

**DIVISION 28 – ELECTRONIC SAFETY AND SECURITY**

Includes the following sections:

- 28 05 00 Common Work Results for Electronic Safety and Security
- 28 05 13 Conductors and Cables for Electric Safety and Security
- 28 05 26 Grounding and Bonding for Electronic Safety and Security
- 28 05 28 Pathways for Electronic Safety and Security
- 28 13 00 Access Control and Alarm Systems
- 28 23 00 Visual Surveillance
- 28 31 00 Fire Detection and Alarm

<b>COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY</b>	<b>28 05 00</b>
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For more information, refer to the University's Standard Specification Section 28 05 00 Common Work Results for Electronic Safety and Security.

<b>CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY</b>	<b>28 05 13</b>
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For more information, refer to the University's Standard Specification Section 28 05 13 Conductors and Cables for Electric Safety and Security.

<b>GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY</b>	<b>28 05 26</b>
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For more information, refer to the University's Standard Specification Section 28 05 26 Grounding and Bonding for Electronic Safety and Security.

<b>PATHWAYS FOR ELECTRONIC SAFETY AND SECURITY</b>	<b>28 05 28</b>
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For more information, refer to the University's Standard Specification Section 28 05 28 Pathways for Electronic Safety and Security.

<b>ACCESS CONTROL AND ALARM SYSTEMS</b>	<b>28 13 00</b>
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For more information, refer to the University's Standard Specification Section 28 13 00 Access Control and Alarm Systems.

<b>VISUAL SURVEILLANCE</b>	<b>28 23 00</b>
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For more information, refer to the University's Standard Specification Section 28 23 00 Visual Surveillance.

**FIRE DETECTION AND ALARM**

**28 31 00**

Refer to the University's Standard Specification Section 28 31 00 Fire Detection Alarm and Section 28 08 00 Commissioning Electronic Safety Security. The specifications shall be modified by the Design Professional to meet project requirements. Electronic copies (Word documents) are available, contact the University's Representative.

Section 28 05 00

Common Work Results For Electronic Safety and Security

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. Section includes, but is not necessarily limited to:
  - 1. Common standards and procedures for the Electronic Safety and Security Work.
  - 2. Design, engineer and provide complete, all means of support, suspension, attachment, fastening, bracing, and restraint (hereinafter "support") of the Work of this Division. Provide engineering of such support by parties licensed to perform work of this type in the Project jurisdiction.
- B. Provisions of this Section apply to Electronic Safety and Security Work, including the following Sections:
  - 1. Section 28 05 13 – Conductors and Cables for Electronic Safety and Security
  - 2. Section 28 05 26 – Grounding and Bonding For Electronic Safety And Security
  - 3. Section 28 05 28 – Pathways for Electronic Safety And Security
  - 4. Section 28 13 00 – Access Control and Alarm Systems
  - 5. Section 28 23 00 – Visual Surveillance

1.2 REFERENCES

- A. Usage in accordance with Section 01 42 19 - Reference Standards.
- B. Conform to the applicable portions of the following standards agencies:
  - 1. American National Standards Institute (ANSI)
    - a. ANSI C39.1 (1981; R 1992) Requirements for Electrical Analog Indicating Instruments
  - 2. ASTM International (ASTM)
    - a. ASTM A 123/A 123M (2002) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
    - b. ASTM B 32 (2004) Solder Metal
  - 3. Electronic Industries Alliance (EIA)
    - a. EIA ANSI/EIA/TIA-232-F (2002) Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange
  - 4. Institute of Electrical And Electronics Engineers (IEEE)
    - a. IEEE 142 (2007) Recommended Practice for Grounding of Industrial and Commercial Power Systems - IEEE Green Book.
    - b. IEEE C2 (2012) National Electrical Safety Code.
    - c. IEEE C62.41.1 (2002; R 2008) Guide on the Surges Environment in Low-Voltage (1000 V and Less) AC Power Circuits. IEEE C62.41.2 (2002) Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits.
  - 5. National Electrical Manufacturers Association (NEMA)
    - a. NEMA 250 (2008) Enclosures for Electrical Equipment (1000 Volts Maximum).
    - b. NEMA ICS 1 (2000; R 2005; R 2008) Standard for Industrial Control
    - c. NEMA ICS 2 (2000) Industrial Controls and Systems: Controllers, Contactors, and Overload Relays Rated Not More than 2000 Volts AC or 750 Volts DC
    - d. NEMA ICS 6 (1993; R 2001) Industrial Control and Systems: Enclosures

6. Underwriters Laboratories (UL)
  - a. UL 294 (1999; Rev thru Oct 2001) Access Control System Units
  - b. UL 365 Standard for Police Station Connected Burglar Alarm Units and Systems.
  - c. UL 636 (1996; Rev thru Mar 2001) Holdup Alarm Units and Systems
  - d. UL 639 (1997; Rev thru Sep 2002) Intrusion Detection Units
  - e. UL 681 (1999; Rev thru Jan 2001) Installation and Classification of Burglar and Holdup Alarm Systems
  - f. UL 796 (1999; Rev thru Dec 2003) Printed-Wiring Boards (1982 issue or latest revision).
  - g. UL 1037 (1999; Rev thru Sep 1999) Antitheft Alarms and Devices
  - h. UL 1076 (1995; Rev thru Feb 1999) Proprietary Burglar Alarm Units and Systems
  - i. UL 1610 (1998; Rev Aug 2001) Central-Station Burglar-Alarm Units
7. U.S. National Archives and Records Administration (NARA)
  - a. 21 CFR 1020 Performance Standards for Ionizing Radiation Emitting Products
  - b. 47 CFR 15 Radio Frequency Devices

### 1.3 DEFINITIONS

- A. See also Section 01 42 10 - Abbreviations, Symbols, and Definitions, and Section 27 05 00 – Common Work Results for Communications.
- B. General Abbreviations used in these specifications. Refer additionally to the abbreviations list appearing on the Drawings.
  1. ACAS Access Control and Alarm System.
  2. ADA Americans With Disabilities Act.
  3. AFC Above Finished Ceiling.
  4. AFF Above the Finished Floor.
  5. BLDG Building
  6. CAT Category
  7. CL Centerline
  8. DIV Division
  9. (E) Existing
  10. FBO Furnished By University
  11. HR Home Run
  12. ID Inside Diameter
  13. IDS Intrusion Detection System
  14. LAN Local Area Network
  15. MAX Maximum
  16. NIC Not In Contract.
  17. NRTL Nationally Recognized Testing Laboratory
  18. NVR Network Video Recorder
  19. OD Outside Diameter
  20. OFE University Furnished Equipment.
  21. PSRH Project Standard Receptacle Height.
  22. PSSH Project Standard Switch Height.
  23. POE Power over Ethernet
  24. TYP Typical
  25. UON Unless Otherwise Noted.
  26. VMS Video Management System

*Omit if Access Control not in Scope*

- C. Definitions of Terms: As defined in Section 28 13 00 – Access Control and Alarm Systems.]

## 1.4 SYSTEM PERFORMANCE REQUIREMENTS

*Adjust to match scope*

- A. [The fully configured access control panels provided under the work of this project in conjunction with devices installed under the work of this project, shall enable the access control and intrusion detection functions as defined in Section 28 13 00 – Access Control and Alarm Systems.
- B. The video surveillance system installed under the work of this Project shall enable viewing and recording images on the University's VMS/NVR system as defined in Section 28 23 00 – Visual Surveillance.]

## 1.5 SUBMITTALS

- A. Comply with Section 01 33 23 – Shop Drawings, Product Data and Samples and the following.
  - 1. Submit all materials for review arranged in the same order as Specifications, individually referenced to Specification Section, Paragraph and Contract Drawing number. Conform in every detail as applies to each referencing Section.
  - 2. Provide electronic submittals in the electronic format defined by Division 1.
  - 3. Make each specified submittal as a coordinated package complete with all information specified herein. Incomplete or uncoordinated submittals will be returned with no review action.
- B. Contractor and Key Personnel Experience.
  - 1. A minimum of 30 days prior to installation, submit documentation of the experience of the Electronic Safety and Security contractor(s) and of their key personnel.
  - 2. Qualifications shall be provided for:
    - a. the Electronic Safety and Security contractor(s),
    - b. the Electronic Safety and Security installers,
    - c. and the supervisor(s) (if different from the installers).
  - 3. Refer to the Quality Assurance paragraph in this section for complete requirements.
- C. Progress Schedule: Comply with Section 01 31 13 - Project Coordination.
- D. Manufacturer's Product Data:
  - 1. Manufacturer's Product Data Sheets. Collate in sequence of List of Materials.
  - 2. Data sheet for each item in each Electronic Security Section, including all accessories, clearly marked for proposed product required for the Project, to including but not limited to the following where required by the Project scope:
    - a. Common Work
      - i. *Power Supplies*
      - ii. *UPS's*
      - iii. *Switches*
      - iv. *Relays*
      - v. *Batteries*
      - vi. *Tamper resistant security fasteners*
      - vii. *Terminal blocks*
      - viii. *End-of-Line Resistors.*

- b. Wiring
    - i. *Cabling of each type used on the project.*
  - c. Racks and Cabinets (where provided under the work of Division 28).
  - d. Electronic Security Systems Pathway
    - i. *Raceway*
    - ii. *Raceway connectors*
    - iii. *Gutter*
    - iv. *Terminal Cans, Pull Boxes, Device Boxes*
    - v. *Enclosures*
    - vi. *Means of support*
  - e. Access Control and Intrusion Device Field Devices
    - i. *Door position sensors*
    - ii. *Duress alarm components,*
    - iii. *Request to exit devices*
    - iv. *Card readers*
    - v. *Card stock*
    - vi. *Vehicle readers*
    - vii. *Motion detectors,*
    - viii. *Glass break sensors,*
    - ix. *Keypad controllers*
    - x. *Local alarm devices/sounders, including key cores and sleeves*
  - f. Headend and Building Level Access Control Electronics
    - i. *DGP and complete daughter card components required to complete the work of the project.*
  - g. Visual Surveillance Devices
    - i. *Cameras*
    - ii. *NVR Camera Licenses*
    - iii. *Line extenders (where permitted),*
    - iv. *PoE injectors.*
3. Material Safety Data Sheet, where applicable.
4. List of Materials Schedule. For each item, include:
- a. Referencing Specification Section
  - b. Referencing Paragraph
  - c. Referencing Drawing, if specified only on plans
  - d. Manufacturer.
  - e. Model number.
  - f. Listing, including name of Nationally Recognized Testing Laboratory.
  - g. Precede each submittal book with a summary schedule, with columns for each item above and rows for each item submitted.
    - i. *Example:*

Specification Section	Paragraph	Contract Drawing Reference	Manufacturer	Model No.	NRTL Listed
28 05 00	2.03C		XYZ	123	Y
28 13 00	2.07A1		AAA	34-56	Y
		TY2.01	ZZY	456	Y

- E. Functional description, provide
  - 1. A system description, including analysis and calculations used in sizing equipment required.
  - 2. Description to show how the equipment shall operate as a system to meet the performance requirements. The following information shall be supplied as a minimum:
    - a. Description of site equipment and its configuration
    - b. Protocol description
  - 3. Startup operations
  - 4. System expansion capability and method of implementation
  - 5. System power requirements and UPS sizing
- F. Field (Installation) and Shop Drawings: Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices. Collate in sequence at least the following plans:
  - 1. Drawing index/symbol sheet.
  - 2. Floor plans. At scale of Contract Documents. Show:
    - a. Device locations, type and circuit number(s).
    - b. Mounting height.
    - c. Conduit size.
    - d. Rough-in.
    - e. Wire type.
    - f. Wire fill.
    - g. Termination rooms, including BDF and IDF Closets where use of these spaces are indicated on the Bid Documents
  - 3. Sections/Elevations: At scale of Contract Documents:
    - a. Mounting location reference.
    - b. Terminal cabinets.
    - c. Power Supplies and UPS.
    - d. Electrical power receptacles required for the work of this Section.
    - e. Block wiring terminations
    - f. Clearances
    - g. Backboard Wire and Cable Management
    - h. Copper cable patch panels.
    - i. Rack layouts.
  - 4. Enlarged plans. At scale of Contract Documents or larger as required for trade coordination. Show:
    - a. Refer to "floor plans" above.
    - b. Architectural features.
    - c. Rack cabinets.
    - d. Clearances required by applicable Code.
    - e. Terminal panels and backboard mounted power supplies
    - f. Terminal blocks
    - g. Electrical and Mechanical panels, including panel boards, EMS and fire alarm, and mechanical systems in vicinity of the work of these Sections.
  - 5. System Conduit Riser Drawing. Submit drawings that clearly and completely indicate the function of each Electronic Safety and Security component. Indicate termination points of devices, and interconnections required for system operation. Indicate interconnection between modules and devices.

Show:

- a. Terminal cabinets.
  - b. Coordination with floor plans.
  - c. Wire runs not shown on floor plans.
  - d. Wire type.
  - e. Wire number
  - f. Wire fill.
6. Single line diagram of Electronic Security and Safety Systems. Indicate the relationship of integrated components on one diagram and show power source, system controls, impedance matches; plus number, size, identification, and maximum lengths of interconnecting wires.
- a. Show at least:
    - i. *Equipment: Function, make, model.*
    - ii. *Rack number.*
  - b. Grounding and bonding scheme
  - c. Terminal cabinets.
  - d. Coordination with floor plans.
  - e. Wire runs not shown on floor plans.
  - f. Wire fill.
  - g. Wire numbers assigned uniquely to each wire/cable.
  - h. Wire type.
  - i. Signal Type
  - j. Signal operating level or voltage (for non-optical communications).
  - k. Shield condition at both ends (float, ground, location of ground) for non optical communications.
7. Equipment rack elevations: All racks scaled at 1-1/2" equals 1 foot, or larger.
- a. Show Equipment:
    - i. *Function.*
    - ii. *Make.*
    - iii. *Model.*

*Include where rack installation is included in the scope of work*

8. [Rack wiring drawings: For each rack, show:
  - a. Power strip: Receptacles, circuiting.
  - b. Equipment.
  - c. Grounding.
  - d. Wiring, all systems.
  - e. Wiring harness scheme.]
9. Mounting details:
  - a. Specific details of restraints including anchor bolts submitted under the Section 28 05 28 – Pathways for Electronic Safety and Security for mounting and maximum loading at each location, showing compliance and coordination with Code and the project Architectural, Structural and Mechanical Documents.
  - b. Stamped and signed by an Engineer licensed in the Project jurisdiction for work of this type.
    - i. *Submit an accompanying engineering analysis stamped and signed by an Engineer licensed in California for work of this type, indicating that the Equipment Enclosure System will comply with California Building Code for the Project Seismic Zone when loaded with the weight of the equipment submitted.*
    - ii. *Show calculations on drawings or in bound volume for review by Authorities having jurisdiction.*

- c. Show loads, type and strength of connections, sizes, dimensions, materials, etc.
  - d. Provide details for:
    - i. *Equipment Rack anchorage.*
    - ii. *Wall Mounted Racks and Enclosures.*
    - iii. *Cable Runway and Cable Tray*
    - iv. *Monitors, cameras or other Electronic Safety and Security Equipment with total weight, including housing and support brackets weighing 20 pounds or more.*
    - v. *Camera mounting at all conditions required by the project, including, flush, surface, pendant, corner or parapet as applies.*
10. Installation details
- a. Terminal cabinets: Draw elevations of terminal blocks corresponding to the Single Line Diagram.
  - b. Firestopping,
  - c. Details of flexible raceway connections to be made to vibrating equipment
  - d. Details of J-Box and sealant application for the typical conditions listed in Section 27 05 48 – Noise and Vibration Controls for Communications Systems.
  - e. California Access Compliance Manual and Americans with Disabilities Act (ADA) compliance.
11. Fabrication details
- a. Receptacles.
  - b. Panels.
  - c. Special mounting provisions
  - d. Legends/engraving details. Half or full size:
12. Schedules of Application
- a. An itemized list of all items of equipment to be fitted with flexible electrical connections.
  - b. Catalog cuts of the products to be applied as J-Box mastic and Acoustical Sealant, and a schedule of rooms to receive application of mastic and sealant at J-Boxes.
- G. Pre-Functional Test plan
- 1. Project Site Pre-Functional Test Reports:
    - a. Schedule: Submit test reports in timely manner relative to Project schedule such that the University's Representative may conduct verification of submitted test data without delay of scheduled progress.
    - b. Project Site test report: Submit following system completion and prior to and as condition precedent to Acceptance Review and Testing of the Work of this Section.
    - c. Content: Include at least:
      - i. *Time and date of test.*
      - ii. *Personnel conducting test.*
      - iii. *Test equipment, including serial and date of calibration.*
      - iv. *Test object.*
      - v. *Procedure used.*
      - vi. *Results of test*
      - vii. *Numerical or graphical presentation.*
      - viii. *Electronic file in format and media directed by the University's Representative.*
    - d. Submit pre-functional testing report,
  - 2. Following submission of Prefunctional Test Reports, refer additionally to the requirements of Part 3 of this Section and of the individual Electronic Safety

and Security Sections for requirement to conduct functional testing session in presence of University's Representative.

## 1.6 QUALITY ASSURANCE

### A. Procedures: In accordance with Section 01 45 00 - Quality Control.

*Omit selected sections of the following paragraphs if no access control scope in Project*

### B. General Qualifications

#### 1. Installer's Qualifications

- a. Prior to installation, submit data of the installer's experience and qualifications. Show that the installer who will perform the work has a minimum of 2 years experience successfully installing Electronic Safety and Security Systems of the same type and design as specified herein. Include the names, locations, and points of contact, including telephone numbers, of at least two installations of the same type and design as specified herein where the installer has installed such systems.
- b. Indicate the type of each system, including a summary written description and certify that each system has performed satisfactorily in the manner intended for a period of not less than 12 months.

#### 2. [Instructor's Qualifications

- a. Access control training to be provided by ACAS Manufacturer personnel. Contractor provided training will not be accepted in lieu of manufacturer provided training.
- b. Prior to installation, submit data of the instructor's experience and qualifications. Show that the instructor, who will train operating and maintenance personnel, has received a minimum of 24 hours of IDS and access control training from a technical organization such as the National Burglar and Fire Alarm Association, and 2 years experience in the installation of IDS and access control of the type specified.

#### 3. Access Control Systems Contractor and Installation Personnel

- a. Contracting firm(s) and installation personnel installing the Software House C-Cure access control systems specified under the work of Division 28 shall be Factory Authorized dealers in the specified products. The Contractor for the work of Section 28 13 00, including all wiring for the work of that section shall hold a Software House Authorized Integrator status, including all persons installing or making contact with the work of that Section, including wiring, termination, labeling, testing or trouble shooting of the installed DGP's, card readers, end-of-line resistors and/or field devices.
- b. Installation personnel of the Authorized Integrator installing the Software House C-Cure access control systems specified under the work of Division 28 shall have received factory training to install and program the specified hardware, including the manufacturer's Advanced Installer class for C-Cure 9000 installation and shall hold a current certificate for same from the manufacturer. Contractor to provide copies of the installer certificates prior to commencing work on site.]

