected screen image. When room lights in the student zone of the classroom are turned on, no more than 3-5 foot candles
of ambient room light should fall on the screen. This requirement tends to preclude indirect lighting.

- To control lights so that someone can turn on lights just in the front, just in the center, or just in the rear of the room, switch the banks of lights parallel to the front of the room.
  - If a room’s lighting control will be integrated with the audiovisual controls in any way, consult with UCB OIT on this aspect of design.
- Design lighting to minimize glare on computer screens in classrooms with computers at each student work station.
- Locate front row of lights near the chalkboard or whiteboard. Light on these improves readability.
- Light switch controls should be simple to use, clearly labeled, and conveniently located at room entrance and at the front of the room, near the technology cabinet, so the teacher can adjust lighting.
- Engrave labels on light switch cover plates so faculty know which switch controls what lights.
- Light from outside the room needs to be controlled. Vision panels in doors should be narrow to reduce spillage of light from the hallway.
- Dimming and blackout capabilities are identified as continuing concerns in college classrooms. In any dimming system the lights must dim down to 5% of output with no light flicker.

Special notes for LARGE LECTURE HALLS:
There should be separate pairs of front podium “spotlights” to focus on a speaker at stage left or stage right, to provide some light on the presenter while showing slides or images from a video/data projector. There should be separate lights for the lower chalkboard and the upper chalkboard/screen (if present), so that the lower chalkboard can be used while images are being shown on the upper screen. Control lights from the booth and from the front of the room so they can be switched from either location.

E. ENTRY DOORS
Vision panels should be installed in or near doors to allow students to check whether the classroom is in use. Panels should be narrow to minimize spillage of light from the hallway. Install paper holders on the wall just outside the door near the entrance of each classroom. Faculty can use them like bulletin boards to post grades, notes etc. without tape or thumbtacks. Some faculty prefer entry doors at the rear of the room so late comers don’t disturb the class, while others prefer entry doors at the front to encourage students to sit up front.

Special notes for LARGE LECTURE HALLS:
Often lecture hall doors are designed for students to enter from the rear and exit at the front. All entry and exit doors in the room should be designed so that no light from outside the room falls on the screen when doors are opened. It is distracting when students who enter late, open the door and wash out an image on the screen.
  - For lecture halls with a projection booths or support technician room, that door should be keyed to allow separate access control from the facility itself.

F. WALLS & CEILINGS
To prevent seats from gouging walls, 8” chair rails should surround the perimeter of classrooms. Top of chair rail should be 33” AFF to accommodate backs of chairs. Bottom should be 25” AFF to accommodate tablet arm edges.
Sound Panels should be used in rooms with 50 or more students to control sound reverberation. There may be alternate solutions to control audio reverberation depending on the space/architecture, options should be reviewed with UCB OIT.

All classroom should have at least a 9 foot high ceiling.

Special note for LARGE LECTURE HALLS:
Ceilings should be at least 15’ high at the front of the room and, even with tiered seating, at least 9’ high at the rear. An angled ceiling at the front of the room can better deliver sound to the rear.

G. WINDOWS & WINDOW COVERINGS
If there are windows, they should be capable of being opened in the spring and fall. Sunlight shining into the room can wash out projection images, so window coverings are imperative. (Requirements for window coverings are addressed in Section 1.6.)

Special note for LARGE LECTURE HALLS:
Windows should be avoided in large lecture halls.

H. VENTILATION
Classroom thermostats should keep temperatures at 65°-68° in winter and 72°-74° in summer. Humidity levels should be maintained close to 50%.

I. SPECIAL CLASSROOMS AND COMPUTER LABS - CONFIGURATION EXAMPLES
Refer to Appendix #1 “Computer Capability for the Presenter” and Appendix #2 “Computers at Each Student Workstation” attached at the end of this Section 274000 for conceptual illustrations of various specialized classroom configurations, including:
- “Plug and Show” Presentation Classrooms
  Designed to provide quick and easy computer connectivity for teachers and other speakers.
- “Connected” Classrooms
  Students with laptop computers are provided with wired (or wireless) access to required network resources.
- Computer Classrooms and Labs
  Each student position is equipped with a desktop workstation. (typical)
  Workstation quantity, physical configuration, and hardware/software/operating system details to be reviewed by UCB OIT.

1.5 CLASSROOM GUIDELINES - AMERICANS WITH DISABILITIES ACT (ADA)
The ADA, enacted in 1990, prohibits discrimination against persons with physical and mental disabilities. Title II of the ADA states, public institutions can choose to follow either UFAS (Uniform Federal Accessibility Standards) or ADAAG (Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities) standards. The goal for classroom designers is to keep in mind persons with mobility, hearing, vision, and mental disabilities.

A. MOBILITY IMPAIRMENTS
Set aside 2% of classroom seating for wheelchairs. While fixed tables are normally 29” high, 31” clearance above floor is needed for wheelchair access. Locate and design the teaching station, including the boards, audiovisual controls and projection screens to be barrier free. A 60” diameter is necessary for wheelchair turnaround. Controls for technology devices in classrooms cannot be higher than 48” nor lower than 18” above the floor and must
accommodate a parallel approach by a person in a wheelchair. Ramps must not exceed one foot rise in twelve feet of run (1:12 ratio).

B. HEARING IMPAIRMENTS
For new construction, if classrooms have at least 50 fixed seats and voice reinforcement/amplification systems, they must have a permanently installed assistive listening system (ALS). These systems often broadcast audio as an infrared or FM signal which is picked up by listeners wearing special receivers and headsets or earphones. UCB OIT will be consulted for equipment standards.

1.6 CLASSROOM GUIDELINES - FURNISHINGS & APPURTENANCES
The guidelines of this section identify the typical furnishings and appurtenances required for classrooms and lecture halls.