*Omit the following for small projects less the \$15,000 in construction cost*

### C. [Designated Supervisor: Provide a designated supervisor present and in responsible charge in

the fabrication shop and on the Project Site during all phases of installation and testing of the Work of this Section. This supervisor shall be the same individual through the execution of the Work unless illness, loss of personnel, or other circumstances reasonably beyond the control of the Contractor intervene.]

- D. Reference Documents: At all times when the work is in progress, maintain at the workplace, fabrication shop or Project Site as applies.
  - 1. A copy of the conformed design team prepared Bid Set.
  - 2. A complete set of the latest stamped, actioned submittals of record.
  - 3. A complete set of manufacturer's original operation, instruction and service manuals for each equipment item.
- E. Test Equipment
  - 1. Requirements:
    - a. Maintain and operate test equipment at the fabrication shop and the job site for both routine and Acceptance Testing of the Work of this Section.
    - b. Maintain test equipment at the job site while work is in progress from installation of equipment racks until University Acceptance of this Work; thereafter remove all of this test equipment from the job site.
    - c. Unless otherwise indicated, test equipment shall remain property of the Contractor.
    - d. Provide all required test cables, jigs and adapters.
    - e. Provide equipment with traceable calibration, with calibration date not greater than one year prior to the date of the use of the equipment to perform the specified testing.
  - 2. Equipment: Specified in individual Sections.

## 1.7 REGULATORY REQUIREMENTS

- A. Regulations Applicable: Including but not limited to those defined in Section 01 41 00 - Regulatory Requirements.
  - 1. Nothing in the Contract Documents shall be construed to permit Work not conforming to applicable laws, ordinances, rules, or regulations.
  - 2. In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the University's Representative. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.
- B. Refer elsewhere in this Section for reference Standards applicable to work of the Project.

## 1.8 DELIVERY, STORAGE AND HANDLING

- A. Procedures:
  - 1. In accordance with Section 01 60 00 – Product Requirements and as specified in the individual Electronic Safety and Security Systems sections.
  - 2. General

- a. Provide protection from weather, moisture, extreme heat and cold, dirt, dust, and other contaminants for cabling and equipment placed in storage.

## 1.9 ENVIRONMENTAL REQUIREMENTS

*Amend to match the expected jobsite conditions*

- A. [Connecting hardware shall be rated for operation under ambient conditions of 32 to 140 degrees F and in the range of 0 to 95 percent relative humidity, non-condensing.
- B. Active components shall installed indoors be rated for operation under ambient conditions of 32 to 100 degrees F and in the range of 0 to 95 percent relative humidity, non condensing]

## 1.10 SEQUENCING

*Edit to match Project Requirements*

- A. [Comply with Section 01 10 00 - Summary and Section 01 32 16 – Progress Schedules and the following:

## 1.11 OPERATING AND MAINTENANCE DATA

- A. Commercial off the shelf manuals shall be furnished for operation, installation, configuration, and maintenance of custom parts and assemblies, and for any products submitted as substitution of the design basis products as a part of the Electronic Safety and Security system. Precede the manuals with a systems narrative specific to this Project, outlining the major systems functionality, the major systems components, and identifying which manuals document the performance of which subsystems.
  1. Submit operations and maintenance data in accordance with Section 01 78 30 - Guarantees Bonds Service and Maintenance Contracts and as specified herein not later than 2 months prior to the date of beneficial occupancy.
- B. Spare Parts
  1. In addition to the requirements of Section 01 78 30 - Guarantees Bonds Service and Maintenance Contracts, provide a complete list of parts and supplies, with current unit prices and source of supply, and a list of spare parts recommended for stocking.

## 1.12 PROJECT RECORD DOCUMENTS

- A. Comply with 01 77 00 - Closeout Procedure, and the following.
  1. Record Drawings
    - a. Content
      - i. *Provide a least as required for the Shop and Installation Drawings defined elsewhere in this Section.*
      - ii. *Contractor shall be responsible for updating building and Electronic Safety and Security plans to reflect as-built conditions.*
      - iii. *Indicate actual work on Drawings; indicate actual products used, replace vendor neutral nomenclature used in bid set with makes and models of actual installed devices.*
    - b. CAD

- i. *Use a computer aided drafting (CAD) system in the preparation of record drawings for this Project. CAD system shall produce files in AutoCAD® .DWG format, latest release at time of Project bid closure. Campus Standard, no substitution permitted.*
  - ii. *Except where prohibited by Contract, University's Representative will furnish CAD backgrounds in AutoCAD® .DWG format, for use by the Contractor in preparing Record Drawings.*
  - iii. *Electronic copy of Record Drawings: Provide electronic copies of each drawing file in the format noted above. Submit in the format required by Division 1.*
- c. Reproducibles: As specified in Division 1.

### 1.13 CLOSEOUT

- A. Punch List: Perform any and all remedial work, at no claim for additional cost or time. Where required, retest and submit Test Report. Notify the University's Representative of completion of Punch List.
- B. Portable Equipment: Furnish all portable equipment and spares to the University's Representative, along with complete documentation of the materials presented. Where applicable, furnish portable equipment in the original manufacturer's packing.
- C. Operating and Maintenance Data: Install framed operating and maintenance instructions. Submit Manuals.
- D. Project Record Documents: Submit print and digital copies. Digital files shall be in AutoCAD .dwg format, latest release at time of Project bidding.
- E. Keys: If applicable, replace construction locks with permanent locks. Provide 5 sets of keys to the University's Representative.
- F. Instruction: Conduct specified instruction.
- G. Warranty: Submit Warranty dated to run from date of Substantial Completion of the Project.

### 1.14 WARRANTY SERVICE

- A. In addition to provisions of 01 78 30 - Guarantees Bonds Service and Maintenance Contracts, provide the following.

*Edit the requirements to match the Project scope*

- 1. Response Time:
  - a. [Provide a technician who is both familiar with the work at the Project Site and, for Access Control Systems issues, is one of the Contractor's C-Cure factory certified staff, on the job site within 24 hours after receipt of a notice of non-emergency malfunction.
  - b. Contractor to respond to calls within 2 hours and provide a technician who is both familiar with the work at the Project Site and, for Access Control Systems issues, is one of the Contractor's C-Cure factory certified staff, on the job site within 4 hours after receipt of a notice of an emergency malfunction, unless the problem has already been resolved remotely. An emergency malfunction is defined as one causing one or more access controlled gate(s) or door openings to a secured area to be rendered either inaccessible or unsecured.
  - c. The malfunctioning ACAS or Visual Surveillance System shall be restored to

- proper operating condition after one (1) calendar day.]
        - d. Provide the University's Representative with telephone number attended 8 hours a day, 7 days a week, to be called in the event of a malfunction.
      - 2. Materials installed during warranty service to match or exceed specification of products originally installed for the specified function.
    - B. Provide all additional Warranties as defined in each Electronic Safety and Security Systems Section.

## PART 2 - PRODUCTS

### 2.1 GENERAL

- A. Standard Products
  - 1. Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section. All components must be of new condition, used or reconditioned products will not be accepted.
    - a. Alternative Qualifications. Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished. Contractor submittal of subject of Alternative Qualifications shall incorporate in their submittal a written description of the installation in a comparable condition to that of the work of the Project and shall provide a telephone contact number for an Owner's representative able to discuss the satisfactory performance of the components being submitted.
- B. Material and Equipment Manufacturing Date
  - 1. Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.
  - 2. Unless recycled content is specified, provide new materials.
- C. Where a particular material, device, piece of equipment or system is specified directly, the current manufacturer's specification for the same shall be considered to be a part of these specifications, as if completely contained herein in every detail.
- D. Each material, device or piece of equipment shall comply with all of the manufacturer's current published specifications for that item.
- E. Provide quantity as shown on Contract Drawings, or as otherwise indicated.
- F. Provide all auxiliary and incidental materials and equipment necessary for the operation and protection of the Work of this Section as if specified in full herein.
- G. In the event the specified product is no longer in manufacture, provide the manufacturer's latest design/model of equivalent functionality, permanently labeled with the manufacturer's name, model number and serial number.
- H. Where products are of similar type or use, provide products of the same manufacturer, unless otherwise indicated.
- I. All devices provided under the Work of this Section which are connected to the Project electrical system shall be listed by a Nationally Recognized Testing Laboratory, and shall be so

labeled.

J. Components

1. NRTL certified. Cabling and interconnecting hardware and components for Electronic Safety and Security systems shall be NRTL or third party independent testing laboratory certified, and shall comply with NFPA 70 and conform to the requirements specified herein.
2. Where equipment or materials are specified to conform to industry and technical society reference standards of the organizations, submit proof of such compliance.
  - a. The label or listing by the specified organization will be acceptable evidence of compliance.
  - b. In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing, and approved by the University's Representative.
  - c. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard.

K. Enclosures:

1. Provide steel frames and enclosures designed and wired to eliminate all induced currents.
2. Make bolted connections with self-locking devices.
3. All enclosures should be appropriate to the environment of installation – refer to the requirements of Section 28 05 28 – Pathways for Electronic Safety and Security.

L. Finishes: Any item or component of the Work of this Section which is visible shall comply with the following.

1. Finishes noted or scheduled on the Contract Drawings take precedence.
2. Where design location requires that products, materials or equipment are visible to the public, no manufacturer's logos larger than 1/2 inch shall be visible. Unless otherwise noted or directed, neatly remove or permanently paint out such logos.
3. Where finishes are not noted or otherwise defined in the Contract Documents, submit manufacturer's standard finish samples for selection by the University's Representative.

## 2.2 LABELING

- A. Shall meet the legibility, defacement, exposure and adhesion requirements of UL 969.
- B. Unless otherwise indicated, provide black text on a white background.
- C. Shall be preprinted or computer printed type. Hand written labels are not acceptable
- D. Manufacturers
  1. Brother P-Touch
  2. Brady
  3. Or equal.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine existing conditions before starting work. Submit conflicts in a timely manner for resolution

### 3.2 GENERAL

- A. Conform to UL 681, UL 1037, and UL 1076, the appropriate installation manual and the requirements of each specification section for each equipment type, whichever is most restrictive. Components within the system shall be configured with appropriate "service points" to pinpoint system trouble in less than 20 minutes.

### 3.3 PREPARATION

- A. Prepare and sequence the work to minimize disruption to each room environment and any existing Electronic Safety and Security systems.
- B. Protection: Cover all computers, electronic equipment, desks, chairs, furniture and other articles when working at ceiling level and/or performing dust producing tasks.

### 3.4 LABELING

- A. Field devices: Each Electronic Security System initiating device and each annunciating device shall be labeled with the assigned C-Cure ID.
  - 1. The ID shall incorporate the device abbreviation, the architectural door number and a sequential number assigned to each device of the same type occurring at the door opening in the form Door Number - Device Abbreviation – Sequential Number - .
    - a. Example: One LA at door number 101A: 101A-LA-1.
    - b. Example: Two DO's at door 121: 121-DO-1, 121-DO-2.
  - 2. Apply label to an unobtrusive spot on the device, cut to minimum practical size before applying.
- B. Panels. Attach to the interior of each control panel clear plastic holder in this holder place a laser printed list of the door and card reader relay points zone numbers and other signals that may be transmitted to the central station, the type of device, exactly what the alarm and restoral signals indicate. This list shall be typed on 8-1/2" x 11" paper and provide a copy of these list(s) in Microsoft Word in electronic media format delivered to the University's Representative.

### 3.5 REPAIR AND RESTORATION

- A. Where working in spaces occupied by the University, return to their original positions any furniture or articles relocated to perform the work.

### 3.6 CLEANING

- A. Where working in spaces occupied by the University:
  - 1. Immediately after completing work within each space, clean up and remove all materials, scrap and dust.
  - 2. All scrap material in work area shall be picked up and removed from the building at the end of each day. See also Division 1 for additional requirements.
  - 3. All dust resulting from work performed shall be vacuumed up daily.
  - 4. All scrap material shall be removed from Campus and disposed of in an authorized disposal site. Refer to Section 01 74 19 - Construction Waste Management and Disposal.

### 3.7 SYSTEMS PERFORMANCE TESTING AND ADJUSTING PROCEDURES

- A. General Procedures
  - 1. It shall be the responsibility of the Security Contractor to demonstrate to the University's Representative that the security system is complete and functional as per

- these specifications. For intrusion detection field devices test shall ensure that the requisite degree of intrusion detection is provided.
2. Acceptance testing shall be scheduled by the Security Contractor through established project channels
  3. Furnish all necessary instruments and equipment required for conducting tests.
- B. Device Level Tests
1. Initially, test each sensor and subsystem component individually.
  2. Test all wire for shorts, open circuits, or grounding.
  3. Immediately correct any defective work
- C. Systems Tests.
1. When the function of each component within a particular subsystem such as each sensor within a particular zone is verified, certify that subsystem of the entire Electronic Safety and Security System is satisfactorily meeting required specifications. Test each subsystem similarly until each detection zone has been certified.
  2. When subsystem certification is complete, test entire integrated system to ensure that subsystem elements are compatible and function as a complete system. Integrated system test shall be accomplished in linear fashion, end-to-end, and shall verify that each simulated intrusion performed within each detection zone produces an appropriate alarm or signal.
  3. Integrated system test shall also verify that alarm is correctly annunciated at the terminal block associated with the field devices,
- D. Contractor Testing
1. Provide for approval, not later than 30 days prior to formal inspection and test, a detailed operational test plan of how each component, subsystem, and entire Electronic Safety and Security System will be tested
  2. Submit a written test report from an authorized representative of the equipment manufacturer that the system has been 100% tested and approved. Submit prior to request for final payment.
  3. Test each individual circuit and device for proper operation in the presence of telecommunications personnel. Correct all failures and retest at contractors expense to verify corrections. Correct as built drawings, O & M manuals, programming sheets and system programming to reflect the University's final occupancy room numbers.
  4. Provide University's Acceptance Form with a check box associated with each card reader and input point. A check mark in the box will indicate that each point has been correctly installed and that communication between the controller and the server has been established. This form shall be completed prior to University acceptance of the system.

### 3.8 COMMISSIONING AND ACCEPTANCE

- A. General:
1. Upon completion of the work, remove excess debris, materials, equipment, apparatus, tools and similar items. Leave the premises clean, neat and orderly.
- B. Results Expected:
1. Electronic Security Systems shall be complete and ready for use.
  2. Testing, start-up and cleaning work shall be complete.
  3. Maintenance Materials: Special tools for proper operation and maintenance of the equipment provided under this Specification shall be delivered to the University.
- C. Inspections
1. There shall be three phases of commissioning inspections:
    - a. Rough-in inspection
    - b. Above-ceiling inspection (after cables are placed)
    - c. Final inspection and testing
  2. The Contractor shall verify that the installation and materials used have been inspected before they are enclosed within building features, or otherwise hidden from

- view. The Contractor shall bear costs associated with uncovering or exposing installations or features that have not been inspected and approved.
- D. Rough-in inspection. Once electrical rough-in and pathways have been installed, but prior to walls and ceilings being installed, the Contractor shall request of the University's Representative, in writing, for the official rough-in inspection to take place. The University's Representative will then schedule a time to be on-site to conduct this inspection.
1. At a minimum, the University's Representative will evaluate the following items:
    - a. Accurate location and height above finished floor for all outlet boxes.
    - b. Accurate dimensions (particularly depth) of all outlet boxes and diameter of in-wall conduit serving outlet boxes.
    - c. Gutter size, location and clearance.
    - d. Location and size of all other electronic security systems conduits or pathways.
    - e. Location, spacing and clearance of and around electronic security systems racks and wall-mounted equipment.
    - f. That electronic security systems hard wired power and power receptacles, where installed under the work of this project, meet the design requirements
  2. The University's Representative is then to issue a written report to the Contractor identifying all items which currently do not meet the construction document requirements. All items are to be resolved prior to walls and ceilings being closed up. This report is not necessarily all-inclusive; should issues be discovered later in the project, the Contractor is still responsible for corrections/repairs.
- E. Above-ceiling and Camera Placement Inspection
1. Once all electronic security systems cabling has been installed and properly supported and suspended light fixtures hung, but prior to the installation of ceiling tiles/material, contractor shall request of the University's Representative, in writing, for the official above-ceiling and final camera placement inspection. The University's Representative will then schedule a time to be on-site to conduct this inspection.
    - a. Prior to the walk, the Contractor is to apply colored tape indicating proposed camera installation locations for field review.
  2. At a minimum, the University's Representative will evaluate the following items:
    - a. That the camera locations can provide the required field of view.
    - b. That all items from the previous inspection have been corrected.
    - c. That electronic security systems cabling is routed correctly and adequately supported.
    - d. That electronic security systems cabling is not painted or over-sprayed.
    - e. That the installed electronic security systems cabling matches what was specified/submitted.
    - f. That there are no kinks, splices, or other damage to the installed electronic security systems cabling.
    - g. That all field devices are properly supported, oriented and labeled.
    - h. That all penetrations through fire-rated walls are properly firestopped, including fire blocking materials installed in the annular spaces; and that the firestops are properly labeled.
  3. The University's Representative is then to issue a written report to the Contractor identifying all items which currently do not meet the construction document requirements. This report is not necessarily all-inclusive; should issues be discovered later in the project, the appropriate communications subcontractor is still responsible for corrections/repairs.
- F. Acceptance Review and Testing Procedures
1. The University's Representative will witness formal Acceptance Tests after receipt of written certification that all prior Punch List work is complete and that Contractor's functionality tests have been completed and that system is ready for final inspection. This request shall be made 3 weeks before substantial completion. The University's Representative will then schedule a time to be on site to conduct this inspection.