A. CHALKBOARDS & WHITEBOARDS
Every inch of available space on the front wall of the room should have chalkboard or whiteboard. Mount writing surfaces 36” above floor and include a tack strip above it. Whiteboards/dry-erase boards are strongly preferred; chalkboards should be black for high contrast. Add flag pole holders to tack strip above the chalkboard as map holders. It is also often desirable to have whiteboard or chalkboard surface available adjacent to projections screens, so they can be used in conjunction with AV projection.

B. WINDOW COVERINGS
Dimming and blackout capabilities are identified as continuing concerns in college classrooms. Sunlight shining into the room can wash out projection images so window coverings are imperative. Venetian blinds, room darkening shades and/or drapes need to cover all windows to block light and assure that glare from windows does not appear on computer screens, display or projection screen(s). Each window should have two window coverings to provide a range of light control and the assurance that if one device malfunctions, the teacher still has an alternative. Blinds inside the window well prevent most direct sunlight and glare. The additional shades or curtains outside the window well, extending several inches past window edge, minimize light seepage emanating around the edges of the window opening. Control of window coverings should not be integrated in room audiovisual control if possible; if such control is required, consult UCB OIT.

C. CLOCK
A large easy to read clock shall be in each classroom and lecture hall mounted at the back of the classroom.

D. ACOUSTICAL TREATMENTS
Acoustical treatments should address the twin concerns of speech intelligibility and sound isolation. Sound isolation between adjacent classrooms and teaching spaces must be sufficiently addressed in the design documents, to include appropriate “voice-friendly” acoustical treatments to permit faculty to teach without sound reinforcement, except in the largest classrooms. Carpeting, acoustical ceiling treatment, sound absorption panels on the back wall and/or side wall(s), and sound absorbing fabric below chair rails helps minimize unwanted noise in the classroom.

In rooms equipped with an educational technology presentation system, front-/wall-mounted loudspeakers are preferred to help minimize signal interference from portable wireless devices now common on campus. Ceiling mounted loudspeakers can help contain sound within the confines of the room, but can be more susceptible to signal interference from the
audience. An audio amplifier is used to supply sound from presentation sources such as computers, CD / DVD players and broadcast and cable television receivers.

Special notes for LARGE LECTURE HALLS:
Side walls should not be parallel, nor should they be a continuous hard surface. The front wall should be constructed using hard surface materials. Sound-dampening material should be applied to rear & side walls. The back wall may need to be completely covered with acoustical absorption materials. The design of any audio system in large lecture halls or auditoriums must take into account the potential for interference from portable wireless devices such as 2-way radios, smartphones, etc. Loudspeakers and an audio amplifier are required and will be used for live voice reinforcement as well as presentation audio from sources such as computers, CD / DVD players and broadcast and cable television receivers.

E. FURNITURE: STUDENT SEATING
In college classrooms, tablet-arm chairs are almost obligatory, and tablets should be large, at least 130 square inches. Chairs should have the dorsal back hinged chair style. 10% of the tablet-arm chairs should be for left-handed students. In larger classrooms continuous writing surfaces should be used to provide students with room to spread out materials. This is a common scenario in classrooms used for advanced courses in professional schools.

Special notes for LARGE LECTURE HALLS:
Theater-style seating is often used in large lecture halls. Each seat shall be equipped with a stowable (fold-down) writing surface for note taking, calculators and examination materials. A minimum seat width of 21 inches should be specified.

F. FURNITURE: TEACHER’S TABLE & CHAIR
A chair and a 60” x 30” teacher’s table are desirable in the front of each classroom. If the table is too large, it becomes a barrier between the teacher and the students.

1.7 CLASSROOM GUIDELINES - CONNECTIVITY AND POWER
These guidelines communicate fundamental classroom design concepts to be used by administrators, architects and contractors. These design guidelines include minimum requirements for classroom connectivity to the building structured cable plant and optimal placement of electrical power outlets to support educational technology devices. Emphasis will be placed on ease of use of the teaching space, including simple user interfaces for educational technology control points and display devices. This section describes general guidelines to be applied to all teaching spaces, but each classroom within the work scope will require individual interpretation. All classroom designs shall be submitted for approval to UCB OIT representatives prior to commencement of work.

A. CLASSROOM CONNECTIVITY
Each classroom is to be equipped with the following IT connectivity:
   One (1) or more data connections (CAT-5E or higher)
   One (1) telephone line
   One (1) television coax connection (Campus CableTV)

The data connection shall be an 8P8C modular wall jack capable of supporting a minimum data rate of 100 Mbps over UTP cabling. The modular jack provided for the data connection shall match the Category/Classification of the existing (or proposed) structured cable plant within the building (i.e. Cat5e, Cat6 or Cat 6A.) UTP cable pairs shall be connected using T568B pin assignments. Fiber optic connectivity in the classroom (if applicable) shall be provided as specified in the design documents.
The telephone connection shall be an 8P8C Category 5e wall jack. UTP cable pairs shall be connected using T568B pin assignments. In all classrooms, the telephone line will be configured either as a typical campus extension, or for “ring down” service in centrally-supported facilities so that faculty members can call for help without dialing a telephone number.

The television connection shall be an f-type coax connector. The terminated connector will typically be mounted in a faceplate, but this should be reviewed with UCB OIT on a case-specific basis.

For classrooms equipped with data/video projectors, one (1) data jack shall be installed for each projector location. The modular jack provided for the data connection shall match the Category/Classification of the existing (or proposed) structured cable plant within the building (i.e. Cat5e, Cat6 or Cat 6A.) Terminate cable pairs using T568B pin assignments.

Classrooms used for distance education purposes shall be provisioned as specified in the design documents.