2. The Contractor shall provide the following for the acceptance testing.
  - a. Personnel: Provide services of the designated supervisor, ACAS manufacturer representative and additional manufacturer qualified technicians familiar with work of this Project. Provide quantity of technicians as required to comply with Project Schedule.
  - b. All tools appropriate for performance of adjustment of and corrections to this Work. Include spare wire and connectors and specified tooling for application.
  - c. Ladders, scaffolding and/or lifts as required to access high devices.
  - d. All test equipment.
  - e. Complete set of latest stamped, actioned submittals of record for reference
  - f. Complete set of Test Reports.
  - g. Complete set of manufacturer's original operation, instruction and service manuals for each equipment item for reference.
3. The Contractor shall execute the test plan required in Submittals section and as approved and/or modified by the University's Representative. The testing must demonstrate complete operation of all systems and equipment, including any portable equipment.
4. These procedures may be performed at any hour of the day or night as required by the University's Representative to comply with the Project Schedule and avoid conflict with University staff or student activities. Provide all specified personnel and equipment at any time without claim for additional cost or time.
5. At a minimum, the University's Representative will check the following items:
  - a. Mechanical/Physical Installation.
    - i. *That all items from the previous inspections have been Corrected.*
    - ii. *That all electronic security systems equipment and cabling terminal rooms is installed per the contract documents, including all required terminal blocks, pull boxes, termination resistors and electronic security systems grounding.*
    - iii. *All other items necessary to guarantee contract documents are met and complete and functioning communications systems are installed.*
    - iv. *All cables and electronic security systems field devices and pathway are properly labeled.*
    - v. *All penetrations through fire-rated walls are properly fire-stopped, including fire blocking materials installed in the annular spaces; and that the firestops are properly labeled.*
  - b. Functionality Demonstration
    - i. *Demonstrate functionality of each installed device is consistent with the read range, sensitivity and immunity to false alarms as specified by the device manufacturer.*
    - ii. *Functional demonstration to also include, but not limited to the following active components and all related items installed under the work of the project:*
      1. *Batteries*
      2. *Cameras*
      3. *Card readers*
      4. *Door position sensors*
      5. *Duress alarm components*
      6. *Electrified hinges*
      7. *Electrified latches*
      8. *Electrified strikes*
      9. *Glass break sensors*
      10. *Key pad controllers*
      11. *Local alarm devices*
      12. *Motion detectors*

13. *Power supplies*
  14. *Relays*
  15. *Request to exit device*
  16. *Servers*
  17. *Switches*
  18. *UPS devices*
6. Access Control Infrastructure:
    - a. Demonstrate that operation of each opening, including access controlled doors and gates. Refer to the System Performance Requirements and Schedule of Programmatic Outcomes by Door Opening in Section 28 13 00 – Access Control and Alarm Systems is in full conformance with the specified functionality, including each C-Cure status item associated with the scheduled UCSC Door Class.
  7. Door Position, Window and Hatch Switches
    - a. Demonstrate functionality of each device. Demonstrate that operation of each monitored door by 1/2" or less from the fully closed position causes the position switch to change state.
  8. Uninterrupted Power Systems:
    - a. Disconnect normal power service. Demonstrate that the system remains in full operation for the specified time.
- G. Adjust: As directed by the University's Representative.

### 3.9 POST ACCEPTANCE TEST REMEDIATION

- A. Temporary Equipment: Provide and operate, without claim for additional cost or time, temporary equipment and/or systems to provide reasonably equivalent function, as determined by the University's Representative, in place of the Work of this Section which is incomplete or found not in conformance with the Contract Documents as of seven (7) days prior to the scheduled completion date. Provide such temporary equipment until Acceptance of the Work of this Section. Thereafter, remove such temporary equipment.
- B. Correct:
  1. In timely manner, correct identified Work of this Section which is incomplete or found not in conformance with the Contract Documents to comply with the Contract Documents, as reasonably determined by the University's Representative.
  2. Conduct additional tests to in the presence of the University's representative to demonstrate that system conforms to the Contract Documents.

END OF SECTION 28 05 00

## Section 28 05 13

## CONDUCTORS AND CABLES FOR ELECTRIC SAFETY AND SECURITY

## PART 1 - GENERAL

## 1.1 SCOPE OF WORK

## A. Defines wiring standards for work of Electronic Safety and Security Systems

*The Division 27 references below assume that Structured Cabling systems conforming to current UCSC ITS standards are being specified in Division 27. If not, preserve the equivalent language in this Section.*

## B. Related Work Under Other Sections

1. [Section 27 10 00 – Structured Cabling, Basic Materials & Methods
  - a. Defines standards and methods for termination of IP-based cabling used for IP cameras and IP work area outlets necessary to support access control systems installed under the work of Division 28.
2. Section 27 15 00 – Communications Horizontal Cabling
  - a. Defines materials and execution standards for installation of TIA/ANSI standard category media installed under the work of Division 27 to provide work area outlets for final connection by the work of Division 28 to cameras and IP alarm system panels.]
3. Section 28 05 00 – Common Work Results for Electronic Safety and Security.
4. Section 28 05 26 – Grounding and Bonding For Electronic Safety And Security
5. Section 28 05 28 – Pathways for Electronic Safety And Security
6. Section 28 13 00 – Access Control and Alarm Systems

## 1.2 SUBMITTALS

- A. Refer to the requirements of Section 01 33 23 – Shop Drawings, Product Data and Samples and Section 28 05 00 – Common Work Results for Electronic Safety and Security.

## 1.3 REFERENCES:

- A. Usage: In accordance with Division 1.
- B. American Society For Testing and Materials (ASTM)
  1. ASTM A228/A228M-02 Steel Wire, Music Spring Quality.
  2. ASTM D 709(2001) Laminated Thermosetting Materials
- C. Federal Communications Commission (FCC)
  1. The Code of Federal Regulations, Title 47, Telecommunications, Chapter 1 - FCC Part 68 (1982 issue or latest revision) (47 CFR 68) .
- D. Institute of Electrical and Electronic Engineers
  1. IEEE 383-2003 Standard for Qualifying Class 1E Electric Cables and Field Splices for Nuclear Power Generating Stations
  2. IEEE 100-00 The Authoritative Dictionary of IEEE Standards Terms
- E. Insulated Cable Engineers Association (ICEA)
  1. ICEA S-56-434 (1983, 5th Ed.) Reaffirmed October 18, 1991 Polyolefin Insulated Communication Cables for Outdoor Use.
  2. ANSI/ICEA S-83-596-2011 Indoor Optical Fiber Cables
  3. ANSI/ICEA S-84-608-2010 Telecommunications Cable, Filled Polyolefin Insulated Copper Conductor

4. ANSI/ICEA S-86-634-2011 Buried Distribution & Service Wire, Filled Polyolefin Insulated, Copper Conductor.
5. ANSI/ICEA S-87-640-2011 Fiber Optic Outside Plant Communications Cable
6. ICEA S-102-700-2004 – ICEA Standard For Category 6 Individually Unshielded Twisted Pair Indoor Cables (With Or Without An Overall Shield) For Use In Communications Wiring Systems Technical Requirements
7. ICEA S-103-701-2011 Riser Cables Technical Requirements
- F. National Electrical Manufacturers Association (NEMA)
  1. NEMA WC 63.1(2000) Twisted Pair Premise Voice and Data Communications Cables
- G. National Fire Protection Association (NFPA)
  1. NFPA 70 National Electrical Code
- H. Telecommunications Industry Association (ANSI/TIA)
  1. ANSI/TIA-568-C.0, Generic Telecommunications Cabling for Customer Premises
  2. ANSI/TIA-568-C.1, Commercial Building Telecommunications Cabling Standard, 2009
  3. ANSI/TIA-568-C.2, Balanced Twisted-Pair Telecommunication Cabling and Components Standard, published 2009
  4. ANSI/TIA-568-C.3, Optical Fiber Cabling Components Standard, published 2008, including errata issued in October, 2008.
  5. ANSI/TIA 569-C (2012) Telecommunications Pathways and Spaces
  6. ANSI/TIA-606-B (2012) Administration Standard Telecommunications Infrastructure
  7. ANSI- J-STD-607-B (2011) Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
- I. Underwriters Laboratories, Inc. (UL)
  1. UL 444(2002; Bul. 2002, 2003) Communications Cables
  2. UL 910(1998) Flame-Propagation and Smoke-Density Values for Electrical and Optical-Fiber Cables Used in Spaces Transporting Environmental Air
  3. UL 1286(1999; R 2004) Office Furnishings
  4. UL 1581 Reference Standard for Electrical Wires, Cables, and Flexible Cords. Oct. 2001
  5. UL 1666(2000; R 2002) Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts
  6. UL 1863(2000; R 2004) Communications Circuit Accessories
  7. UL 969 (1995; R 201) Marking and Labeling Systems

#### 1.4 DELIVERY, STORAGE AND HANDLING

- A. Comply with requirements of Division 1, Section 27 05 00 – Common Work Results for Communications and the following:
- B. Shipping Conditions:
  1. All cable shall be shipped on reels or manufacturer supplied “handy boxes”.
  2. The diameter of the drum shall be at least 13 times the diameter of the cable.
  3. The reels shall be substantial and so constructed as to prevent damage during shipment and handling.
  4. Secure the outer end of the cable to the reel head so as to prevent the cable from becoming loose in transit.
  5. Project the inner end of the cable into a slot in the side of the reel, or into a housing on the inner slot of the drum, in such a manner and with sufficient length to make it available for testing.
  6. The inner end shall be fastened so as to prevent the cable from becoming loose during installation. End seals shall be applied to each of the cables to prevent moisture from entering the cable.
- C. Storage:
  1. Do not roll or store cable reels without an appropriate underlay.
  2. Retain factory cable protection until installation. Supplement with heavy gauge plastic

sheeting if factory protective membrane is pierced prior to installation. Tape ends and seams water and dust tight.

3. The reels with cable shall be suitable for outside storage conditions when the temperature ranges from minus 40 degrees C to plus 65 degrees C, with relative humidity from 0 to 100 percent.
4. Protect cable reels from physical damage from site construction vehicles or from settling into the soil.
5. Equipment, other than outside plant rated cable protected with fully watertight cable caps, to be delivered and placed in storage, suitably protected from the weather, humidity and temperature variation, dirt and dust, or other contaminants.

D. Handling

1. Cabling other than outside plant cabling exposed to standing water or other liquids at any time during storage, delivery or placement shall be replaced at no expense to the University.
2. Cut ends of outside plant rated cabling or portions of outside plant rated cable with a damaged jacket shall not be exposed to standing water or other liquids at any time during storage, delivery or placement. Where such conditions occur, the University's representative may require that the cable be replaced at no cost to the University.

## 1.5 SEQUENCING

- A. Coordinate the installation of the horizontal cabling with the other work of this Project, or Projects simultaneously in progress in each building of the project. The Contractor shall ensure that construction and preparation of the rooms and spaces in which the work of this Section are to be installed are sufficiently complete before beginning work.
- B. Removal, replacement and re-installation of materials and equipment required to permit the completion or correction of other building trade work that is the work of this Project shall be done at no cost to the University or impact to the project schedule.

*Include the next two subsections where work of the Project has no Division 27 spec and relies on this Section to install station cabling supporting the TCP/IP cameras and/or DGP uplink signaling.*

## 1.6 CATEGORY RATED CABLE PERFORMANCE STANDARDS

- A. Horizontal (Station) Category 6 Copper Cabling – Permanent Link
  1. Testing shall commence while the University's equipment in the area of service is operational and creating worst case emissions associated with its operation while in good working order. Every effort shall be made to include worst case influence on the materials install shall be taken.
  2. In accordance with the field test specifications defined in ANSI/TIA-568-C.2 "Commercial Balanced Twisted-Pair Telecommunications Cabling and Components Standard", every horizontal station cabling link in the project shall be tested for
    - a. Wire Map
    - b. Length
    - c. Insertion Loss
    - d. NEXT Loss
    - e. PS NEXT Loss
    - f. ACR-F Loss
    - g. PS ACR-F Loss
    - h. Return Loss
    - i. Propagation Delay
    - j. Delay Skew
    - k. Using the listed Category 6 cable test set, test installed cabling using Permanent Link procedure and submit report demonstrating that the link

meets the following parameters:

Frequency (MHz)	Insertion Loss	NEXT (Worst pair to pair)	Power Sum NEXT	ELFEXT (Worst pair to pair)	Power Sum ELFEXT	Return Loss
1.0	2.0	79.3	77.3	72.8	69.8	20.0
4.0	3.8	70.3	68.3	60.7	57.7	23.6
10.0	5.9	64.3	62.3	52.8	49.8	26.0
16.0	7.5	61.3	59.3	48.7	45.7	26.0
20.0	8.4	59.8	57.8	46.7	43.7	26.0
31.3	10.6	56.9	54.9	42.9	39.9	25.0
62.5	15.3	52.4	50.4	36.8	33.8	23.5
100.0	19.7	49.3	47.3	32.8	29.8	22.5
150.0	24.7	48.7	44.7	29.3	26.3	21.6
200.0	29	44.8	42.8	26.8	23.8	21.0
250.0	32.6	43.3	41.3	24.8	21.8	20.5

1. Each permanent link shall demonstrate a positive PSACR beyond 350 MHz to meet and exceed the bandwidth requirements of TIA-568-C.2 Category 6 standards. Each permanent link shall demonstrate 2 dB of cross talk headroom over TIA-568-C.2 Category 6 standard for NEXT, PSNEXT, ELFEXT and PSELFEXT bit error rate.
3. Report whether tested link passes or fails
4. Note exceptions to required Category standards. Remedy and retest

## 1.7 CATEGORY RATED CABLE TESTING

### A. General

1. In addition to the tests detailed in this specification section, the contractor shall notify the University's Representative of any additional tests that are deemed necessary to guarantee a fully functional system. The contractor shall carry out and record any additional measurement results at no additional charge
2. Test and report on each intermediate cabling segment separately, including station cabling, horizontal distribution (each segment, if multiple) and telecommunications room wiring.
3. Test each end to end cable link.
4. Submit machine-generated documentation and raw data of all test results on Contractor-provided, and University's Representative approved forms; and in electronic format approved by the University's Representative.
5. Provide machine-generated data on an appropriate disk media (CD-ROM CD-R format) to be transferred to the University's computers.
  - a. Where the machine-generated documentation requires use of a proprietary

- computer program to view the data, provide the University with 1 licensed copy of the software.
6. Provide registered testing software used for the actual tests to the University for review of test data.
- B. Test Equipment:
1. Test systems using at least one (1) each of the following test measurement devices or their functional equivalents:
    - a. Level III field testers as defined in ANSI/TIA-1152 - Fluke DX-1800, Agilent or equal.
      - i. *The tester including the appropriate interface adapter must meet the specified accuracy requirements. The accuracy requirements for the permanent link test configuration (baseline accuracy plus adapter contribution) are specified in Table 4 of ANSI/TIA-1152 (Table 4 in this TIA document also specifies the accuracy requirements for the Channel configuration).*
      - ii. *The RJ45 test plug shall fall within the values specified in ANSI/TIA-568-C Annex C for NEXT, FEXT and Return Loss.*
      - iii. *The tester interface adapters must be of high quality and the cable shall not show any twisting or kinking resulting from coiling and storing of the tester interface adapters. In order to deliver optimum accuracy, preference is given to a permanent link interface adapter for the tester that can be calibrated to extend the reference plane of the Return Loss measurement to the permanent link interface. The contractor shall provide proof that the interface has been calibrated within the period recommended by the vendor. To ensure that normal handling on the job does not cause measurable Return Loss change, the adapter cord cable shall not be of twisted-pair construction.*
    - b. Site portable communications systems (walkie-talkie, cell phone or similar).
    - c. Any other items of equipment or materials required to demonstrate conformance with the Contract Documents.
- C. Station Wiring, General
1. Test station wire only after all pairs of station wire in a work area have been terminated at both ends, and no work of this Section or other Sections may cause physical disturbance to the wiring.
  2. Correct any and all transpositions found. Retest.
  3. If any conductor in a station wire tests either open or short, then the entire station wire is to be removed, replaced, and re-tested.
- D. Inside Category 6 Cabling.
1. Using the listed Category 6 cable test set, test and submit report on the parameters specified for Category 6 cabling in this Section. Report whether tested link passes or fails the Category 6 standards. Cables must pass TIA Permanent Link Certification for the cable type being installed. A "Marginal" test result will not be accepted.
  2. Note exceptions to required Category standards. Remedy and retest.]

## PART 2 - PRODUCTS

### 2.1 NON-CATEGORY RATED CABLING

#### A. General

1. Where not otherwise specified or indicated, conform to manufacturers most stringent

recommendations with respect to pair count, gage, conductor construction and shielding for indicated run length.

2. Conform to Code requirements with respect to acceptable jacket construction for each application and condition. Provide NEC/CEC CMP listed cable construction at plenum at environmental air and underfloor applications.
3. Analog Video Cabling, Copper Coax and Related. Provide cable with electrical conductors of soft drawn annealed copper, bare or tinned, solid or concentric stranded as applies, conductivity not less than 98% of pure copper. Comply with applicable Code for insulation, jacket, marking and listing for applicable use.
4. Manufacturers:
  - a. Alpha
  - b. Belden
  - c. Commscope/Isotec
  - d. West Penn
  - e. or equal.

B. Card Reader Cabling

1. Construction:

- a. Conform to Code requirements with respect to acceptable jacket construction for each application and condition
- b. 4 pair
- c. 22 ga. minimum
- d. Overall foil shield with drain wire.
- e. Manufacturers:
  - i. *Belden*
  - ii. *Alpha*
  - iii. *Commscope/Isotec*
  - iv. *West Penn*
  - v. *or equal.*

*Omit where work of the Project has no Division 27 spec and relies on this Section to install station cabling.*

f. [Manufacturers, Alternate Construction:

- i. *Provide Category 6 cabling as specified in Section 27 15 00. ]*

C. Release Button, Door Switch

1. 2 stranded conductors, 22-18 gauge minimum
2. Manufacturers:
  - a. Belden 8442, 8461, 5300UE, 5500UE, 6300UE, 6500UE
  - b. Alpha
  - c. Commscope/Isotec
  - d. West Penn
  - e. or equal.

D. Request to Exit, Motion Detector, Glass Break

1. 4 stranded conductors, 22-18 gauge minimum
2. Manufacturers:
  - a. Belden 5302UE, 5502UE, 6302UE, 6502UE
  - b. Alpha
  - c. Commscope/Isotec
  - d. West Penn
  - e. or equal.