B. CLASSROOM POWER

Each classroom and lecture hall room needs a grounded three-prong duplex electrical outlet in the front center of the room, 18” above finished floor to provide power for instructor laptops and other instructional equipment. Due to the prevalence of laptops and other portable devices needing power and/or recharging, multiple convenience outlets should be included in classroom design. These should be placed with anticipated seating in mind. If possible, there should be a duplex outlet available for every four occupants, especially in new construction. Depending on seating design, an outlet for every two occupants may be more effective.

If a lectern is part of the design, two (2) grounded three-prong duplex electrical outlets should be provided at the lectern to provide power for laptop computers and peripherals. Four (4) grounded three-prong electrical outlets (in a single quad junction box) should be installed inside the media cabinet, if present, to provide power for the educational technology and presentation components. Media cabinet and data projector power outlets must not be on the same circuit as room lights, printers, or any high-power devices.

Special notes for facilities with WALL BOX AV installations:
Electrical fixtures must be flush mounted to the wall behind the box, and must not impede placement of the box or internal components.

Special notes for COMPUTER LABS:
Circuiting for computer labs should be designed within the following guidelines:
- For traditional desktop/tower computers with separate monitors, there should be no more than four (4) workstations per 20amp circuit;
- For all-in-one computers (e.g. Apple iMacs), there should be no more than eight (8) workstations per 20amp circuit;
- For laptop computer labs, there should be no more than ten (10) workstations per 20amp circuit; also note that for environments that will use a laptop cart, the cart itself typically needs two (2) 20amp circuits in separate fixtures, and sufficient convenience outlets in the room to allow all-day use.
- Consult with UCB OIT for all computer lab environment designs.
Special notes for LARGE LECTURE HALLS:
Ample electrical power is needed in the booth and at the presentation area of the lecture hall.
An accessible raceway should connect the projection booth and the front of the room. The AV consultant will also need to provide accurate electrical load information for system components, and specify sufficient circuiting in designs. Whenever possible, system designs should support and manage power consumption automatically for efficiency.

1.8 CLASSROOM GUIDELINES - AV EDUCATIONAL TECHNOLOGY COMPONENTS

A. SCREENS
In the majority of classrooms, one or two matte projection screens mounted above the whiteboard(s) or chalkboard in the front of the classroom will fill video, data, and other projection needs. Matte white screens can be viewed over a wide angle, typically 100° or wider (50° off-center axis). In typical classrooms, square screens should be used regardless of the aspect ratio of anticipated video (4:3 is traditional, 16:9 and 16:10 are the standards for High Definition video). Using square screens allows the most flexibility in projection. Some environments will require a wide-aspect screen (e.g. large lecture halls, performance stage/auditorium, low ceilings), and some will require powered screens due to size; UCB OIT will be consulted for designs.

A screen trough recessed up into the ceiling creating a pocket across the entire front of the room will permit easy screen exchange as screen replacement becomes necessary. For powered screens, ensure that sufficient clearance remains around the motors and low-voltage controllers to allow technician access. Fit the screen to the size of the audience and the distance from the furthest seat. (See chart below.)

Rough rule of thumb: No one should be closer than 2x the image height nor further than 7x the height. Mount screen high enough for the students in the back of the classroom to see the bottom of the screen, typically 4 feet above the floor. (See chart below for mounting height.) Multiple screens, for simultaneous projection in a classroom, provide more flexibility than one screen. Faculty projecting materials and wanting to use the whiteboard or chalkboard at the same time feel a large screen obstructs those boards. This can be avoided by ensuring writing surfaces are available outside the space covered by the projection screen(s).

Video and data will come from one or more ceiling-mounted video/data projectors.

Attach Velcro to bottom of the screen cord and top of the chalkboard to prevent screen cord from hanging down the middle of the chalkboard.

Special notes for LARGE LECTURE HALLS
Lecture halls with capacity exceeding 200 students are equipped with 10’, 12’ or 14’ motorized screens, possibly even larger, consult with UCB OIT. Lecture halls need two or more screens for projection of more than one image at a time.

B. DETERMINING SCREEN SIZE & MOUNTING HEIGHT
Depth of the room, ceiling height, & seating capacity determine the size of the screen installed in each room.
For additional flexibility, add one or two screens on either side of the one center screen as sized above. Sometimes a classroom will lend itself to an additional corner screen mounted at an angle. While square classrooms are preferred, many rectangular classrooms have been constructed and there is a question of long & skinny versus wide & shallow orientation. Technical professionals often choose long & skinny for narrower viewing angles from screens, but faculty usually request wide & shallow to keep the teacher closer to the students and provide a larger front wall for more board space & multiple screens. When practicable, design precedence shall favor “square” or “wide and narrow” classroom wall layouts. Regardless of the physical classroom wall layouts, the AV Educational Technology system designs must meet the functional requirements of these design guidelines.

<table>
<thead>
<tr>
<th>Room Depth</th>
<th>Seating Capacity</th>
<th>Measurement from Center of Screen to Furthest Seat (Typically Corner Located)</th>
<th>Screen Required* (Minimum, in Inches)</th>
<th>Typical Mounting Height AFF (Dependent on space)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 25’</td>
<td>15-25</td>
<td>Less than 30’</td>
<td>72 x 72</td>
<td>8.5’</td>
</tr>
<tr>
<td>25’-30’</td>
<td>25-50</td>
<td>Between 30’ and 35’</td>
<td>84 x 84</td>
<td>9.25’</td>
</tr>
<tr>
<td>30’-35’</td>
<td>50-100</td>
<td>Between 35’ and 40’</td>
<td>96 x 96</td>
<td>10’</td>
</tr>
<tr>
<td>35’-40’</td>
<td>100-150</td>
<td>Between 40’ and 45’</td>
<td>108 x 108</td>
<td>10.75’</td>
</tr>
<tr>
<td>40’-45’</td>
<td>150-210</td>
<td>Between 45’ and 50’</td>
<td>120 x 120</td>
<td>11.5’</td>
</tr>
<tr>
<td>45’-50’</td>
<td>210-275</td>
<td>Between 50’ and 55’</td>
<td>132 x 132</td>
<td>12.5’</td>
</tr>
<tr>
<td>50’-55’</td>
<td>275-400</td>
<td>Between 55’ and 60’</td>
<td>144 x 144</td>
<td>13’</td>
</tr>
<tr>
<td>55’-60’</td>
<td>400-500</td>
<td>Between 60’ and 65’</td>
<td>168 x 168</td>
<td>14.5’</td>
</tr>
</tbody>
</table>

To be ADA compliant, the work surface of a lectern must be height-adjustable, preferably via manual or hydraulic mechanism vs. electrical motor/actuator. The work surface should be at least 30” wide x 24” deep for wired lecterns, and angled down slightly toward the presenter with a slight lip at the front. Wired/fixed lecterns should be positioned such that the presenter will face the center of the back of the room.

D. EDUCATIONAL TECHNOLOGY CABINET AND CONTROL PANEL
(USED IN ROOMS EQUIPPED WITH A CEILING MOUNTED VIDEO/DATA PROJECTOR)
Any classroom with an audiovisual system requires some form of control panel/interface, and a housing for components. Typically these should be placed at the front of the room. There are two standard types of educational technology equipment installations: a technology cabinet or “media cabinet”, and a wall box. Wall boxes consume significantly less floor space.
space than technology cabinets, while the full size cabinets offer better capacity for future expansion/addition of devices.

- For rooms that will house a built-in, full height technology cabinet, a standard 19” sliding/rotating equipment rack will be mounted inside the cabinet for components. Audiovisual system controls and inputs should be mounted on the front of such a cabinet, ideally between 36”-48” AFF; ADA requires controls no higher than 54” AFF. This cabinet/rack also incorporates a DVD or BluRay media player, a wireless transmitter for the assistive listening device (if required), and external audio & video inputs. A locking door below provides storage for additional media hardware. A black polycarbonate sheet covers the control panel/rack. Cutouts in the polycarbonate shall be provided by the installer to allow user access to AV components such as the control panel and media player, and will be specific for each installation due to variance in hardware. The polycarbonate should be mounted to the cabinet face with T-25 Torx security screws and threaded hardware (e.g. “T-nuts”). See Appendix #4, Figure 1 attached at the end of this Section 274000 for a sample installation.
- For rooms that will house classroom audiovisual components and controls in a surface-mounted wall box (campus standard is SP Controls’ “SmartBox+”), no equipment rack will be needed. The control panel, interface(s), and typical components as described in the Technology Cabinet above get mounted on or inside this wall box. See Appendix #3 “SmartBox Mounting” attached at the end of this Section 274000 for mounting instructions, including ADA compliance. Wall boxes can have a wood trim surround added after installation if desired. See Appendix #4, Figures 2 through 5 attached at the end of this Section 274000 for examples of SmartBox installations. If a surround is installed, it must allow for the upper section that covers the top and sides of the wall box to be easily removed in order to allow access to cabling pathways within the box. As with the cabinets above, a lockable storage area below the box is often desirable.

Simple and clear signage and labels are required to provide the basic information necessary to utilize the hardware. Labeling and naming conventions must be approved by UCB OIT.

Special notes for LARGE LECTURE HALLS
A booth in the rear of the room is desirable for AV equipment storage and operation. The booth is to be equipped with a work surface to allow placement of portable projectors and other equipment as necessary for a given presentation. To minimize disruptions to the lecture presentation or class, an entrance to the projection booth should be provided in rear of lecture hall. In some cases it will be desirable to duplicate audiovisual system controls and/or inputs at both the lectern/podium and inside the projection booth, consult UCB OIT as needed.

E. VIDEO PROJECTORS
Video projectors are permanently mounted on the ceiling. Locate the projector mount such that the projector lens will be approximately two-times the screen width (“Width” x “2”) away from the screen for 4:3 projection; this distance may be slightly different for 16:9/16:10 projection. See chart under section 1.8 B., above. Brightness is measured in ANSI lumens. 2500 ANSI lumens is considered the minimum allowable output from the data/video projector.

Desirable features for data/video projectors include:
- Automatic detection of proper projector input (e.g. composite video, component video, DVI, HDMI, and/or computer VGA)
● Low ambient fan noise
● Lens filter and lamp access available even while projector is mounted
● RS-232 DB9 control connectors; DIN-type control connectors should be avoided
● Compatibility with BMS “LCD Loc II” projector mounts (campus standard, not model-specific)

Models and quantities of projectors shall be provided as shown in the construction documents. UCB OIT must review all proposals for non-standard equipment.

Projectors should be mounted such that the lens is centered on the target projection screen.

Attention should be given to potential sources of vibration in building structure. If vibration affects the stability of the projected image after installation, a Chief “Vibration Isolator” should be installed.

F. FLAT PANEL TELEVISIONS AND DISPLAYS
If specified, flat panel televisions and displays will be used in classrooms and lecture halls. These display devices may be used for visual announcements and paging provided by campus public safety and administrative entities (“digital signage”), Campus CATV, emergency broadcasts, and as a display device for content used during classes and lecture.

General guidelines and desirable features for flat panel displays include:
  ● Native, non-interlaced High Definition resolution support, 720p minimum
  ● Availability of external, mountable speakers from manufacturer, if make/model not available with internal speakers
  ● Input support:
    ○ Audio: stereo-mini (1/8 inch); unbalanced RCA
    ○ Video: VGA/DB15; composite; component; DVI and/or HDMI
  ● RS-232 DB9 control connectors

1.9 DRAWINGS AND SPECIFICATIONS

A. It is the intention of these specifications and related project drawings to call for finished work, tested and ready for operation in complete accordance with all applicable codes, regulations, standards, and ordinances.