E. Combination dual detector

1. 6 stranded conductors, 22-18 gauge minimum
2. Manufacturers:
  - a. Belden 5304UE, 5504UE, 6304UE, 6504UE
  - b. Alpha

- c. Commscope/Isotec
  - d. West Penn
  - e. or equal.
- F. Lock Power and General Low Voltage Power, Indoor Applications
  - 1. 2 stranded conductors, 16-18 gauge minimum. Size to exceed manufacturer's minimum recommendations for voltage drop for required run lengths.
  - 2. Manufacturers:
    - a. Belden 5300UE, 5200UE, 6300UE, 6200UE
    - b. Alpha
    - c. Commscope/Isotec
    - d. West Penn
    - e. or equal.
- G. RS-232 Cabling
  - 1. At least 2-3 pairs, actual pair count as required by interface.
  - 2. 22 gauge minimum, paired construction.
  - 3. Overall foil shield with drain wire
  - 4. Manufacturers:
    - a. Belden 9855, 89855
    - b. Alpha
    - c. Commscope/Isotec
    - d. West Penn
    - e. or equal.
- H. RS-485 Cabling
  - 1. At least 2 pairs, or as required by interface.
  - 2. 18 gauge minimum, paired construction.
  - 3. Overall foil and braid shield with drain wire
  - 4. Manufacturers:
    - a. Belden 9842, 82842
    - b. Alpha
    - c. Commscope/Isotec
    - d. West Penn
    - e. or equal.
- I. Control Cabling, Underground, in ducts
  - 1. As specified for the applications above with waterblocking construction consisting of two ply tape designed to swell on exposure to water.
  - 2. Jacket is sunlight and moisture resistant
  - 3. NEC CM or CL3 listed or better. Transition to listed cabling type within 50 feet of entering building
  - 4. Manufacturer listed for underground application subject to extended exposure to standing water.
  - 5. Manufacturer:
    - a. West Penn Aquaseal
    - b. Alpha
    - c. Belden
    - d. Commscope/Isotec
    - e. or equal.
- J. Cable, Precision Video:
  - 1. Drawing Reference: PVideo.
  - 2. Description: 100% sweep tested (0.01 to 100 MHz) double braided shield solid center conductor 75 ohms coaxial precision video cable.
  - 3. Performance:
    - a. Cable Type: Coaxial precision video.
    - b. Center Conductor AWG: At least twenty (20) bare copper. Copper clad steel center conductors not acceptable. Increase gauge for longer runs as

- recommended by camera manufacturer.
- c. Jacket
  - i. *Underground: Flooded, waterblocked. Suitable for continuous immersion in water.*
  - ii. *Riser and General Applications:*
  - iii. *Underfloor and in environmental airspace: Plenum*
- d. Insulation: Polyethylene.
- e. Shield: Tinned copper double braid, 95% coverage.
- f. Nominal Impedance: 75 ohms.
- g. Velocity of Propagation: at least 66%.
- h. Maximum Attenuation Per 100':
  - i. *1 MHz: 0.25 dB*
  - ii. *4.5 MHz: 0.45 dB.*
  - iii. *10 MHz: 0.78 dB.*
- 4. Jacket: Polyethylene.
- 5. Diameter: 0.305" maximum.
- 6. Manufacturers
  - a. Interior Application
    - i. *Belden 8281A, 8281B, 543945, 643948*
    - ii. *Commscope/Isotek IR201V59*
    - iii. *West Penn*
    - iv. *or equal*
  - b. Underground Outside Plant, as for above with flooded jacket, at least NEC CM rating.
    - i. *Belden 5339W5*
    - ii. *Commscope/Isotek*
    - iii. *West Penn*
    - iv. *or equal*
  - c. Siamese cabling with specified coaxial cable and integral camera control cabling:
    - i. *Belden*
    - ii. *Commscope/Isotek*
    - iii. *West Penn*
    - iv. *or equal*

*Include the next subsection where work of the Project has no Division 27 spec and relies on this Section to install station cabling.*

## 2.2 STRUCTURED CABLING

### A. General

1. Provide horizontal cable in compliance with NFPA 70 and performance characteristics in accordance with TIA/EIA-568-C
2. UCSC has established an installed product set for the campus IT systems. It is the intention of UCSC ITS to continue the use of the established product set to match existing. The first-named product in these specifications is the basis for the design. Substitutions which are equal in quality, utility, and appearance to those specified must be submitted and meet all requirements of Division 01 specification section 01 25 00 Substitution Procedures.

### B. Definitions

1. Keystone Opening: A communications industry standard rectangular opening in a wall plate or patch panel having nominal dimensions of 0.58" wide and .76" high and designed to securely mount industry standard keystone jacks.

- C. Intervendor compatibility
  - 1. Keystone Jack Compatibility test.
    - a. Any jack or panel system proposed as meeting the keystone compatibility requirements of this specification shall be able to interchangeably mount or mount in (as applies) Leviton Quickport series components.
    - b. Systems exhibiting excess play, inability to insert, inability to remove, damage to the plate or jack or occupying excessive area behind the plate opening will not be accepted.
- D. Copper Cabling, Category Rated Data/Voice
  - 1. General
    - a. Provide horizontal cable in compliance with NFPA 70 and performance characteristics in accordance with ANSI/TIA-568-C
  - 2. High Speed, EIA/TIA Category Cabling
    - a. Drawing Reference: \*\* UTP6-4, where \*\* denotes cable count
    - b. Construction:
      - i. *Provide horizontal copper cable in accordance with:*
        - 1. ANSI/TIA-568-B.2
        - 2. UL 444
        - 3. NEMA WC 66 (Performance Standard for Category 6 and Category 7 100 Ohm Shielded and Unshielded Twisted Pair)
        - 4. ICEA S-90-661
      - ii. *UTP (unshielded twisted pair),*
      - iii. *100 ohm impedance*
      - iv. *No shield in the sheath.*
      - v. *Jacket*
        - 1. *Color: Blue unless otherwise indicated*
        - 2. *Provide communications general purpose (CM or CMG), communications plenum (CMP) or communications riser (CMR) rated cabling in accordance with NFPA 70.*
        - 3. *Type CMP and CMR may be substituted for type CM or CMG and type CMP may be substituted for type CMR in accordance with NFPA 70.*
    - c. Certification
      - i. *Warrantied by the manufacturer to provide Category 6 performance when installed in accordance with applicable ANSI/TIA standards and when terminated with the jacks supplied by the Contractor for this Project.*
    - d. Minimum Performance
      - i. *Assembly electrically meets or exceeds ANSI/TIA 568-C.2 Category 6 performance standards and the following:*

FQ = Frequency (MHz) / TIA = TIA Spec / PG = Product Guarantee							
	RL (dB)	NEXT (dB)	PSNEXT (dB)	ACRF (dB)	LCL/TC L		
FQ	TIA / PG	TIA / PG	TIA / PG	TIA / PG	PG		
1	20.00 / 20.00	74.30 / 76.30	/	72.30 / 74.30	/	67.80 / 67.80	40.00

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4	23.00 / 23.00	65.30 / 67.30	/	63.30 / 65.30	/	55.80 / 55.80	40.00
10	25.00 / 25.00	59.30 / 61.30	/	57.30 / 59.30	/	47.80 / 47.80	40.00
16	25.00 / 25.00	56.20 / 58.30	/	54.20 / 56.30	/	43.70 / 43.70	38.00
20	25.00 / 25.00	54.80 / 56.80	/	41.80 / 54.80	/	41.80 / 41.80	37.00
31.25	23.60 / 23.60	51.90 / 53.90	/	49.90 / 51.90	/	37.90 / 37.90	35.10
62.5	21.50 / 21.50	47.40 / 49.40	/	45.40 / 47.40	/	31.90 / 31.90	32.00
100	20.10 / 20.10	44.30 / 46.30	/	42.30 / 44.30	/	27.80 / 27.80	30.00
150	18.90 / 18.90	41.70 / 43.70	/	39.70 / 41.70	/	24.30 / 24.30	28.20
200	18.00 / 18.00	39.80 / 41.80	/	37.80 / 39.80	/	21.80 / 21.70	27.00
250	17.30 / 17.30	38.30 / 40.30	/	36.30 / 38.30	/	19.80 / 19.80	26.00
300	— / 16.80*	— / 39.10*	—	/ 37.10*		— / 18.30*	25.20
350	— / 16.30*	— / 38.20*		— / 36.20*		— / 16.90*	24.60*
400	— / 15.90*	— / 37.30*		— / 35.30*		— / 15.80*	24.00*
450	— / 15.50*	— / 36.50*		— / 34.50*		— / 14.70*	23.50*
500	— / 15.20*	— / 35.80*		— / 33.80*		— / 13.80*	23.00*
	IL (dB/100 m)			m) PSACR		PSACRF (dB/100 m)	EL TCTL
FQ	TIA / PG	TIA / PG		TIA / PG		TIA / PG	PG
1	2.00 / 2.00			72.20 / 74.30 / 70.30 / 72.30 / 64.80 / 64.80			35.00
4	3.80 / 3.80			61.50 / 63.50 / 59.50			23.00

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			/ 61.50 52.80 / 52.80		
10	6.00 / 6.00		53.40 / 55.40 51.30 / 53.40 44.80 / 44.80		15.00
16	7.60 / 7.60		48.80 / 50.70 46.70 / 48.70 40.70 / 40.70		10.90
20	8.50 / 8.50		46.40 / 48.40 44.30 / 46.40 38.80 / 38.80		9.00
31.25	10.70 / 10.70		41.40 / 43.30 39.20 / 41.30 37.90 / 34.90		—
62.50	15.40 / 15.40		32.40 / 34.00 30.00 / 32.00 28.90 / 28.90		—
100	19.80 / 19.80		25.20 / 26.60 22.50 / 24.60 24.80 / 24.80		—
150	24.70 / 24.60		16.90 / 19.10 14.90 / 17.10 21.30 / 21.30		—
200	29.00 / 29.00		.80 / 10.90	18.80 / 18.70	—

250	32.80 / 32.80	7.30 / 7.50	3.50 / 5.50	16.80 / 16.80	—
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300	— / 36.40*	— / 2.70*	— / —	— / 15.30*	—
350	— / 39.80*	— / -1.60*	— / —	13.90 / 13.90*	—
400	— / 43.00*	— / -5.70*	— / —	12.80 / 12.80*	—
450	— / 46.00*	— / -9.50*	— / —	— / 11.70*	—
500	— / 48.90*	— / -13.10*	— / —	10.80 / 10.80*	—

e. Technical Data - Physical

- i. *Conductor: 23 AWG Bare Copper*
- ii. *Conductor diameter - in.: 0.022"*
- iii. *Insulated conductor dia.-in.: 0.039"*
- iv. *Cable diameter - in.: 0.21"*
- v. *Nom. cable wt.-lb./kft.: 22*
- vi. *Max. installation tension - lb.: 25*
- vii. *Min. bend radius - in.: 1.00*
- viii. *Color Code:*
  1. *Pair-1: White/Blue Blue*
  2. *Pair-2: White/Orange Orange*
  3. *Pair-3: White/Green Green*
  4. *Pair-4: White/Brown Brown*
- ix. *Temperature Rating (degrees C)*
  1. *Installation: 0 to +50*
  2. *Operation: -20 to +75*
- x. *Mutual Capacitance: 5.1 nF/100 m max.*
- xi. *DC Resistance: 9.38 Ohms/100 m max.*
- xii. *Skew: 45 ns/100 m max.*
- xiii. *Pair to Ground Unbalance: 330 pF/100 m max.*
- xiv. *Velocity of Propagation: 69% nom.*
- xv. *DC Resistance unbalance: 5% max.*

3. Manufacturers:

- a. Berk-Tek LANmark-6
- b. General Cable
- c. or equal

E. High Speed, Category 6 Cabling, Plenum Rated

1. Drawing Reference: \*\* UTP6-4P, where \*\* denotes cable count
2. Construction:
  - a. As for non-plenum, with fire retardant overall jacket construction.
  - b. National Safety Agency – UL or ETL listed, NEC compliant for plenum installation - CMP.
3. Manufacturers
  - a. As for non-plenum Cat. 6, plenum construction.
4. Minimum Performance
  - a. Category 6 CMP, where FQ = Frequency (MHz), TIA = TIA Spec, PG = Manufacturer's Product Guarantee

	RL (dB)	NEXT (dB)	PSNEXT (dB)	ACRF (dB)	LCL/T CL
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FQ	TIA / PG	TIA / PG	TIA / PG	TIA / PG	PG
1	20.00 / 20.00	74.30 / 76.30	72.30 / 74.30	67.80 / 67.80	40.00
4	23.00 / 23.00	65.30 / 67.30	63.30 / 65.30	55.80 / 55.80	40.00
10	25.00 / 25.00	59.30 / 61.30	57.30 / 59.30	47.80 / 47.80	40.00
16	25.00 / 25.00	56.20 / 58.30	54.20 / 56.30	43.70 / 43.70	38.00
20	25.00 / 25.00	54.80 / 56.80	41.80 / 54.80	41.80 / 41.80	37.00
31.25	23.60 / 23.60	51.90 / 53.90	49.90 / 51.90	37.90 / 37.90	35.10
62.5	21.50 / 21.50	47.40 / 49.40	45.40 / 47.40	31.90 / 31.90	32.00
100	20.10 / 20.10	44.30 / 46.30	42.30 / 44.30	27.80 / 27.80	30.00
150	18.90 / 18.90	41.70 / 43.70	39.70 / 41.70	24.30 / 24.30	28.20
200	18.00 / 18.00	39.80 / 41.80	37.80 / 39.80	21.80 / 21.70	27.00
250	17.30 / 17.30	38.30 / 40.30	36.30 / 38.30	19.80 / 19.80	26.00
300	— / 16.80*	— / 39.10*	— / 37.10*	— / 18.30*	25.20
350	— / 16.30*	— / 38.20*	— / 36.20*	— / 16.90*	24.60*
400	— / 15.90*	— / 37.30*	— / 35.30*	— / 15.80*	24.00*
450	— / 15.50*	— / 36.50*	— / 34.50*	— / 14.70*	23.50*
500	— / 15.20*	— / 35.80*	— / 33.80*	— / 13.80*	23.00*
	IL (dB/100 m)		m) PSACR (dB/100 m)	PSACRF (dB/100 m) EL TCTL	
FQ	TIA / PG	TIA / PG	TIA / PG	TIA / PG	PG

1	2.00 / 2.00		0.30 / 72.30	64.80 / 64.80	35.00
4	3.80 / 3.80		9.50 / 61.50	52.80 / 52.80	23.00
10	6.00 / 6.00		1.30 / 53.40	44.80 / 44.80	15.00
16	7.60 / 7.60		6.70 / 48.70	40.70 / 40.70	10.90
20	8.50 / 8.50		4.30 / 46.40	38.80 / 38.80	9.00
31.25	10.70 / 10.70		9.20 / 41.30	37.90 / 34.90	—
62.50	15.40 / 15.40		0.00 / 32.00	28.90 / 28.90	—
100	19.80 / 19.80		2.50 / 24.60	24.80 / 24.80	—
150	24.70 / 24.60		4.90 / 17.10	21.30 / 21.30	—
200	29.00 / 29.00	10.80 / 12.90 8.80 / 10.90		18.80 / 18.70	—
250	32.80 / 32.80	7.30 / 7.50	3.50 / 5.50	16.80 / 16.80	—
300	— / 36.40*	— / 2.70*	— / —	— / 15.30*	—
350	— / 39.80*	— / -1.60*	— / —	13.90 / 13.90*	—
400	— / 43.00*	— / -5.70*	— / —	12.80 / 12.80*	—
450	— / 46.00*	— / -9.50*	— / —	— / 11.70*	—
500	— / 48.90* —	/ -13.10*	— / —	10.80 / 10.80*	—

5. Technical Data - Physical

- a. Conductor: 23 AWG Bare Copper
- b. Conductor diameter - in.: 0.023"
- c. Insulated conductor dia.-in.: 0.041"
- d. Cable diameter - in. 0.22"
- e. Nom. cable wt.-lb./kft. 29
- f. Max. installation tension - lb.: 25
- g. Min. bend radius - in. 1.00
- h. Color Code
  - i. *Pair-1 White/Blue Blue*
  - ii. *Pair-2 White/Orange Orange*
  - iii. *Pair-3 White/Green Gree*
  - iv. *Pair-4 White/Brown Brown*
- i. Temperature Rating (degrees C)
  - i. *Installation 0 to +50*
  - ii. *Operation -20 to +75*

6. Electrical

- a. Mutual Capacitance 5.2 nF/100 m max.

- i. *DC Resistance: 9.38 Ohms/100 m max.*
      - ii. *Skew: 45 ns/100 m max.*
    - b. Pair to Ground Unbalance: 330 pF/100 m max.
    - c. Velocity of Propagation: 67% nom.
    - d. DC Resistance unbalance: 5% max.
  - 7. Manufacturers:
    - a. Berk-Tek LANmark-6
    - b. General Cable
    - c. or equal
- F. Work Area Outlets
- 1. Data Jacks Performance Requirements, General
    - a. Jack
      - i. *Construction:*
        - 1. *Industry standard keystone construction.*
        - 2. *Performance - The jack shall meet or exceed the following standards.*
        - 3. *TIA/EIA 568C.1*
      - ii. *UL listed*
      - iii. *Physical - The modular jacks shall meet the following physical requirements.*
      - iv. *Connector-insulation displacement connectors accepting 22 and 24 gauge AWG solid conductor wire.*
      - v. *Wired to meet EIA 568C.1 and T568B Color Code*
      - vi. *Color:*
        - 1. *Jacks: Blue.*
        - 2. *Blank jack cover: To match plate.*
      - vii. *"C6" or equivalent molded on face of jack.*
      - viii. *Mechanical - The modular jacks shall meet the following mechanical requirements*
      - ix. *Plug insertion - minimum 750 plug insertions*
    - b. Blank connector modules.
      - i. *Features.*
        - 1. *Snaps into faceplate, fills blank openings.*
    - c. Manufacturers – Jacks, subject to keystone interchangeability requirement:
      - i. *Leviton eXtreme 6+ Connector*
      - ii. *Panduit Mini-com TX6*
      - iii. *or equal.*
    - d. Manufacturers - Blank Module.
      - i. *Leviton SnapIn Blank Module*
      - ii. *Panduit Mini-com Blank Module*
      - iii. *or equal*
  - 2. Telecommunications Outlets, Copper Jacks, Wall Mount, Flush
    - a. Drawing Reference(s):
      - i. *MMP4*
      - ii. *MMP6*
    - b. Assembly. Provide complete telecommunications outlet assembly, including but not limited to:
      - i. *Faceplate with industry standard keystone openings*
      - ii. *Blank connector modules at faceplate openings not filled with connector modules.*
      - iii. *Labels and label holders.*
      - iv. *Faceplate Features:*
        - 1. *Single gang.*
        - 2. *Front Loading*

3. *Openings for up to 4 keystone jack connector modules – MMP4, up to 6 openings – MMP6.*
  4. *At wall mount locations calling for 4 jacks or fewer, provide with flat faced openings for jacks relative to the place of the faceplate, oriented along the long edge of the plate.*
  5. *At other jack locations, including wall mount locations with more than 4 jacks, inside floor boxes or above ceiling, provide with flat face faceplates.*
  - v. *Label holders with space to label the plate number and the number of each jack.*
  - vi. *Color: To match electrical receptacles and switch plates mounted on same wall,*
  - c. Manufacturers - flat plates, subject to keystone interchangeability requirement:
    - i. *Leviton Quickport Multimedia MOS Single Gang Wall Plates and Adapters.*
    - ii. *Panduit Mini-com Classic Series*
    - iii. *or equal*
3. MultiMedia Surface Mount Box
- a. Drawing Reference (s):
    - i. *\* MMSB, where \* represents the number of Category connectors of the type specified elsewhere herein.*
  - b. Biscuit Box
  - c. Features Functions
    - i. *Surface mount enclosure holds terminated station cabling with Category connectors parallel to face of mounting surface.*
    - ii. *Mechanically fastened to enclosure surface.*
    - iii. *2 part assembly includes fixed mounting base plate and removable cover over terminations*
  - d. Manufacturers:
    - i. *Leviton Quickport Surface Mount Boxes*
    - ii. *Panduit*
    - iii. *Or equal*
- G. Data Patch Panels, Keystone, Rack Mounted
1. Drawing Reference: \*\*\*CXPPK, or CXPP, where \*\*\* refers to port count and X to Category rating of ports.
  2. Functions/Features:
    - a. 19" EIA rack mountable.
    - b. At least 24 ports per EIA rack unit (1.75").
    - c. Industry standard keystone openings in steel plate
    - d. arranged in rows on steel panel.
    - e. jacks on front.
    - f. terminations on rear.
    - g. Port identifier label space on front.
    - h. Fill each opening with Category 6 keystone jacks as specified herein above. Coordinate jack selection with patch panel construction to ensure that jack width behind the panel does not prevent fully loading panel.
    - i. Integral cable management bar at rear.
  3. Manufacturer
    - a. Leviton QuickPort High Density Multimedia Patch Panels with Management Bar
    - b. Panduit Netkey
    - c. Hubbell Xcelerator Series Panels
    - d. Molex EZ Patch
    - e. Suttle SE-2504 and SE-2504-48 Patch Panels

- f. AMP
- g. ADC/Krone
- h. Ortronics
- i. or equal.]