B. These specifications and the project drawings are complimentary, and what is called for in either of these shall be binding as though called for by both. Should any conflict arise between the drawings and specifications, such conflict shall be brought to the attention of the Engineer for resolution. If the Contractor fails to contact Engineering in writing of any conflict between the specifications and the project drawings, the Contractor shall be subject to re-work the area of conflict at the Contractor’s cost.

C. Omissions from the specifications and/or project drawings or the incorrect description of details of work which are evidently necessary to carry out the intent of the specifications and project drawings, or which are customarily performed, shall not relieve the Contractor from performing such omitted or incorrectly described detail of the work. All work shall be performed as verified in field measurements, field construction criteria, material catalog numbers and similar data checked and coordinated with each shop drawing by the Contractor.
D. The Educational Technology project drawings are diagrammatic and indicate general design, layout, and arrangement of equipment and various systems. Being diagrammatic, the drawings may not necessarily show all details such as pull-boxes, conduit runs or sizes, etc., necessary for a complete and operable system. Unless detailed dimensioned drawings are included, exact locations are subject to approval of UCB OIT.

E. Do not scale project drawings for dimensions. Take all dimensions and measurements from the site and actual equipment to be furnished. All dimensions, measurements, and the location and existence of underground equipment must be verified in the field since actual locations, distance, and elevations will be governed by actual field conditions. Contractor shall be responsible for all measurements taken from the field.

1.10 EXAMINATION OF PROJECT SITE

A. Prior to any project work, examine the project site carefully, including all project drawings showing existing systems and equipment. The Contractor shall be fully informed of and shall identify all utility, state, and local requirements that will affect the classroom Educational Technology work at the project site.

B. It shall be the Contractor's responsibility to determine if the installation of the proposed systems will affect the operation or code compliance of existing systems. With UCB OIT approval, relocate, modify, or otherwise revise existing Educational Technology systems as required to maintain operational integrity and code compliance.

C. The Contractor shall become familiar with the local conditions under which the work is to be performed and correlate the on-site observations with the requirements of the specifications and project drawings. No allowance will be made for claims of concealed conditions which the Contractor, in exercise or reasonable diligence in examination of the site, observed or should have observed.

D. Before ordering any materials or doing any project work, verify all measurements and be responsible for correctness of same. No extra charge or compensation will be allowed for duplicate work or material required because of unverified differences between actual dimensions and the measurements indicated on the project drawings. Any discrepancies found shall be submitted in writing to the Engineer for consideration before proceeding with the project work.

1.11 WORKMANSHIP, WARRANTY, AND SUPPORT

A. Materials and workmanship shall meet or exceed industry standards and be fully guaranteed for one full year from final acceptance for each project. Cable integrity and associated terminations shall be thoroughly inspected, fully tested and guaranteed as free from defects, transpositions, opens/shorts, tight kinks, damaged jacket insulation, etc.

B. Furnish a written warranty to UCB OIT for a minimum of:
   1. One-year materials warranty on parts and labor to repair/replace defective classroom Educational Technology materials specified herein. This warranty only applies to materials provided by Contractor and does not apply to materials provided by UCB OIT.
   2. One-year installation workmanship warranty on parts and labor to resolve problems related to Educational Technology system installation workmanship.
C. The Contractor shall be responsible for and make good, without expense to UCB OIT, any and all defects arising during this warranty period that are due to imperfect materials, appliances, improper installation, or poor workmanship.

1. During the warranty period, provide all labor required to repair or replace defects in the Educational Technology system, at no cost to UCB OIT.

2. During the warranty period, provide new materials to repair or replace defects in the Educational Technology system, at no cost to UCB OIT.

PART 2 – PRODUCTS

2.1 EQUIPMENT AND MATERIALS MINIMUM REQUIREMENTS

A. All materials and equipment shall be new, free from defects, installed in accordance with manufacturer’s current published recommendations in a neat manner and in accordance with standard practices of the industry.

B. Where no specific material, apparatus, or appliance is mentioned, any standard, first-class product made by reputable manufacturer regularly engaged in the production of such material may be used providing it conforms to the contract requirements and meets the approval of UCB OIT Personnel and/or the Consultant/Engineer.

C. Materials shall meet or exceed the following minimum requirements:

1. Where applicable, all materials and equipment shall bear the label and listing of UL. Application and installation of all listed equipment and materials shall be in accordance with such labeling and listing.

2. Equipment shall meet all applicable FCC regulations.

3. Electrical equipment and systems shall meet UL standards and requirements of the NEC. This listing requirement applies to the entire assembly. Any modifications to equipment to suit the intent of the specifications shall be performed in accordance with these requirements.

4. The listing of a manufacturer as “acceptable” does not include acceptance of a standard or catalogued item of equipment. All equipment and systems must conform to the specifications and meet the quality of the specified item.

5. Materials and equipment shall bear the manufacturer’s name or trademark and model/serial number permanently marked.

2.2 CABLES

A. All Educational Technology cable inside classrooms and lecture halls shall be UL listed and marked type CL2, CL2P, CL3, or CL3P in accordance with NEC articles 310.11(A)(2), (A)(3), (A)(4), (A)(5), and Table 725.179 and shall be installed in accordance with NEC articles 725.133 and 725.154, as well as applicable sections of NEC article 800.

B. All UTP cable inside the building shall be UL listed and marked type CM, CMR, or CMP and shall be installed in accordance with NEC articles 300-22, 800-49, 800-50, 800-51, 800-52, and 800-53.

C. All fiber optic cable inside the building shall be UL listed and marked type OFN, OFNR, or OFNP and shall be installed in accordance with NEC articles 300-22, 770-49, 770-50, 770-51, 770-52, and 770-53.

2.3 COMPATIBILITY OF RELATED EQUIPMENT

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A. Equipment and materials installed shall be compatible in all respects with other items being furnished and with existing items so that a complete and fully operational system will result.

2.4 SPECIAL TOOLS AND KITS

A. The Contractor shall furnish any special installation equipment, tools, or kits necessary to properly complete the telecommunications system installation. This may include, but is not limited to, tools for pulling, splicing, terminating, and testing the cables, communication devices, stands for cable reels, cable wenches, assembly and adjustment devices, etc.

2.5 GROUNDING AND BONDING MATERIALS

A. Mechanical Connectors: Bronze.
B. Bonding Conductor: 6 AWG minimum copper
C. All grounding equipment shall be UL listed for that purpose.

PART 3 – EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. The locations of existing and new Educational Technology outlets, cabling and equipment will be indicated on the project drawings. The drawings, however, may not reveal conditions specific to the project site causing potential interference with planned placement of devices. Contractor is responsible to field verify existing outlets and cabling prior to submitting quote. Determine the exact location after thoroughly examining the general building plans and by actual measurements before and during construction, subject to the approval of UCB OIT and/or the Consultant/Engineer.

B. Before construction work commences, visit the site and identify the exact routing for all Educational Technology cable pathways and equipment placement. Verify all dimensions, locating the work and its relation to existing work, all existing conditions and their relation to the work and all man made obstructions and conditions, etc. affecting the completion and proper execution of the work as indicated in the project drawings and specifications.

C. If core drills are required, the exact core locations shall be identified and coordinated with the UCB Asbestos Management plan as necessary.

D. All equipment locations shall be coordinated with UCB OIT, other trades and existing conditions to eliminate interference with required clearances for equipment maintenance and inspections.

E. Install Educational Technology cabling and equipment to facilitate maintenance and repair or replacement of equipment components. Provide easy, safe and code mandated clearances at equipment racks and enclosures, and other equipment requiring maintenance and operation. Coordinate with UCB OIT exact location and mounting height of all equipment in finished areas, such as Educational Technology cabinets, equipment racks, termination equipment, communication and electrical devices. As much as practical, connect equipment for ease of disconnecting, with a minimum of interference with other installations.
F. Coordinate ordering and installation of all materials and equipment with long lead times or having major impact on work by other trades so as not to delay the job or impact the schedule. Coordinate delivery of UCB OIT-provided Educational Technology components.

G. Provide all scaffolding, rigging, hoisting and services necessary for delivery, installation, and erection of materials, equipment, and apparatus furnished into the premises. These items shall be removed from premises when no longer required. With the exception of UCB OIT provided Educational Technology components provided as part of this project, use of University owned supplies and equipment is prohibited.

3.2 WORKMANSHIP

A. All labor must be thoroughly competent and skilled, and all work shall be executed in strict accordance with the best practice of the trades.

B. Good workmanship and appearance shall be considered of equal importance with Educational Technology systems operation. Lack of quality workmanship shall be considered sufficient reason for rejection of a system in part or in its entirety. Carefully lay out all work in advance and install in a neat and workmanlike manner in accordance with recognized good practices and standards. Provide workmen who are skilled in their craft and a competent Project Manager who will be on the job at all times.

3.3 CABLES

A. Educational Technology cabling shall be placed in separate dedicated pathways.

B. Educational Technology pathways shall be dedicated for use for AV Educational Technology cabling only. Cables for other low voltage systems (intercom, data, voice, security, fire, etc.) may share the AV Educational Technology pathways only if specified in the design documents, or only with prior written approval from UCB OIT.

3.4 CONCEALMENT

A. Use existing classroom conduit and pathways where possible and practicable. Conceal all project work above ceilings and in walls, below slabs, and elsewhere throughout building. If concealment is impossible or impracticable, notify UCB OIT and/or the Consultant/Engineer before starting that part of the work and install only after approval.

3.5 EQUIPMENT MODIFICATION

A. Where existing equipment is to be modified, Contractor shall furnish materials and labor as necessary to modify or add to the equipment. Modifications shall be done neatly with factory parts and assemblies approved for the application. Modification shall in no way jeopardize the operation or compliance of existing equipment with any governing codes and regulations.

3.6 GROUNDING AND BONDING

A. Bond all new metallic cable shields and metallic supporting structures, in all classrooms and lecture halls, including Educational Technology cabinets, racks, and projectors as required by the project documentation and according to the manufacturer’s specifications.

B. Ground all Educational Technology devices and equipment per manufacturer’s specifications and/or project documentation.
C. Ensure that the grounding system is physically secured.

D. All grounding conductors leaving the classroom or lecture hall shall be in a separate conduit from all Educational Technology cabling, and terminate at the nearest ground source.

E. All grounding items shall be installed in complete compliance with Division 16 – Electrical (or CSI 2004 Division 26 - Electrical) and NEC.

END OF SECTION 274000
COMPUTER CAPABILITY FOR THE PRESENTER (PLUG-&-SHOW Classrooms & Laptops)

In a typical PLUG & SHOW computer presentation classroom, faculty bring in a laptop computer, already loaded with the necessary configurations, applications, files, and appropriate cards or adapters to access still and moving images via the classrooms' Ethernet. A ceiling-mounted video/data projector with a user-friendly interface makes it possible to show computer displays from laptops or workstations as well as campus cable TV, and VHS videotapes. A single, commonly available cable connects the user-supplied computer to a small lectern, with AC power, computer display connection, network jack and audio input, in the front corner of the room. The control panel, recessed into a corner wall, at eye-level, contains controls & VCR.