## 2.3 CABLE TERMINATION DEVICES AND RELATED, NON-CATEGORY RATED

- A. Screw type or Tubular Clamp Barrier Blocks:
  - 1. Buchanan 125, 0625 Series.
  - 2. Electrovert equivalent.
  - 3. TRW Cinch 140, 141, 142 Series.
  - 4. Weidmuller
  - 5. Pass & Seymour/Legrand equivalent.
  - 6. Phoenix
  - 7. or equal.
- B. Tubular Clamp Barrier Blocks, High Density, Switch Block Section
  - 1. Drawing Reference: TB15.
  - 2. Features/Functions
    - a. Paired screw terminals on opposite sides of insulating base.
    - b. TB15 Base mounts to DIN rail, providing space beneath TB15 to dress field and source cabling.
    - c. Terminates range of wire gages used by project – at least 30 gage to 10 gage.
    - d. High density:
      - i. *At least 33 pairs of connections per foot for 12 and smaller gage terminations,*
      - ii. *At least 16 pairs of connections per foot for 10 gage terminations.*
    - e. Switch Block Section permits load, such as field devices, to be separated from monitoring panel for testing independent of source then restored without disturbing field wiring terminations.
    - f. Rated at least fifteen (15) amperes at 300V AC/DC
  - 3. Approvals
    - a. UL
  - 4. Manufacturers:
    - a. Allen Bradley Isolation Switch Blocks.
      - i. *1492-H7 for 30 to 12 gage*
      - ii. *1492-CE9 for 10 gage.*
    - b. Tyco Buchanan 0135 Series.
    - c. WECO Electrical Connectors
    - d. Altech
    - e. Curtis Industries
    - f. Electrovert
    - g. Weidmuller
    - h. Pass & Seymour/Legrand
    - i. Phoenix
    - j. or equal.
- C. Video connector, BNC type, 75 ohms, cord, crimp applied. Coordinate with cable.
  - 1. Amp.
  - 2. Amphenol.
  - 3. Augat/LRC Products
  - 4. Canare.
  - 5. Kings.
  - 6. RFI/Celltronics.
  - 7. Trompeter.

8. or equal.

## 2.4 PATCH CORDS

- A. Category 6 Patch Cords
  1. Reference: Cat 6 Patch Cords
  2. Features/Function/Construction:
    - a. Manufactured product – field/contractor assembled patch cords not acceptable.
    - b. Manufacturer certified to exceed EIA/TIA 568 C.1 Category 6 performance and construction standards.
    - c. Snagless Boot Covers
    - d. Color: Green, Aqua or Turquoise, unless directed otherwise by the University's Representative. In no event the color of the supplied voice patch cabling match that used by the University furnished data systems patch cords
  3. Length: As required to meet function
  4. Quantity: As required to meet function
  5. Manufacturers:
    - a. Belden
    - b. Belkin
    - c. Leviton
    - d. Systemax/Commscope
    - e. AMP
    - f. Hubbell
    - g. Siemon
    - h. Or equal.

## 2.5 ELECTRONIC SECURITY SYSTEMS CABLING LABELS, INTERIOR

- A. Shall meet the legibility, defacement, exposure and adhesion requirements of UL 969.
- B. Shall be preprinted or computer printed type. Handwritten labels are not acceptable.
- C. Provide vinyl substrate with a white printing area and black print. 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. Shall be flexible vinyl or other substrates to apply easy and flex as cables are bent.
- E. Shall use aggressive adhesives that stay attached even to the most difficult to adhere to jacketing.
- F. Manufacturers:
  1. Brady
  2. Brother
  3. Panduit
  4. Or equal.

## 2.6 ELECTRONIC SECURITY SYSTEMS CABLE LABELS, OUTSIDE PLANT

- A. Cable Tags in Manholes, Handholes, and Vaults
  1. Provide tags for communications cable or wire located in manholes, handholes, and vaults.
    - a. The tags shall be polyethylene.
    - b. Machine printed - Do not provide handwritten letters.
  2. Polyethylene Cable Tags
    - a. Provide tags of polyethylene that have an average tensile strength of 22.4 MPa (3250 pounds per square inch) 3250 pounds per square inch; and that are two millimeter (0.08 inch) 0.08 inch thick (minimum), noncorrosive non-conductive; resistive to acids, alkalis, organic solvents, and salt water; and distortion

- resistant to 77 degrees C 170 degrees F.
  - b. Provide 1.3 mm (0.05 inch) 0.05 inch (minimum) thick black polyethylene tag holder.
  - c. Provide a one-piece nylon, self-locking tie at each end of the cable tag.
  - d. Ties shall have a minimum loop tensile strength of 778.75 N (175 pounds) 175 pounds. The cable tags shall have black block letters, numbers, and symbols 25 mm (one inch) one inch high on a yellow background.
  - e. Letters, numbers, and symbols shall not fall off or change positions regardless of the cable tags' orientation.
3. Manufacturers:
- a. Panduit
  - b. Brady
  - c. or equal.

## PART 3 - EXECUTION

### 3.1 WIRING CLASSIFICATION AND RELATED

- A. Audio Signal Wiring Classification:
1. Type A-1: Microphone level wiring less than -30 dBu, 20 Hz to 20 kHz.
  2. Type A-2: Line level wiring -30 dBu to +24 dBu, 20 Hz to 20 kHz.
  3. Type A-3: Loudspeaker level or circuit wiring greater than +24 dBu, from 20 Hz to 20 kHz.
- B. Video and Related Signal Wiring Classification:
1. Type V-1: Baseband and composite video wiring 1 volt peak-to-peak into 75 ohms, 0 to 10.0 MHz.
  2. Type V-2: Synchronization and switching pulse wiring 4 volts peak-to-peak into 75 ohms, 15.62 to 15.75 kHz.
  3. Type V-3: Color subcarrier wiring 0 to 4 volts peak-to-peak into 75 ohms, 3.57 to 4.43 MHz.
  4. Type V-4: MATV system wiring 0.1 to 1000 microVolts peak-to-peak into 50 or 75 ohms, 47 to 890 MHz.
- C. Control Signal Wiring Classifications:
1. Type C-1: DC control wiring 0 to 50 volts.
  2. Type C-2: Synchronous control or data wiring 0 to 40 volts, peak-to-peak.
  3. Type C-3: AC control wiring 0 to 48 volts, 60 Hz.
- D. Additional Wiring Classifications:
1. Type M-1: DC power wiring 0 to 48 volts.
  2. Type M-2: AC power wiring greater than 50 volts, 60 Hz.
  3. Wiring Combinations:
- E. Except as indicated herein, conduit, wireways and cable bundles shall contain only wiring of a single classification. The following combinations are acceptable in conduit, or cable harnesses. Additional acceptable combinations may be indicated on the Drawings.
1. Types A-1, C-1, and M-1.
  2. Types A-2, C-1, C-2, and M-1, runs less than 20 feet.
  3. Types A-2, C-1, and M-1.
  4. Types A-3, C-1, C-2, and M-1.
  5. Types A-2, V-1, and V-3.
  6. Types V-1, V-2, V-3, and C-1.
  7. Types M-2 and C-3.

## 3.2 WIRING PRACTICE, NON CATEGORY RATED CABLING

- A. All wiring of Division 28 to be installed in raceway except above accessible ceilings.
1. Separate raceway systems, including backboxes and conduit, shall be provided for to electromagnetically isolate electric lock and door motor operators, local door alarms and other similarly powered sources of electro-magnetic noise from door position switches, card reader, door release buttons, duress alarms and similar low power, electromagnetic noise sensitive applications. Refer to Wiring Classification and Related above and comply.
  2. Minimum conduit size for multiple conductor runs shall be  $\frac{3}{4}$ ". In each control panel 2 empty  $\frac{3}{4}$ " conduits shall be installed for future use. These conduits shall be routed to an accessible area above the ceiling or to a location approved by University. Run circuits for AC separate from circuits using DC. Each supervisory/data loop shall be run separately from any other supervisory/data loops they shall not be permitted to share the same conduit. From security alarm control panel provide one  $\frac{3}{4}$ " conduit to nearest telephone backboard or panel location for tie-in to University furnished central station. Provide min 1" conduit to each card access or exterior door, unless otherwise shown or scheduled on the plans
  3. Conduits including flexible metal and armored cable shall terminate in the sensor or device enclosure.
  4. Ends of conduit shall be fitted with insulated bushings. Exposed conductors at ends of conduits external to sensors and devices are not acceptable.
  5. Refer to additional requirements in Section 28 05 28 - Pathways For Electronic Safety And Security.
- B. All field wiring shall run continuous from device to device no splices shall be permitted except at specified terminal blocks installed in lockable termination cabinets.
1. The use of wire nuts and crimp type connectors shall not be permitted.
  2. Where shielded wire is used it shall be connected to an earth ground at the panel. Tin terminated shield drain wires and insulate with heat shrinkable tubing.
  3. Dress, lace or harness all wire and cable to prevent mechanical stress on electrical connections. No wire or cable shall be supported by a connection point.
  4. Provide service loops where harnesses of different classes cross, or where hinged panels are to be interconnected.
  5. Security alarm conductor terminations in control panels, termination cabinets, junction boxes and annunciator panels to be made on specified terminal strips with a separate point for each conductor.
    - a. All such strips to be number identified as shown in wiring diagram attached to inside of door of control panel.
    - b. Connect wiring neatly to terminals strips.
    - c. Set up termination of cabling so that section of the system may be isolated or shorted out for servicing.
- C. No control panel shall be mounted where is not readily accessible the highest connection point shall not be above 6'6" nor shall the bottom of the panel be below 30".
- D. All necessary interconnections, services, and adjustments required for a complete and operable system shall be provided. All installation work must be done in accordance with the safety requirements set forth in the general requirements of ANSI C2 and NFPA 70.
- E. Coordinate insulation displacement (quick connect) terminal devices with wire size and type. Comply with manufacturer's recommendations. Make connections with automatic impact type tooling set to recommended force.
- F. Security alarm conductor terminations in control panels and termination panels to be made on terminal strips with a separate point for each conductor. All such strips to be number or labeled identified as shown in wiring diagram attached to inside of door of control panel. Connect wiring neatly to terminals strips. Bundle with nylon cable straps. Set up termination of cabling so that sections of the system may be isolated or shorted out for servicing.
- G. Mount end-of-line resistor for each circuit at the device. Glass break devices may be grouped

orderly to a zone. Do not allow glassbreak zones to cover more than one side of the building without approval from University. Connect glass break detectors to C-Cure DGP panel and provide programming of campus C-Cure database to enable remote reset.

- H. Correct unacceptable wiring conditions including but not limited to:
1. Deformed, brittle or cracked insulation.
  2. Torn or worn cable jacket.
  3. Excessively scored cable jackets.
  4. Insulation shrunken or stripped further than 1/8" away from the actual point of connection within a connector, or on a punch block.
  5. Ungrommated, unbushed, or uninsulated wire or cable entries.
  6. Deformation or improper radius of wire or cable.

### 3.3 UNDERGROUND WIRING PRACTICE

#### A. General

1. Provide safety barriers and flag persons for all open manholes and pullboxes that are located in areas accessible to the public.
2. Provide traffic control in accordance with the requirements of Division 1.
3. Conform to OSHA guidelines when accessing manholes and handholes, inclusive of the requirement for air sampling. Provide continuous measurements. Provide the University's Representative with contractor maintained logs of air samples taken at most two hours apart.
4. Provide sufficient personnel to permit one individual to remain above the surface at all times, in visual contact with persons in manholes and similar. Provide the observer with an appropriate means of obtaining assistance.
5. Provide ladders for access to manholes. Do not permit workers to use cables or splice cases as ladders.
6. Install a 3/8" nylon pullrope with all underground cables placed by this project.

#### B. Cable Pulling

1. Test existing duct lines with a mandrel and thoroughly swab out to remove foreign material before pulling cables.
2. Pull cables down grade with the feed-in point at the manhole or buildings of the highest elevation.
3. Use flexible cable feeds to convey cables through manhole opening and into duct runs.
4. Accumulate cable slack at each manhole or junction box where space permits by training cable around the interior to form one complete loop.
5. Maintain minimum allowable bending radii in forming such loops.
6. Do not exceed the specified cable bending radii when installing cable under any conditions, including turnups into outdoor pedestals or other enclosures.
7. Cable with tape shield shall have a bending radius not less than 12 times the overall diameter of the completed cable.
8. If basket-grip type cable-pulling devices are used to pull cable in place, cut off the section of cable under the grip before splicing and terminating.

#### C. Cables in Manholes, Pull boxes and Handholes.

1. Do not install cables utilizing the shortest route, but route along those walls providing the longest route and the maximum spare cable lengths.
2. Form cables to closely parallel walls, not to interfere with duct entrances, and support on brackets and cable insulators.
3. In existing manholes and handholes where new ducts are to be terminated or where new cables are to be installed, locate the existing installation of cables, cable supports and grounding as required for a uniform installation with cables carefully arranged and supported.
4. Where underground cable splices are called for on the plans, support cable splices in

- underground structures by racks on each side of the splice.
- 5. Located splices to prevent cyclic bending in the spliced sheath.
- 6. Install cables at middle and bottom of cable racks, leaving top space opening for future cables, except as otherwise indicated for existing installations.
- D. Service Loop at Building Entry
  - 1. For outside plant entering a communications room, provide at least 20 feet of cable in excess of the minimum required to reach terminal device by a dressed route. Form into a storage loop, typically around the perimeter of the backboard and fix in place as directed by the University's Representative.

### 3.4 SPLICING, NON-CATEGORY RATED CABLING

- A. All wire and cable shall be continuous and splice-free for the entire length of run between designated connections or terminations.
  - 1. At designated splices, maintain conductor color code across all splices.
    - a. All shielded cables shall be insulated. Do not permit shields to contact conduit, raceway, boxes, panels or equipment enclosures.
    - b. Within buildings, make splices only in designated terminal cabinets and/or on designated equipment backboards.

### 3.5 PULLING IN

- A. Verify that all raceway has been de-burred and properly joined, coupled, and terminated prior to installation of cables. Verify that all raceway is clear of foreign matter and substances prior to installation of wire or cable.
- B. Inspect all conduit bends to verify proper radius. Comply with Code for minimum permissible radius and maximum permissible deformation.
- C. Apply a chemically inert lubricant to all wire and cable prior to pulling in conduit. Do not subject wire and cable to tension greater than that recommended by the manufacturer. Use multi-spool rollers where cable is pulled in place around bends. Do not pull reverse bends.
- D. Provide a box loop for all wire and cable routed through junction boxes or distribution panels. Cable loops and bends shall not be bent at a radius greater than that recommended by the manufacturer.
- E. Field Device Wiring
  - 1. Wire each device as a home run from the device to the terminal block
  - 2. Loop or Zone wiring not acceptable unless addressable devices are specified and provided. Wire all potential monitoring and signaling points (each pin) of each field device and alarm sensor, including internal tamper sensors.
  - 3. At electric strikes and electric locks, provide end-of-line resistors, diodes or MOV's where device does not already include such components. Document where such devices have been added on As-Built drawings.
- F. Card Reader Wiring
  - 1. Verify that the slack loops called for on the plans are provided.

### 3.6 CEILING TILE

- A. Ceiling tile shall be removed as necessary for the cable installation and put back in place

without damaging or soiling any of the tiles or supporting framework.

- B. Ceiling tile shall be handled so no fingerprints or marks are left on the tiles, and the tiles are not damaged in any way.
- C. The Contractor is responsible for the cost of repair or replacement of any tile or ceiling tile support/framework hardware that is damaged or soiled by the Contractor.

### 3.7 SUPPORT

- A. Support: Provide support for all cabling. Conform to the most restrictive of the California Electric Code and Section 28 05 28 Pathways for Electronic Safety and Security. Provide support for all cabling. Conform to the restrictions of the California Electric Code and Section 27 05 29. Secure all wire and cable run vertically for continuous distances greater than thirty (30) feet. Secure robust non-coaxial cables with screw-flange nylon cable ties or similar devices appropriate to weight of cable. For all other cables, provide symmetrical conforming nonmetallic bushings or woven cable grips appropriate to weight of cable.
- B. Separation from sources of Electromagnetic Interference: Conform with the requirements of ANSI/TIA-569-C, 9.3 Pathway Separation from EMI sources. Secure all wire and cable run vertically for continuous distances greater than thirty (30) feet. Secure robust non-coaxial cables with screw-flange nylon cable ties or similar devices appropriate to weight of cable. For all other cables, provide symmetrical conforming nonmetallic bushings or woven cable grips appropriate to weight of cable.

*Include the next subsection where work of the Project has no Division 27 spec and relies on this Section to install station cabling supporting the TCP/IP cameras and/or DGP uplink signaling.*

### 3.8 WIRING PRACTICE, CATEGORY RATED CABLING USED IN TCP/IP APPLICATIONS

- A. Signal Polarity and Color Code Convention
  - 1. Category 6 Station Wire, RJ45 - Per EIA/TIA-568, designation T568B
- B. Station Cable Installation And Termination Procedures
  - 1. General:
    - a. All cable runs shall be installed per manufacturer's installation instructions.
    - b. Cable installation is "home-run" between the jack termination of the cable at the faceplate to the patch panel jack termination in its assigned IDF (TR).
      - i. *Each cable shall be installed without any splices.*
      - ii. *Each cable shall be installed without intermediate termination points unless approved by the University's Representative.*
  - 2. Run Lengths:
    - a. Station, Horizontal and IDF Links, Copper
      - i. *The total length of any horizontal station cable from jack termination of the cable at the WAO faceplate to the patch panel jack termination in its assigned IDF (TR) shall not exceed ninety meters (90m) - two hundred ninety-five feet (295') - unless approved by the University's Representative.*
- C. WAO Horizontal Cable Placement
  - 1. No cable shall run unsupported by conduit, cable tray, hangers, or other specified support for distances greater than five feet (5').