TYPICAL PLUG & SHOW PRESENTATION CLASSROOM

FEATURES:
- Video/Data Projector
- Lectern & connections
- Recessed media panel
- Controlled Lighting
- 2 Screens & 20' of Board
- Moveable chairs

UNIQUE FEATURES OF "PLUG & SHOW" PRESENTATION CLASSROOMS

Laptop Computer, PLUG & SHOW Lectern & Intelligent Panel

Presentations require little set-up in the classroom

Laptop computers are powerful, user-friendly, non-intimidating hardware with choice of platform

The PLUG & SHOW CLASSROOM is self-service so staffing costs are minimized

Connecting a computer in the PLUG & SHOW CLASSROOM is simple
- One cable connects the laptop at the lectern to the ceiling-mounted projector in the classroom

Ethernet connectivity provides access to information outside the classroom

CLASSROOMS WIRED FOR STUDENT LAPTOP COMPUTERS AT EACH STATION

Technology classrooms may be moving away from installed computers in the classrooms. Students and faculty will carry laptop computers with them and simply connect at classroom scholar stations. These wired classrooms will have power outlets and data connections for computing and communicating on and off campus, providing fingertip access to information.

Case-Study or U-shaped Layout:

FEATURES:
- Video/Data Projector
- Lectern & connections
- Recessed media panel
- Controlled Lighting
- 3 Screens & 20' of Board
- Fixed Tables, Moveable chairs

Power & Data Network connections for each student Semi-Circular or Chevron Layout:

Seats facing each other encourage student interaction
Aisles make it easy for the presenter to walk to each student
Moveable chairs make it easy for students to work in teams

JULY 2010

UCB STANDARDS

Appendix 1-1
274000
COMPUTERS AT EACH STUDENT WORKSTATION IN THE CLASSROOM

Furniture layouts in computer classrooms depend on the type of computer use in the class. Intermittent use of the computer for simulations, science experiments, investigations, writing classes, etc., suggest a layout where the presenter can see all the student computer screens. Constant use of the computer for interactive question and answer sessions and computer-accessible dialectic instruction demand that the students can see each other. Each work space must allow sufficient room for the computer and any peripherals, as well as for student notes and papers. A minimum of 36" wide is sufficient, although 40"-48" is preferred.

POSSIBLE ROOM CONFIGURATIONS FOR INTERACTIVE COMPUTER CLASSROOMS
(with computer at each student workstation)

Conventional Layout
Computers are placed in rows parallel to the front of the classroom facing the students. Presenter cannot see the computer screens and there are some sightline problems between students and presenter. Aisles on both sides make it easy for the presenter to walk around to all students. Acceptable design for some computer instruction.

Swivel Chair Design I
Computers in rows parallel to the front of the classroom, face presenter instead of students. Students swivel 180° from the computers to small tables for good sightlines. Three sets of risers let students see over the computers and let presenters see all of the computer screens. Good design for writing lab, and any intermittent computer use. Notre Dame uses a variation of this design.

Swivel Chair Design II
Computers are placed around the perimeter of the classroom. Students can swivel around to small tables for ideal sightlines. Presenter can see the computer screens. Good design for any course with some computer-based and some group discussion elements. Easy for the presenter to walk around to all students.

Classroom drawings are schematic and not drawn precisely to scale. Each room is approximately 25' wide x 31' deep for a total of 775 sqft. Approximately 32 sqft per student.
COMPUTERS AT EACH STUDENT WORKSTATION IN THE CLASSROOM

**Virtual Studio Classroom**
Computers in concentric ovals. Computers don't disrupt sightlines between presenter and students. Presenter can see computer screens. Often used for computer-based instruction in physics, chemistry & biology lab courses. This team-based collaborative working environment concept used at Rensselaer Polytechnic.
www.ciue.rpi.edu/about.html

**Flexible Class-Lab**
Furniture can be rearranged to provide computer access, but it is time consuming. Laptop computers use floor junction boxes for connectivity. Good for humanities classes and interactive instruction. Easy for the presenter to walk around to all students.

**Socratek Classroom Design**
Computers are placed in rows perpendicular to the front of the room. Aisles make it easy for presenter to walk to every student. Design accommodates small groups. Students can swivel 90° for better sightlines between student & presenter. Ideal collaborative environment for interactive, question & answer, computer-accessible dialectic instruction.

Classroom drawings are schematic and not drawn precisely to scale. Each room is approximately 25' wide x 31' deep for a total of 775 sqft. Approximately 32 sqft per student.
PRELIMINARY DOCUMENTATION

Use the provided template to determine the location of the mounting bolts. We have provided mounting bolts for sheetrock (the KAP toggles), wood (the LAG bolts), and masonry (the expansion bolts).

The enclosed Smart Box is fully assembled. Remove the VCR/DVD cover with the star-point security bit provided. Remove the facia (where the SmartPanel is installed) by pulling the top towards you. It is held by clips at the top and hinges at the bottom. Slide the spring hinge pins towards the center. Remove the side panels by unscrewing the (5) 4-40 screws on each (one is on the bottom of the unit).

Mount the box to the wall. Install the VCR/DVD player and place the (2) brackets on the threaded rods. Use the (4) flange nuts provided to tighten the brackets onto the top of the VCR/DVD.

Route the wires from the VCR/DVD up the sides using the split tubing. Power should go up one side, video and audio up the other. Use the cable ties and bases to secure the tubing so that there is a sufficient service loop for the box to close and open without pinching or straining the cables.

Re-install the VCR/DVD cover, the right and left sides. Re-Install the facia after you have installed the Smart Panel in it.

If you are using a SP3-AFVP+, it can be mounted to the studs inside the top of the enclosure with the 4-40 nuts attached to this documentation.