2. No cable shall be attached to the suspended ceiling structure or laid directly on the ceiling tiles or hard lid as a means of support, and the bottom of a cable or cable bundle shall be minimum of six inches (6") above the ceiling tile grid.
  3. No cable or cable bundle shall be supported by or attached by any means to fire sprinkler heads, delivery system hardware, environmental sensor system hardware, or the exterior of any conduit, ladder rack, or cable tray. Cable shall be supported by systems specifically installed for cable support.
  4. Where cable being installed is not enclosed in conduit or cable tray, cross all electrical power circuit transport at right angles.
  5. Where discontinuity of cable trays or conduit pathway occurs that causes cable or cable bundle to sag vertically three inches (3") or more, support the cable or cable bundle over the discontinuity using hangers, brackets, hooks, rings, and other applicable supporting devices specified in Section 27 05 29 - Hangers and Supports for Communications Systems.
  6. During placement of cable runs, do not exceed manufacturer's maximum pulling tension or minimum bend radius limits.
  7. Do not bundle cables in cable trays.
  8. Do bundle two (2) or more cables with plenum-rated Velcro ties that are snug but which do not deform the cable geometry as follows:
    - a. Whenever cables in cable trays leave the cable tray and enter/exit distribution conduit.
    - b. Wherever cables enter a TR. Maintain bundling within the TR.
  9. Manage slack to avoid excess cable or kinking.
  10. Pull new pulling string through all conduits while placing new horizontal cable. Leave a pulling string in the utilized conduits for future use.
  11. Do not roll or store cable reels without an appropriate underlay.
  12. Cables with jackets that are chaffed, burned, have exposed internal conductor insulation, or have any bare copper (shiners) shall be replaced.
  13. After cable installation is complete, tested, and, if necessary, repairs made, install all required fire stopping. The University Representative or his/her designate will not accept the installation as completed until all required fire stopping has been installed and accepted as complete. See Section 27 05 33 – Conduits and Backboxes For Communications Systems.
  14. Any horizontal cable installed, then removed for any reason, shall not be reused.
  15. Bundle voice cross-connect cables separately from horizontal WAO cables. Do not mix with horizontal WAO cables.
  16. Test cable as for station cabling.
- D. Termination
1. Comply with the following:
    - a. Termination of wiring at the station outlet:
      - i. *All data and voice station cable shall be terminated at the individual receptacle modules in accordance with EIA/TIA-568-C.*
      - ii. *Termination shall not untwist more than 1/2 inch of cable maximum from the manufactured condition*
      - iii. *Service loop at WAO*
        1. *Copper. Provide slack, which is to be no less than 2.5" and no greater than 5.0", in the station cable at the station outlet end. This is to allow the Work Area Outlet to be removed from the outlet box and visually inspected without leaving so much wire in the box that it might become accidentally damaged during installation.*
    - iv. *Termination of wiring at existing station outlets:*
      1. *Install in data and voice inserts in place of existing blank insert in existing faceplate.*

2. *Install new labels and label holders.*
  - b. Termination of copper station wiring at the Telecommunications Room
    - i. *For the installation/layout of station cable within the Communications Rooms, see detail on drawings.*
    - ii. *Install one (1) 48-port patch panel for every 48 WAO cables.*
    - iii. *Mount patch panels per the Project drawings.*
    - iv. *Each patch panel shall have a 2RU horizontal manager (WMP) placed both above and below the panel.*
    - v. *Horizontal cables are to be routed neatly on overhead cable runway to equipment racks; exit cable runway into equipment rack vertical cable management and proceed to the patch panels.*
    - vi. *Cable termination.*
      1. *Cables on the left side of the patch panel shall enter from the left side vertical cable manager. Cables on the right side of the patch panel shall enter from the right side vertical cable manager. Cables shall not cross the center line of the patch panel.*
      2. *Terminate cables using the 8-pin jack, T568-B four (4) pair termination standard and comply with manufacturer's termination practices, specifications, instructions, and recommendations.*
- E. Testing, Verification, Adjustments and Acceptance
1. Comply with the requirements of Part 1 of this Section and the following:
    - a. After submittal of test result documentation and the associated as-built drawings, the University's Representative shall randomly pick five percent (5%) of the submitted cable plant installation for re-test.
    - b. If more than 2% of the sample results differ in terms of the pass/fail determination, the installation contractor under supervision of the representative shall repeat 100% testing at no cost to the University.

### 3.9 LABELING

- A. Label each end of each cable to indicate its terminal point.
- B. Non category rated cabling and category cabling used for non-TCP/IP applications
  1. For field devices, use the device label assigned per the requirements of Section 28 05 00 - Common Work Results for Electronic Safety and Security.

*Include the next paragraph where work of the Project has no Division 27 spec and relies on this Section to install station cabling supporting the TCP/IP cameras and/or DGP uplink signaling.*

- C. [Category rated cabling used in TCP/IP applications
  1. Label placement: Attach a label to both ends of each cable six inches (6") from the cables termination at WAO and TR patch panel port.
  2. Label content and format, both ends of cable shall be XXX - YZZZ where:
    - a. XXX = the 3-digit building number which is the last 3 digits of the facility asset designator - a 4-digit number called a CAAN number.
    - b. Y = the floor number - use zero (0) for basement.
    - c. ZZZ = the WAO jack number the cable is terminated on - 001 through 999.
    - d. Example: 195-2001 = Building 195, (2) second floor, (001) first jack on the second floor.]
  3. All labels shall be machine created labels. Hand labeling is not acceptable.

### 3.10 REMOVAL OF ABANDONED CABLING

- A. The California Electrical Code (CEC) requires all unused cable intended for future use to be terminated and labeled for such use. Any other unused cable is considered abandoned including cable abandoned due to installation of new cabling under the work of this Project.
- B. Abandoned cable must be removed and disposed of, per CEC 770.53(A) & 770.53(B) (fiber) and 800.52(B), 800.53(A) & 800.53(B) (copper). Similar requirements are elsewhere in the CEC for other types of cable. Refer to Division 01 regarding means and methods to be employed in the disposal of construction waste materials including material subject to recycling such as abandoned copper cabling.

### 3.11 AS-BUILT DRAWINGS

- A. Comply with Division 1 and Section 28 05 00 – Common Work Results for Electronic Security and Safety.

END OF SECTION 28 05 13

Section 28 05 26

Grounding and Bonding For Electronic Safety and Security

PART 1 - GENERAL

1.1 SCOPE OF WORK

*The Division 26 and 27 references below assume that the Communications work installed in accordance with UCSC ITS masterspecs are being installed in parallel with the Division 28 ESS scope. Alter as necessary to indicate where equivalent scope is being specified.*

- A. Section includes grounding and bonding of Electronic Safety and Security Work, including but not limited to:
  - 1. Electronic Safety and Security Raceways
  - 2. Cable Shields
  - 3. [Electronic Safety and Security Cabinets and Enclosures.]
- B. Related Work Under Other Sections.
  - 1. [Section 26 05 26 – Grounding & Bonding for Electrical Systems]
  - 2. [Section 27 05 26 – Grounding and Bonding For Communications Systems]
  - 3. Section 28 05 00 – Common Work Results for Electronic Safety and Security
  - 4. Section 28 05 13 – Conductors and Cables for Electronic Safety and Security
  - 5. Section 28 05 28 – Pathway for Electronic Safety and Security

1.2 SYSTEM DESCRIPTION

- A. Provide Electronic Safety and Security Grounding System as described herein and indicated on drawings.
- B. Except as otherwise indicated, the complete Electronic Safety and Security installation including the racks, cabinets, panels, cable tray, runway, lightning protectors cable shields and splice cases provided under the work of this project shall be completely and effectively grounded in accordance with all Code and Standards requirements, whether or not such connections are specifically shown or specified.

1.3 RESISTANCE:

- A. Resistance from the farthest ground bus through the ground electrode to earth shall not exceed 5 Ohms or the requirements of ANSI-J-STD-607-B-2011, whichever is more restrictive.
- B. Resistance from Electronic Safety and Security Rack Buss ground to Ufer ground must remain less than or equal to the electrical ground presented at A/C outlet for electronic equipment in the communications rack.

1.4 REFERENCES

- A. American National Standards Institute (ANSI)

1. ANSI/TIA/-606-B-2012, Administration Standard Telecommunications Infrastructure. ANSI-J-STD-607-B-2011 Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises.
- B. ASTM INTERNATIONAL (ASTM)
  1. ASTM B3 (2013) Standard Specification for Soft or Annealed Copper Wire
- C. IEEE
  1. IEEE C135.30 (1988) Standard for Zinc-Coated Ferrous Ground Rods for Overhead or Underground Line Construction
  2. IEEE 81 (2012) Guide for Measuring Earth
- D. Underwriters Laboratories (UL)
  1. UL 467 (1993); R 2004 Grounding and Bonding Equipment

## 1.5 SUBMITTALS

- A. Conform with the requirements of Section 01 33 23 - Shop Drawings, Product Data and Samples and Section 27 05 00 - Common Work Results for Communications.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Equal products by the following manufacturers will be considered providing that all features of the specified product are provided:
  1. Ground Bushings, Connectors, Jumpers and Bus:
    - a. O-Z/Gedney
    - b. Thomas & Betts Corp.
    - c. Or equal.
  2. Compression Connector Lug
    - a. Panduit
    - b. Harger Lightning & Grounding
    - c. Or equal.
  3. Telecommunications Ground Bus Bar
    - a. Panduit
    - b. Harger Lightning & Grounding
    - c. or equal.
  4. Rack and Cabinet Grounding
    - a. Panduit Structured Ground Kit
    - b. Harger Lightning & Grounding
    - c. or equal.

### 2.2 GROUND CONDUCTORS

- A. General purpose insulated: UL listed and code sized copper conductor, with dual rated THHN/THWN insulation, color identified green.
- B. Cable jacket marking:

- C. Must be legible and shall contain the following information:
  - 1. Manufacturer's name
  - 2. Copper conductor gauge
  - 3. UL listing
  - 4. Cable jacket shall be green with black lettering
- D. Telecommunications Bonding Backbone Cable: 3/0 AWG THHN/THWN CU - Must be listed.
  - 1. Manufacturer:
    - a. General Cable
    - b. Harger Lightning & Grounding
    - c. Equal
- E. Bonding pigtails: Insulated copper conductor, identified green, sized per code, and provided with termination screw or lug. Provide solid conductors for #10 AWG or smaller and stranded conductors for #8 AWG or larger.
- F. Bonding Conductors sized at 2 kcmil per linear foot of conductor length up to a size of 3/0 AWG ground wire.

## 2.3 COMPRESSION CONNECTOR LUG

- A. Description
  - 1. Long-barrel compression lugs shall be used on all ground wire.
  - 2. Copper alloy body.
  - 3. Provide lug size to match conductor being terminated.
  - 4. Provide 2 hole pattern lugs.
  - 5. Provide each lug with silicon bronze hardware, including 2 bolts, 2 split lock washers and 2 nuts.
- B. Manufacturer:
  - 1. Panduit
  - 2. Harger Lightning & Grounding GECLBxxx (xxx depending on Cable Size) 3. or equal.

## 2.4 INSULATED GROUNDING BUSHINGS

- A. Plated malleable iron or steel body with 150 degree Centigrade molded plastic insulating throat and lay-in grounding lug.

## 2.5 CONNECTIONS TO STRUCTURAL STEEL, GROUND RODS, OR SPLICES

- A. Where required by the Drawings or Specifications, grounding conductors shall be spliced together, connected to ground rods or connected to structural steel using exothermic welds or high pressure compression type connectors.
  - 1. Exothermic welds shall be used for cable-to-cable and cable-to-ground rod and for cable to structural steel surfaces. Exothermic weld kits shall be as manufactured by Harger Lightning & Grounding, Cadweld, Thermoweld or equal. Each particular type of weld shall use a kit unique to that type of weld.
  - 2. High-pressure compression type connectors shall be used for cable-to-cable and cable-to-ground rod connections. Connections shall be as manufactured by Thomas & Betts #53000 series, Burndy "Hy-Ground" or equal.

## 2.6 EXTRA FLEXIBLE, FLAT BONDING JUMPERS

- A. Two Hole Tinned Flat Braided Copper Ground Straps, 6 Gauge equivalent, 12" long with crimped lugs on each end and ¼"-20 mounting hardware.
  - 1. Manufacturer:
    - a. Harger GS12094122C3/8
    - b. or equal.

## PART 3 - EXECUTION

### 3.1 GENERAL

- A. Provide Grounding and Bonding according to the most restrictive requirements of:
  - 1. ANSI-J-STD-607-B-2011.
  - 2. California Electrical Code Article 250 and references therein.
  - 3. California Electrical Code Article 800.
- B. In the event of conflicting requirements, National Electrical Code requirements shall prevail.
- C. Point of Connection
  - 1. Under Work of this Section, ground to the building Telecommunications Grounding System as installed under the work of Division 27 at the TMGB
- D. Ground And Bonding Conductor Installation
  - 1. All lug connections to the ground bars and opposite end shall use Antioxidant Joint Compound.
  - 2. Unless otherwise noted, all bonding and ground wires on electronic security systems and communications systems cable trays and runways shall be routed on the outer edge of the cable trays and runways.
- E. Mechanical Connections
  - 1. Make connections bare metal to bare metal.
  - 2. Where required, remove paint to bare metal, make grounding or bonding connection, and touch up paint.
  - 3. Torque threaded fasteners to manufacturer's recommended values.
- F. Compression Connections
  - 1. Make compression connections with the lug or fitting manufacturer's recommended tooling, with the tooling set to the recommended force and stroke.
- G. Electronic Safety and Security Raceways and Sleeves
  - 1. Bond metallic raceway and sleeves to the Telecommunications Ground Busbar at the Telecommunications Room that serves the related Electronic Safety and Security systems.
  - 2. Where a metallic raceway connects 2 or more Telecommunications Rooms, bond to the Telecommunications Ground Busbar at each.
- H. Cable Shields
  - 1. Comply with California Electrical Code Article 800.
- I. Protector Fields
  - 1. Comply with California Electrical Code Article 800. Electronic Safety and Security cabinets and enclosures
    - a. Bond to the Communications Ground Busbar at the Communications Room

### 3.2 LABELING

- A. Provide labeling according to the requirements of:
  - 1. ANSI/TIA/EIA-606-A.
  - 2. Section 28 05 13 – Conductors and Cables for Electronic Safety and Security

END OF SECTION 28 05 26

Section 28 05 28

Pathways For Electronic Safety and Security

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. Provide electronic security systems pathways as specified in this Section and as shown diagrammatically on the plans. Contractor to design complete Electronic Safety and Security pathway system including provision:
  - 1. Rigid steel conduit and fittings.
  - 2. Intermediate metal conduit and fittings.
  - 3. Electrical metallic tubing and fittings.
  - 4. Non-metallic raceway and fittings.
  - 5. Flexible metallic conduit and fittings.
  - 6. Liquidtight flexible metallic conduit and fittings.
  - 7. [Underground duct and structure]
  - 8. Miscellaneous conduit fittings and products.
  - 9. Junction Boxes
  - 10. Hinged cover enclosures.
  - 11. Pullboxes and Terminal Cabinets.
  - 12. Wireway
  - 13. Strut supports
  - 14. Beam clamps
  - 15. Concrete Fasteners
  - 16. Touch-Up Materials
  - 17. Conduit supports.
  - 18. Equipment supports.
  - 19. Fastening hardware
- B. At Hazardous Occupancies, installation conforms to the requirements of California Electric Code for Class and Division rating of spaces.

1.2 RELATED WORK IN OTHER SECTIONS

- A. Related work: Consult all other Sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.
  - 1. [Section 01 71 23 – Field Engineering.]
  - 2. Section 28 05 00 – Common Work Results for Electronic Safety and Security
  - 3. Section 28 05 13 – Conductors and Cables for Electronic Safety and Security
  - 4. Section 28 05 26 – Grounding and Bonding for Electronic Safety and Security
  - 5. Section 28 13 00 – Access Control and Alarm Systems

1.3 SYSTEM DESCRIPTION

- A. Provide devices specified in this Section and related Sections for support of electronic safety equipment specified for this Project.

- B. Provide support systems that are adequate for the weight of equipment, conduit and wiring to be supported.

#### 1.4 SEISMIC DESIGN REQUIREMENTS

- A. Identify each item requiring seismic restraint installation in accordance with CBC Chapter 16A. Include floor mounted items weighing more than 400 pounds and wall mounted or suspended items weighing more than 20 pounds.
- B. Supports for such items, including racks, conduit, cable trays and similar shall be provided support, bracing, and anchorage, designed by the Contractor in accordance with the following criteria:
  - 1. Design to resist seismic forces in accordance with CBC Chapter 16A.
  - 2. Minimum Design Parameters - As defined for the Building, with respect to Occupancy Category, Site Classification, Seismic Design Category, Importance Factor, Spectral Acceleration and SDI.

*The Electronic Security System design should always conform to the standards of execution and code of reference typically established for the Project and stated on the cover sheets of the drawing set. Include the following texts only on projects where no Architectural drawings are being prepared (example: a standalone security upgrade*

- a. *[If not defined for this Project, conform with at least Seismic Importance Factor 1.25 Table 11.5-1 of ASCE-705, or latest edition.]*

#### 1.5 REFERENCES

- A. Usage: In accordance with Section 01 41 00 – Regulatory Requirements.

*The AASHTO references below are required when underground electronic security duct placement is required.*

- B. American Association of State Highway and Transportation Officials (AASHTO) 1. AASHTO M-306 Standard Specification For Drainage, Sewer, Utility, And Related Castings
- C. American Institute Of Steel Construction (AISC)
  - 1. AISC 325 (2005) Steel Construction Manual
  - 2. American National Standards Institute (ANSI)
    - a. ANSI C80.1 1994 Rigid Steel Conduit - Zinc Coated
    - b. ANSI C80.3 1991 Electrical Metallic Tubing - Zinc Coated
- D. American Society For Testing and Materials (ASTM)
  - 1. ASTM A123/A123M-02 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
  - 2. ASTM A153/A153M-04 Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
  - 3. ASTM B633-98e1 Specification for Electro-deposited Coatings of Zinc on Iron and Steel.
  - 4. ASTM A653/A653M-04a Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

*The Caltrans references below are required when underground electronic security duct placement is required.*

- E. *[California Department of Transportation*

1. *Standard Specifications, 2010 Edition, 86 Electrical Systems*
  - a. Materials only. Refer to this Section, Related Sections and the plans for means of execution.
- F. National Electrical Manufacturers Association (NEMA)
  1. NEMA 250-2003 Enclosures for Electrical Equipment (1000 Volts Maximum)
  2. NEMA FB 1 (ANSI/NEMA FB 1-2003) Fittings, Cast Metal Boxes and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable
  3. FB 2.102000 Selection and Installation Guidelines For Fittings For Use With Non-Flexible Metallic Conduit Or Tubing (Rigid Metal Conduit, Intermediate Metal Conduit, And Electrical Metallic Tubing).
  4. FB 2.202000 Selection and Installation Guidelines for Fittings for use with Flexible Electrical Conduit and Cable
  5. NEMA ICS 6 1988 (Rev. 1) Enclosures for Industrial Control and Systems
  6. NEMA OS 3-2002 Selection and Installation Guidelines for Electrical Outlet Boxes.
  7. NEMA RN 1-1998 Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
  8. NEMA TC 7 2000 Smooth Wall Coilable Polyethylene Electrical Plastic Duct
  9. NEMA TC 13 2000 Electrical Nonmetallic Tubing (ENT).
  10. NEMA TC 14 1984(R 1986) Filament-Wound Reinforced Thermosetting Resin Conduit and Fittings
- G. Underwriters Laboratories, Inc. (UL)
  1. UL 1 2000 Flexible Metal Conduit
  2. UL 6 2004 Electrical Rigid Metal Conduit - Steel
  3. UL 50 (1995; R 1999, Bul. 2001) Enclosures for Electrical Equipment
  4. UL 360 1986 (Bul. 1991) (R 1993) Liquid-Tight Flexible Steel Conduit
  5. UL 514A 1991 (R 2004) Metallic Outlet Boxes
  6. UL 514B 1989 (R 2004) Conduit, Tubing and Cable Fittings
  7. UL 514C 1996 (R 2000) Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers.
  8. UL 651 1989 (R 1989) (Bul. 1993) Schedule 40 and 80 Rigid PVC Conduit.
  9. UL 797 1993 (R 2004) Electrical Metallic Tubing - Steel
  10. UL 1242 1983 (R1993) (Bul. 1993) Intermediate Metal Conduit.
  11. UL 1286(1999; R 2001, Bul. 2002) Office Furnishings
  12. UL 1479 Fire Tests of Through Penetration Firestops
  13. UL Fire Resistance Directories

## 1.6 DEFINITIONS

- A. Exposed. Visible to the public following completion of the project. Not concealed.
- B. Concealed. Fully enclosed in finished construction, and not visible to the public. Examples include installation above finished ceiling or within a wall cavity.