If you have questions, please call us at 877 367 8444 and we would be happy to walk you through the installation process.
Install DVD/VCR COVER

INSTALL SIDE COVERS
front screws

INSTALL SIDE COVERS
top & bottom screws

INSTALL FACIA

ASSEMBLED VIEW
The SmartBox can be mounted to masonry, wood, or sheet rock walls. It will come with mounting screws for each type. It is designed to be mounted over a finished electrical receptacle box. The back plate of the box has a hole for access to the power receptacles and low voltage wiring. Under no circumstances is high voltage wiring to be exposed inside the enclosure.

The SmartBox can mount on studs at 16" and 12" centers. The SmartBox can also be mounted to one center stud if no other options are available. A backing board should be specified in new construction if studs are at 24" centers.

The location of the power receptacle will determine the height of the final box. We recommend that the finished receptacle be mounted at 46" height. This will achieve the dimensions shown in Figure 2.

![Figure 1: Smart Box Wall Infrastructure](image-url)
ADA Compliance Notes

To the best of our knowledge, we believe that the following mounting arrangement will comply with ADA laws. It is your responsibility to verify that your installation will comply with ALL federal, state, and local laws including ADA requirements.

We have provided the text and diagrams of the applicable ADA rules as a convenience. For more information visit http://www.access-board.gov/adaag/html/adaag.htm#4.4.

Applicable ADA Regulations

4.4 Protruding Objects.

4.4.1* General. Objects projecting from walls (for example, telephones) with their leading edges between 27 in and 80 in (685 mm and 2030 mm) above the finished floor shall protrude no more than 4 in (100 mm) into walks, halls, corridors, passageways, or aisles (see Fig. 8(a)). **Objects mounted with their leading edges at or below 27 in (685 mm) above the finished floor may protrude any amount (see Fig. 8(a) and (b)).** Free-standing objects mounted on posts or pylons may overhang 12 in (305 mm) maximum from 27 in to 80 in (685 mm to 2030 mm) above the ground or finished floor (see Fig. 8(c) and (d)). Protruding objects shall not reduce the clear width of an accessible route or maneuvering space (see Fig. 8(e)).

4.2 Space Allowance and Reach Ranges.

4.2.5* Forward Reach. If the clear floor space only allows forward approach to an object, the maximum high forward reach allowed shall be 48 in (1220 mm) (see Fig. 5(a)). The minimum low forward reach is 15 in (380 mm). If the high forward reach is over an obstruction, reach and clearances shall be as shown in Fig. 5(b).
Figure 5b
Maximum Forward Reach over an Obstruction
The maximum level forward reach over an obstruction with knee space below is 25 inches (635 mm). When the obstruction is less than 20 inches (510 mm) deep, the maximum high forward reach is 48 inches (1220 mm). When the obstruction projects 20 to 25 inches (510 mm to 635 mm), the maximum high forward reach is 44 inches (1120 mm). (4.2.5, 4.25.3)

Figure 8a
Protruding Objects
Walking Parallel to a Wall
FIGURE 1 - FULL HEIGHT CORNER TECHNOLOGY CABINET
WITH POLYCARBONATE SHEET
NTS - FOR ILLUSTRATIVE PURPOSES ONLY

NOTE: DRAWING IS TO BE USED AS A GUIDELINE FOR CONCEPTUAL PURPOSES ONLY. IT IS UP TO THE INSTALLER TO SPECIFY AND FOLLOW ANY CODE ISSUES RELATED TO THE PROJECT. CONSULT WITH UCB ITS STAFF IF THERE ARE ANY QUESTIONS.
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FIGURE 4 - SURFACE MOUNTED "SMART BOX+"
WITH SURROUND - CLOSED POSITION

FIGURE 5 - SURFACE MOUNTED "SMART BOX+
WITH SURROUND - OPEN POSITION

NTS - FOR ILLUSTRATIVE PURPOSES ONLY
SECTION 27 50 00
CCURE, PAGING, BAS, ETC.

PART 1 – GENERAL

1.01 RELATED DOCUMENTS
A. Drawings, Contract Forms, and Conditions of the Contract, including Construction Manager/General Contractor (CM/GC) Agreement including Exhibits and other Division 1 Specification Sections, apply to this section

1.02 SCOPE OF WORK
A. This section applies to low voltage cabling requirements as directed by UCB Access Services. This section does not apply to voice, data, and CATV cabling, as identified in other sections of these specifications, that are intended support UCB OIT services.
B. All low voltage other than voice, data and CATV that does not have service from CU OIT shall have a standalone pathway and location for electronics. Conduit is the preferred pathway structure. CU Access Services must approve the Ccure pathway design prior to installation.
   a. Refer to Division 27 05 00 section 3.03 to review the exceptions to other services within the OIT pathways.
C. The standalone pathways shall be used for systems such as, but not limited to, inter-department voice/data/TV systems (none OIT supported voice/data/TV), paging systems, clock systems, public address and mass notification systems, sound systems, intercom systems, fire alarm and Andover systems, and Ccure system.
D. Contact Wayne Shigley of CU Access Services for specific additional project requirements:
   303-492-6609 (office)
   wayne.shigley@colorado.edu
E. The current BAS (building automation systems) setup for new buildings will be one Ethernet uplink from the TR to a location outside the TR as indicated by the Facilities BAS group. At the designated location Facilities will maintain and arrange supply of a data switch that will support the BAS within the building. Horizontal cabling from the designated location of the BAS to the endpoints can be run within the OIT pathways as covered in this standard for Horizontal cabling for other services.

PART 2 – MATERIALS

2.01 EQUIPMENT AND MATERIALS MINIMUM REQUIREMENTS
A. (Not Applicable)

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS
A. (Not Applicable)

APPENDIX FOR EQUIPMENT SCHEDULE:

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END OF SECTION 27 50 00