## 1.7 SUBMITTALS

- A. Conform with the requirements of Section 01 33 23 – Shop Drawings, Product Data and Samples and Section 28 05 00 - Common Work Results for Electronic Safety and Security.
  1. As part of the project submittals, the contractor to provide engineered shop drawings indicating the proposed design for mounting all work of this Division as defined under the Seismic Design Requirements and defined elsewhere in this Section, inclusive of mounting systems, equipment mounted at the exterior, inclusive of its effective wind load under the range of conditions expected.

- a. Shop drawings to be accompanied by anchorage calculations indicating that it shall remain attached to the mounting surface after experiencing forces in conformance with California Code of Regulations, Title 24, California Building Code, edition as referenced in Division 1 and as shown on the Architectural Plans
- b. Structural Calculations shall be prepared and signed by a California Registered Structural Engineer. Specify proof loads for drilled-in anchors, if used.

## 1.8 QUALITY ASSURANCE

- A. All materials, equipment and parts comprising the units specified herein shall be new and unused, and of current manufacturer.
- B. Only products and applications listed in this Section may be used on the project unless otherwise submitted and approved by the University's Representative.

## PART 2 - PRODUCTS

*Pathway construction throughout the majority of the UC Santa Cruz campus requires conventional materials. Refer to the most recent edition of the PP&C Division 26 raceway standard to conform with its latest requirements. At the present time, PP & C does not permit the use of setscrew fittings for EMT construction. Note that due to severe salt water exposure at the Marine Science Campus, pathways installed at the exterior of buildings on that site utilize 316 stainless steel and/or nonmetallic pathway.*

### 2.1 GENERAL

- A. Provide the following types of conduit systems listed by their commonly used generic name.

### 2.2 RACEWAY

#### A. Manufacturers:

##### 1. Raceway:

- a. Allied Tube and Conduit Co.
- b. Triangle PWC, Inc.
- c. Western Tube and Conduit Corp.
- d. Spring City Electrical Manufacturing Co.
- e. Occidental Coating Co. (OCAL).
- f. Alflex Corp.
- g. American Flexible Metal Conduit Co.
- h. Anaconda.
- i. Or equal.

*Stainless steel only applies for work installed at the exterior at the Marine Science campus.*

##### 2. Stainless Steel Raceway and Fittings

- a. Constructed of Type 316 Stainless Steel with either EMT, IMC type stainless steel fittings.
- b. Approvals

- c. UL6A
  - d. Manufacturers
    - i. Calbrite
    - ii. Allied Tube and Conduit
    - iii. Or equal.]
3. Fittings:
- a. Appleton Electric Co.
  - b. OZ/Gedney.
  - c. Thomas & Betts Corp.
  - d. Spring City Electrical Manufacturing Co.
  - e. Occidental Coating Co. (OCAL).
  - f. Carlton.
  - g. or equal.
- B. Rigid Steel Conduit.
- 1. Drawing and Spec Reference: RSC.
  - 2. Construction:
    - a. Conduit: Full weight, threaded, hot-dip galvanized steel, conforming to ANSI C80.1 and UL 6.
- Select compression type for severe exposure conditions, otherwise use standard.*
- b. [Standard threaded] [Compression Type] couplings locknuts, bushings, and elbows: Only materials of steel or malleable iron are acceptable. Locknuts shall be bonding type with sharp edges for digging into the metal wall of an enclosure.
  - c. Three piece couplings: Electroplated, cast malleable iron.
  - d. Insulating bushings: Threaded polypropylene or thermosetting phenolic rated 150 degree C minimum.
  - e. Insulated grounding bushings: Threaded cast malleable iron body with insulated throat and steel "lay-in" ground lug with compression screw.
  - f. Insulated metallic bushings: Threaded cast malleable iron body with plastic insulated throat rated 150 degrees
3. All fittings and connectors shall be threaded.
- C. Coated Rigid Steel Conduit:
- 1. Drawing and Spec Reference: CRSC.
  - 2. Conduit: Full weight, threaded, hot-dip galvanized steel, conforming to ANSI C80.1 and NEMA RN-1 with nominal 40 mil thermoplastic vinyl coating, heat fused and bonded to the exterior of the conduit.
  - 3. Fittings:
    - a. Conduit couplings and connectors shall be as specified for galvanized rigid steel conduit and shall be factory PVC coated with an insulating jacket equivalent to that of the coated material.
    - b. Fittings over-sleeve to extend 1 conduit diameter or 1-1/2" beyond fitting, whichever is less.
  - 4. Performance:
    - a. Tensile Strength: 3500 psi.
  - 5. Approvals:
    - a. NEMA RN1 (Type 40 - 40 mils thick)
    - b. CalTrans Type 2
  - 6. Manufacturers:
    - a. Plastibond by RobRoy Industries.
    - b. Occal-40 by Occidental Coating Company.
    - c. KorKap by Plastic Applicators.
    - d. Ocal-Blue
    - e. or equal.

## D. Intermediate Metal Conduit

1. Drawing Reference: IMC
2. Conduit: Hot dip galvanized steel meeting the requirements of CEC Article 345 and conforming to ANSI C80.6 and UL 1242.

*Select compression type for severe exposure conditions, otherwise use standard.*

3. Fittings: *[Standard threaded][Compression Type]* couplings, connector and bushing shall be as specified for galvanized rigid steel conduit. Integral retractable type IMC couplings are also acceptable.

## E. Electrical Metallic Tubing.

1. Drawing and Spec Reference: EMT.
2. Conduit: Shall be formed of cold rolled strip steel, electrical resistance welded continuously along the longitudinal seam and hot dip galvanized after fabrication. Conduit shall conform to ANSI C80.3 specifications and shall meet UL classifications.
3. Raintight compression couplings: Electroplate steel or cast malleable iron; UL listed raintight and concrete tight, using gland and ring compression type construction.
4. Raintight compression connectors: Electroplated steel or cast malleable iron, UL listed raintight and concrete tight, with insulated throat, using gland and ring compression type construction.
5. Use of set-screw couplings and connectors is not permitted.

## F. Flexible Conduit:

1. Drawing Reference: FLEX
2. Construction:
  - a. Flexible steel, zinc coated on both inside and outside by hot-dipping process.
  - b. Interlocking spirally wound continuous steel strip.
  - c. 3/4" minimum size.
3. Fittings: Compression type connectors shall be of the single screw clamp variety with steel or cast malleable iron bodies and threaded male hubs with insulated throats. Exception: Pressure cast screw-in connectors shall be acceptable for fixture connection in suspended ceilings and cut-in outlet boxes within existing furred walls.
4. Approvals:
  - a. UL 1

## G. Liquidtight Flexible Metallic Conduit

1. Drawing Reference: Liquidtight
2. Conduit: Shall be fabricated in continuous lengths from galvanized steel strips, interlocking spirally wound, covered with extruded liquid tight jacket of polyvinyl chloride (PVC) and conforming to UL 360. Provide conduit with a continuous copper-bonding conductor wound spirally between the convolutions.
3. Fittings: Compression type connector body and gland nut shall be of cadmium plated steel or cast malleable iron, with tapered, male, threaded hub; insulated throat and neoprene "O" ring gasket recessed into the face of the stop nut. The clamping gland shall be of molded nylon with an integral brass push-in ferrule.

## 2.3 DUCTBANK CONSTRUCTION

## A. PVC Conduit

1. Drawing and Spec Reference: PVC.
2. Construction:
  - a. 4" trade diameter, unless otherwise noted.
  - b. Poly-vinyl chloride.
  - c. Schedule by Application
    - i. *Straight segments, Schedule 40.*
    - ii. *Flat elbows, Schedule 40.*
    - iii. *Vertical elbows sweep up to grade, Schedule 80.*
    - iv. *Above grade, Schedule 80.*

- d. Elbows.
  - i. Where the innerduct liner is scheduled – CRSC.
  - ii. Elsewhere, Schedule 80.
  - iii. 90° C rated.
  - iv. Solvent welded joints, joints by pipe manufacturer.
- e. Application.

Conform with the latest PPDO master specs for underground ductbank installation. UCSC typically encases underground ductbanks in concrete.

- i. Soil Backfill/Direct Burial
  - 1. RUS Type II, Type C or Type DB
  - 2. Schedule 40.
- ii. Concrete Encasement:
  - 1. PVC Type DB-120,
  - 2. RUS Type I, Type B ohim him him r Type EB
  - 3. Any meeting Soil Backfill/Direct Burial.
- iii. Boring
  - 1. HDPE.
  - 2. RUS Type Flexible Plastic.
- f. Performance:
  - i. Tensile Strength: 7,000 psi at 73.4° F.
  - ii. Flexural Strength: 11,000 psi.
  - iii. Compressive Strength: 8,600 psi
- g. Approvals:
  - i. RUS Listed for Telephone Cable Installation 5-99 Edition, or latest release thereof.
  - ii. NEMA TC-2, PVC Type EPC-40 and EPC-80.
  - iii. NEMA TC-3.
  - iv. NEMA TC14 Fiberglass Conduit.
  - v. UL 514 fittings.
  - vi. UL 651.
  - vii. ANSI C33.91.
- h. Manufacturers:
  - i. RUS Listed:

Manufacturer	RUS Listed for	Manufacturer Part Number
Allwire, Inc.	Flexible plastic	ALLDUCT
American Pipe & Plastics	Plastic	Type B, C, and D
	Plastic	Type EB and DB
	Plastic	PVC Multi-Duct (2,3,4 and 6-way)

American International Flexible plastic	Flexible plastic	HDPE Duct
	Plastic	PVC Type C

Apache Plastics, Inc.	Plastic	Type EB and Type DB
ARMCO	Plastic	Smooth-Cor Type B and Type C
Arnco	Flexible plastic	HDPE Conduit
Bay Plastics, Inc.	Plastic	Type B and Type C
Bristolpipe	Plastic	Type B, C, and D
	Plastic	Type EB and Type DB
Can-Tex	Plastic	Type EB and Type DB
	Plastic	Type B, C, and D
Carlton	Plastic	Type EB and Type DB
	Plastic	Type B, C, and D
	Plastic	Multi-Gard
Certain-Teed Products Corp.	Plastic	Type EB and Type DB
CIBA-GEIGY	Fiberglass	T & D Conduit
Condux International, Inc.	Concrete	Condux
	Plastic	Type EB and Type DB
CSR Polypipe	Flexible plastic	HDPE Duct
Dura-line	Flexible plastic	HDPE Duct
Eagle Pacific Industries, Inc.	Plastic	Type EB and Type DB
	Flexible plastic	HDPE Coiled Duct
Endot Industries	Flexible plastic	HDPE Duct
Hercules, Inc.	Flexible plastic	Corflo plastic conduit
Hurlbut Plastic Pipe	Plastic	Type C
Ingomar Plastic Pipe	Plastic	Type B and Type C
J-M Manufacturing Company	Plastic	Types C, EB, and DB
Kyova	Plastic	Type EB and Type DB

LCP National Plastics, Inc.	Plastic	Type EB and Type DB
	Plastic	Type B and Type C
Northern Pipe Products	Plastic	Type B, C, and D
OMNI	Flexible plastic	HDPE Duct
Petroflex	Flexible plastic	HDPE Duct
	Flexible plastic	Corrugated HDPE Duct
Phillips Products Co., Inc.	Flexible plastic	Driskon 3200
Phone Ducs	Plastic	Multiple plastic conduit (4, 6, & 9 Way)
PLEXCO	Flexible plastic	PLEXCO Duct
PWPipe	Plastic	Type EB and Type DB
Pyramid Industries, Inc.	Plastic	Type EB and Type DM
	Flexible plastic	HDPE Conduit
Quail Plastics	Plastic	Type EB and Type DB
Queen City Plastics	Plastic	Type EB and Type DB
River City Plastics	Plastic	Type EB and Type DB
Sedco	Plastic	Type EB and Type DB
Southern Pipe, Inc.	Plastic	PVC Types EB, DB, and Sch. 40
Tamaqua Cable Products	Flexible plastic	HDPE Duct
Tridyn Industries	Plastic	Type EB and Type DB
Vassallo Industries	Plastic	Type B and Type C
Wesflex	Flexible plastic	Flex-Con

i. or equal

B. Fiberglass Conduit

1. Drawing Reference: Fiberglass
2. Construction:
  - a. Trade Standard Sizes
  - b. Meets NEMA TC 14
  - c. Complete system of joints and threaded steel conduit couplers
3. Manufacturers:

- a. TVC Communication/Vikimatic Fiberglass Conduit
- b. Champion Fiberglass
- c. FRE Composite
- d. or equal.

## 2.4 MISCELLANEOUS CONDUIT FITTINGS AND PRODUCTS

- A. General
  - 1. UL 514B.
  - 2. Listed in UL Electrical Construction Materials List.
- B. Conduit Fittings, Insulated Throat Grounding Bushings
  - 1. Description
    - a. Threaded for Rigid Steel Conduit and Intermediate Metal Conduit.
    - b. UL Listed for use with copper conductors.
    - c. Thermoplastic insulated liner for 105 degrees Celsius.
    - d. Body of malleable iron, zinc plated; or die cast zinc.
  - 2. Manufacturer
    - a. Thomas & Betts (Steel City) BG-801 Series
    - b. O-Z/Gedney
    - c. or equal.
- C. Watertight conduit entrance seals: Steel or cast malleable iron bodies and pressure clamps with PVC sleeve, neoprene sealing grommets and PVC coated steel pressure rings. Fittings shall be supplied with neoprene sealing rings between the body and PVC sleeve.
- D. Watertight cable sealing bushings: One piece, compression molded sealing ring with PVC coated steel pressure disks, stainless steel sealing screws and zinc plated cast malleable iron locking collar.
- E. Expansion fittings: Multi-piece unit consisting of a hot dip galvanized malleable iron or steel body and outside pressure bussing designed to allow a maximum of 4" conduit movement (2" in either direction). Furnish with external braid tinned copper bonding jumper. Unit shall be UL listed for wet or dry locations.
- F. Expansion/deflection couplings: Multi-piece unit comprised of a neoprene sleeve with internal flexible tinned copper braid attached to bronze end couplings with stainless steel bands. Coupling shall accommodate .75-inch deflection, expansion, or contraction in any direction, and allow 30-degree angular deflections. Flexible, corrosion-resistant, watertight, moisture and heat resistant molded rubber jacket and stainless steel jacket clamps. Unit shall comply with UL467 and UL514.
  - 1. Manufacturer:
    - a. OZ/Gedney Type DX
    - b. Steel City Type EDF
    - c. or equal.
- G. Standard products not herein specified:
  - 1. Submit for review a listing of standard electrical conduit hardware and fittings not herein specified prior to use or installation, i.e. locknuts, bushings, etc.
  - 2. Listing shall include manufacturers name, part numbers, and a written description of the item indicating type of material and construction.
  - 3. Miscellaneous components shall be equal in quality, material, and construction to similar items herein specified.
- H. Hazardous area fittings: UL listed for the application.

## 2.5 JUNCTION AND DEVICE BOXES

- A. Junction and Device Boxes
  - 1. Drawing References: As shown on Symbol Schedule
  - 2. Construction:
    - a. Concealed/Flush Mounted:

- i. *One or two piece welded knockout boxes. UL 514A, cadmium or zinc-coated 1.25 oz/sq. ft., if ferrous metal.*
    - ii. *Pressed sheet steel, for flush indoor locations.*
    - iii. *UL 514C approved if non-metallic.*
    - iv. *At hollow masonry, tile walls and plaster walls, provide with device rings as required.*
    - v. *Exterior: Where installed in hazardous locations or exposed to corrosive atmosphere, rain or spray, boxes shall be corrosion resistant cast metal with threaded entrances, removable covers, gaskets, and corrosion resistant screws.*
  - b. Surface mounted:
    - i. *Conform to the Junction and/or PullBox construction scheduled on the Plans. Where construction not otherwise scheduled or noted on the plans, conform to the following:*
      - 1. *Junction boxes with knockouts are not to be used for surface mounted locations or exposed locations.*
      - 2. *Cast iron with threaded hubs and mounting lugs.*
    - ii. *Exterior: Where installed in hazardous locations or exposed to corrosive atmosphere, rain or spray, boxes shall be corrosion resistant cast metal with threaded entrances, removable covers, gaskets, and corrosion resistant screws.*
  - c. Concrete floor embedded:
    - i. *Cast iron concrete pour boxes with screwed brass cover, unless otherwise noted.*
    - ii. *Cadmium plated screw cover attachment at least 6" on center.*
  - d. If size not otherwise noted, at least 4S (4" square) by 2-1/8" deep, or Code minimum size, whichever is larger.
    - i. *Wherever 4S is indicated, contractor may at their option substitute 4-11/16" or 5" (5S) square boxes while maintaining the minimum depth required by these specifications and the drawings.*
    - ii. *At recessed masonry wall installations, provide gangable masonry boxes.*
  - e. Provide complete with approved type of connectors and required accessories, including attachment lugs or hangers. Provide raised device covers as required to accept scheduled device.
- 3. Approvals.
  - a. UL 514A
- 4. Manufacturers:
  - a. Interior, flush:
    - i. *Steel City.*
    - ii. *Bowers*
    - iii. *Randl Industries, Inc. (5S Boxes).*
    - iv. *or equal.*
  - b. Interior, flush 5S Boxes
    - i. *Randl, Inc. 5 Square Telecommunications Boxes*
    - ii. *or equal.*
  - c. Surface mount or exterior, exposed with cover of same construction.
    - i. *Appleton*
    - ii. *Pyle-National*
    - iii. *or equal.*
  - d. Other conditions:
    - i. *Any meeting approvals and requirements.*

## 2.6 CABINETS AND ENCLOSURES

A. Terminal Cabinets:

1. Drawing Reference: As Scheduled.
2. Construction:
  - a. All security system enclosures to be equipped with tamper detection.
  - b. All enclosures should be appropriate to the environment.
    - i. Interior:
      1. Zinc Coated Sheet Steel, code gauge with standard concentric knockouts for conduit terminations.
      2. NEMA 250 Type 1, unless otherwise noted. Refer to plans and schedules.
    - ii. External enclosures:
      1. NEMA 250 Type - As Scheduled, not less than NEMA 3R.

*Stainless steel Type 316 only applies for work installed at the exterior at the Marine Science Campus and similar campus settings.*

2. [NEMA 250 Type - NEMA 4X.]
  - c. Rear wall dimensions not less than those scheduled.
  - d. Finish: Manufacturer's standard gray baked enamel finish.
  - e. Covers: Trim fitted, continuous hinged steel door, flush catch – lockable and keyed to match. Screw fastened doors not acceptable.
    - i. Door face to be not less than 95% of panel interior dimensions.
  - f. Provide with 3/4" fire retardant treated ply backboard.
3. Mounting:
  - a. Flush cabinets shall be furnished with concealed trim clamps and shall be not less than 4 inches deep.
  - b. Surface cabinets shall be furnished with screw cover trim, flush hinged door and shall not be less than 6 inches deep.
4. Manufacturers:
  - a. B-Line Electrical Enclosures
  - b. Circle AW Products.
  - c. Hammond
  - d. Henessey.
  - e. Hoffman.
  - f. Myers Electric Products
  - g. Rittal.
  - h. or equal.

2.7 WIREWAY

*Note that UCSC Physical Security does not accept nonmetallic "finger" wireway at electronic security backboards in lieu of the steel wireway (gutter) specified here.*

A. Lay-In Wireway

1. Drawing Reference: Gutter
2. Features/Functions/Construction
  - a. NEMA Type 1, unless otherwise noted.
  - b. ANSI 61 Gray polyester powder finish inside and outside.
  - c. Screw fastened cover completely removable to provide complete access to interior.
  - d. 6"x6" cross-section minimum, size for 30% fill maximum
3. Approvals
  - a. UL 870
  - b. NEMA Type 1
4. Manufacturers

- a. Hoffman Lay-In Type 1 Wireway
- b. Square D
- c. Circle AW
- d. or equal

## 2.8 THROUGH PENETRATION SEALING SYSTEMS

*Conform with current PPDO master specs for through-penetration sealant systems. UCSC ITS requires that communications cabling including cabling placed for Division 28 security cameras be placed using re-enterable through-penetration sealant system equivalent to STI EZ-Path.*

- A. Through Penetration Sealant Assembly, Re-Enterable (Zero Maintenance)
  - 1. Drawing Reference: TPSR and as required at all new through-penetrations through rated partitions.
  - 2. Application
    - a. Provide at all locations where open wire communications cabling penetrates fire-rated assemblies in basket tray, cable tray or supported by J-hooks. Zero-maintenance firestop assemblies shall be used when the pathway on one or both sides of the wall, ceiling or floor is open, such as J-hooks or cable tray.
    - b. Communications conduit sleeves through a single fire-rated wall shall not be used. For these applications, a zero-maintenance firestop assembly is required.
  - 3. Functions
    - a. Cables passing through fire-rated floors or walls shall pass through fire rated assemblies which can be used by the University's technical staff to add and remove cabling without having to apply or remove putty fill, backing or similar compounds to maintain the necessary fire rating.
    - b. Through penetration system to feature either automatic self-adjustment mechanisms, or integral mechanical adjustment mechanisms to permit the University's staff to adapt the assembly to the fill condition without need for supplementary or disposable materials. The assembly shall contain a self-contained sealing system which shall automatically adjust to the installed cable loading and shall permit cables to be installed, removed or retrofitted without the need to adjust, remove or reinstall firestop material.
    - c. Assemblies shall have an F Rating and T Rating equal to the rating of the barrier in which the device is installed, where such is performance is required by Code.
    - d. Assembly size and quantity shall be determined as follows:
      - i. *For round openings, the fill ratio of cabling-to-opening-size shall not exceed 40%, or as dictated by the manufacturer, whichever is more stringent.*
      - ii. *For rectangular openings, the fill ratio of cabling-to-opening size shall not exceed 50%, or as dictated by the manufacturer, whichever is more stringent.*
      - iii. *Include in the cabling cross-sectional area enough spare capacity to accommodate 50% growth. Upon commissioning, if adequate spare capacity is not observed, the contractor shall install additional assemblies at their own cost to provide such spare capacity*
  - 4. Approvals:
    - a. California State Fire Marshal.
    - b. Tested to UL 1479
    - c. UL 2043
  - 5. Manufacturers - Select for application:
    - a. Specified Technologies Inc. EZ-Path Fire Rated Pathway

- b. Wiremold FlameStopper
  - c. Hilti CP 653 Speedsleeve
  - d. or equal.
- B. Firestopping for Conduits and Other Closed Pathways
1. Approvals: California State Fire Marshal
  2. Tested to UL 1479 or ASTM E814.
  3. Manufacturers:
    - a. Specified Technologies, Inc.
    - b. 3M
    - c. or equal.

## 2.9 SUPPORTING DEVICES

- A. General
1. Supports to be sized to suit load and selected to match mounting conditions
- B. Manufacturers
1. Equal products by the following manufacturers will be considered providing that all features of the specified product are provided:
    - a. Concrete fasteners:
      - i. *Phillips "Red-Head".*
      - ii. *Remington.*
      - iii. *Ramset.*
      - iv. *Hilti*
      - v. *Simpson Strong-Tie*
      - vi. *or equal.*
    - b. Concrete inserts and construction channel:
      - i. *Unistrut Corp.*
      - ii. *GS Metals "Globe Strut."*
      - iii. *Thomas & Betts "Kindorf" Corp.*
      - iv. *Or equal.*
    - c. Conduit straps:
      - i. *O-Z/Gedney.*
      - ii. *Erico "Caddy" Fastening Products.*
      - iii. *Thomas & Betts "Kindorf" Corp.*
      - iv. *Or equal.*
    - d. Beam Clamps
      - i. *Cooper B-Line*
      - ii. *SuperStrut*
      - iii. *Unistrut*
      - iv. *or equal*
    - e. Aircraft Cable Sway Braces
      - i. *Mason Industries*
      - ii. *M.W. Sausse/Vibrex*
      - iii. *Loos & Company, Inc.*
      - iv. *or equal.*
- C. Concrete Fasteners
1. Provide expansion-shield type concrete anchors.
  2. Provide powder driven concrete fasteners with washers. Obtain approval by University's Representative prior to use.
- D. Concrete Inserts
1. Provide pressed galvanized steel, concrete spot insert, with oval slot capable of accepting square or rectangular support nuts of ¼ inch to ½ inch diameter thread for rod support.
- E. Aircraft cable sway braces

1. Steel rope sized to meet load.
- F. Construction Channel:
  1. Construction:
    - a. 1-5/8" square galvanized channel formed from U.S.S.G No. 12 or 0.109 inch cold formed steel with 17/32-inch diameter bolt holes, and 1-1/2 inch on center in the base of the channel.
    - b. 10 foot sections.
  2. All supporting materials by same manufacturer.
- G. Beam Clamps
  1. Malleable iron electro-galvanized steel beam clamps selected to match building structural steel members.
- H. Conduit Straps
  1. One hole strap, steel or malleable iron, with malleable iron clamp-back spacer for surface mounted wall and ceiling applications.
    - a. Use malleable strap with spacers for exterior and wet locations.
    - b. Use steel strap without spacers for interior locations.
  2. Steel channel conduit strap for support from construction channel.
  3. Steel conduit hanger for pendant support with threaded rod
  4. Steel wire conduit support strap for support from independent #12 gauge hanger wires.
- I. Threaded rods, couplings, screws and nuts:
  1. Electrolytically coated with zinc, 2 oz. zinc per square foot of surface, ASTM A123 or A153.
- J. Miscellaneous Parts
  1. Hot dipped galvanized after fabrication; after cutting, de-burring and hole drilling. Coated with zinc, 2 oz. zinc per square foot of surface, ASTM A123 or A153.
- K. Exterior/Wet Service Application
  1. Electronic security systems hangers or supports in wet areas or areas exposed to outside air including but not limited to building exterior, Tank Farm, AH-1 Mechanical Room, Greenhouse Interior or similar, shall be need to be suitably corrosion resistant, constructed of either 316 stainless steel or non-metallic
  2. Manufacturers:
    - a. Cooper Industries
    - b. Champion Fiberglass
    - c. Enduro Composites
    - d. Seasafe
    - e. Or equal.
- L. Paint/Tape for Touch-up:
  1. Zinc: CRC "Zinc-It", Glyptal, Enterprise Galvanizing "Galambra", or equal.

## 2.10 CABLE HANGERS

- A. Ceiling Hung J-Hooks
  1. Drawing Reference(s):
    - a. WMJ
    - b. ACJ
  2. Features/Functions/Construction
    - a. Specifically intended to carry the load of up to 50 communications cables without applying excess forces to cables at bottom of bundle.
    - b. Integral broad bottom edge to spread cable load with flat bottom and provide a minimum of 1-5/8 inch cable bearing surface.
    - c. Integral hanger rod attachment hardware at top.
    - d. Load rated for application.
    - e. Incorporates smooth 90-degree radiused edges to prevent snagging cable

- jackets on installation.
  - f. Designed so the mounting hardware is recessed to prevent cable damage.
  - g. Integral mechanical cable latch retainer to provide containment of cables within the hook. The retainer shall be removable and reusable.
  - h. Suitable for direct attachment to walls, hanger rods, beam flanges, purlins, strut, floor posts, etc. to meet job conditions.
  - i. Multi-tiered cable hooks to be used where required to provide separate cabling compartments, or where additional capacity is needed.
  - j. Finishes:
    - i. Cable hooks for non-corrosive areas shall be pre-galvanized steel, ASTM A653. Where additional strength is required, cable hooks shall be spring steel with a zinc-plated finish, ASTM B633, SC3.
    - ii. Cable hooks for corrosive areas shall be stainless steel, AISI Type 304.
3. Manufacturer
- a. Cooper B-Line series BCH21, BCH32, BCH64
  - b. Caddy/Erico CableCat
  - c. or equal.

*The next subsections only applies when the electronic security system includes underground work.*

## 2.11 UNDERGROUND STRUCTURE AND PATHWAY

### A. Fittings

1. *Couplings, adapters, transition fittings, etc., shall be molded PVC, slip on, solvent weld type conforming to NEMA TC3 for Schedule 40 or 80 and NEMA TC 9 for type EB or DB.*
2. *Fitting Types*
  - a. Expansion Fittings, 12", Metallic:
  - b. Function: At road or bridge expansion joints requiring up to 12" of expansion compensation.
  - c. Construction
    - i. Steel, hot dip galvanized.
    - ii. Nylon wear bushings
    - iii. O-ring seal
    - iv. Bonding jumper
  - d. Manufacturers:
    - i. O-Z Gedney Type AX, Type AX-8, and Type EX fittings with Type BJ Bonding Jumper.
    - ii. TVC/Vikimatic VB0285X series.
    - iii. Or Equal.
3. *Expansion Fittings, 6", Non-metallic:*
  - a. Function: At road or bridge expansion joints requiring up to 6" of expansion compensation.
  - b. Construction
    - i. Fiberglass
    - ii. Provide bonding jumper.
  - c. Manufacturers:
    - i. TVC Communications HW or Extra Heavy Wall Expansion Joint.
    - ii. Vikimatic
    - iii. FRE Composites, Inc.
    - iv. Or Equal.
4. *Caps, Underground Conduit Stubs*

- a. Provide at each location indicated for future expansion.
- b. Wateright.
- c. Manufacturers:
  - i. Carlon E985N
  - ii. Vikimatic
  - iii. or equal by manufacturers listed in this Section for underground ductbank construction.

**B. Underground Structures**

**1. Vaults, PullBoxes and Manholes, Precast, General**

- a. Precast units shall be the product of a manufacturer regularly engaged in the manufacture of precast concrete products, including precast manholes, boxes and handholes.
  - b. Construction
    - i. General
      - 1. Castings shall be free from warp and blow holes that may impair strength or appearance.
      - 2. Structures shall be precast to the design and details indicated, precast monolithically and placed as a unit, or structures may be assembled in sections, designed and produced by the manufacturer in accordance with the requirements specified
      - 3. Structures shall be identified with the manufacturer's name embedded in or otherwise permanently attached to an interior wall face.
      - 4. Structure top and wall shall be of a uniform thickness of not less than 4 inches except at knockouts.
      - 5. The minimum concrete cover for reinforcing steel shall be 2 inches.
      - 6. All steel, except reinforcing steel, shall be hot dip galvanized after fabrication.
      - 7. Knockouts & Windows
        - a. Thin-walled knock-out panels designed for future duct bank entrances are permitted.
        - b. Sides of precast windows shall be a minimum of 4 inches from the inside surface of adjacent walls, floors, or ceilings.
        - c. Form of the perimeter of precast window openings to have a keyed or inward flared surface to provide a positive interlock with the mating duct bank envelope.
        - d. Provide welded wire-fabric reinforcing through window openings for in-field cutting and flaring into duct bank envelopes.
        - e. Provide additional reinforcing steel comprised of at least 2 No. 4 bars around window openings.
      - 8. Extension Rings
        - a. Provide extension rings as-required to extend from finished grade to communications utilities.
      - 9. Bottom and Drain Sumps
        - a. Provide solid concrete bottom surface.
        - b. Provide drain sumps for precast structures a minimum of 12 inches in diameter and 4 inches deep.
- c. Joints:
  - i. Provide tongue-and-groove or shiplap joints on mating edges of precast components.
  - ii. Design joints to firmly interlock adjoining components and to provide

- waterproof junctions, and adequate shear transfer.
- iii. Seal joints watertight using preformed plastic strip conforming to AASHTO M198, Type B.
- d. Frames and Covers
- i. Covers to match across all utilities.
  - ii. Provide fiber composite lids at pedestrian rated covers, H-20 steel slip resistant covers otherwise.
  - iii. Labeling
    - 1. Provide labeling as follows:
      - a. "Communications"
      - b. University's Manhole or Vault No, as shown on drawings or provided to Contractor prior to vault order placement.
    - 2. Labeling shall be:
      - a. Cast in concrete lids
      - b. Written in weld on steel lids
      - c. Alternatively, for pedestrian grade vault lids and for the vault number only, provide ½" tall, 1/8" min. thickness lamacoid label, rivet attached to box top in recess area below surface of lid.
- e. Pulling-In-Irons
- i. Steel bars bent in the form indicated and cast in the walls and floors.
  - ii. Install a pulling-in iron in the wall opposite each duct line entrance at walls, not less than 6 inches above or below, and opposite the conduits entering the manhole.
  - iii. Pulling-in irons shall project into the manhole approximately 4 inches, or be cast in a pocket. Iron shall be hot-dipped galvanized after fabrication.
- f. Cable Racks and Arms
- i. Provide nonmetallic cable racks:
    - 1. Vaults and pullboxes. Minimum two (2), at each vault face 24 inches or longer, at least one (1) each face otherwise.
    - 2. Manholes. Provide AT&T standard arrangement of cable racks at each manhole
      - a. Provide two nonmetallic cable racks arms - minimum 12" arms – for each cable rack provided at each manhole or vault as required above.
2. Underground Pull Boxes and Vaults, Concrete with Diamond Plate Steel or Concrete Lids
- a. Drawing and Specification References:
- i. PB1P
  - ii. PB1T
  - iii. PB2P
  - iv. PB2T
  - v. PB3T
- b. Minimum Size (inches)
- i. PB1: 12x18
  - ii. PB2: 24x36
  - iii. PB3: 36x60
  - iv. Provide scheduled or larger size.
  - v. Provide extension rings as required to meet required depth.
- c. Minimum Load Performance:
- i. PB\*P – where \* is the vault size: Manufacturer's Parkway/Pedestrian Box/Lid or using Polymer Concrete Box lid meeting ANSI/SCTE

- 77-2007 Tier 8.
- ii. PB\*T – where \* is the vault size: Per AASHTO H-22. See options described in plans and Part 3 for Contractors Option to use Polymer Concrete Vaults at specific dirt road/path conditions where indicated on the plans. Refer below for specification of Polymer Concrete Vaults.
- d. Lid Construction:
  - i. As scheduled on the plans and in the schedule of applications in Part 3.
  - ii. Labeling "Communications" in addition to the vault number identified by the University.
- e. Solid Bottom, with sump as indicated on the plans.
- f. Sidewall Duct Entries with bell end fittings.
- g. Cover Components
  - i. PB1 and PB2 Size: One piece construction
  - ii. PB3 Size: Two piece hinged lids with torsion spring lifters.
- h. Manufacturers:
  - i. Oldcastle Precast
  - ii. Brooks Products
    - 1. 1P & 1T: 5 Series and extension rings as required
    - 2. 2P & 2T: 67 Series and extension rings as required
    - 3. 3T: 400 Series with 11C Type Lid.
  - iii. Jensen PreCast
    - 1. PB1P: P9 with FL9D lid, P9BA base and extension rings as required.
    - 2. PB1T P9 with P9-61 lid, P9BA base and extension rings as required
    - 3. PB2P: P36 with FL36D cover, P36BA base and extension rings as required
    - 4. PB2T: P36 with P36-61D lid, P36BA base and extension rings as required
    - 5. PB3T: 35TA
  - iv. Utility Vault Company, Inc./Oldcastle Precast
    - 1. PB3T: PTS-3660, with H-20-44 loading cover, with 3660- 06 and 3660-12 extensions as required.
  - v. Associated Concrete Products
  - vi. Forni Corporation.
  - vii. Or equal.
- 3. Manhole/Maintenance Hole
  - a. Drawing and Specification Reference:
    - i. MH: Maintenance Hole, 8'-6" feet long by 4'-6" wide minimum inside dimensions, 6'-6" clear interior height.
  - b. Minimum Load Performance: AASHTO H-22.
  - c. Construction:
    - i. AT&T Reference Specification PTS-65 for overall size and shape.
      - 1. Arrange duct bank entry per 2004 BICSI Customer Owner Outside Plant Manual, Basic A Splayed Duct Entries, not AT&T standard Basic A center window.
      - 2. Provide non-metallic racking and cable support arms, not AT&T standard metallic arms.
      - 3. Increase wall thickness where indicated installation depth exceeds rating of PTS-65 assembly.
      - 4. Provide extension rings as required to meet required depth.
    - ii. Ladder
      - 1. Provide 1 ladder per maintenance hole

2. Steel, hooks to rungs at top of maintenance hold neck, long enough to reach bottom of maintenance hole.
  - d. Labeling
    - i. Labeling "Communications" in addition to the manhole number identified by the University.
  - e. Manufacturers
    - i. Jensen PreCast PTS65 Manhole with ladder, with cover with nameplate "Communications", and with extension rings as required.
    - ii. OldCastle/Utility Vault Company, Inc.
    - iii. Teichert Precast Products
    - iv. Associated Concrete Products
    - v. Forni Corporation.
    - vi. Or equal.
4. Underground Pull Boxes and Vaults, Polymer Concrete
- a. Drawing and Specification References – where the option to use of composite vault assemblies is indicated on the plans and per Part 3 of these specifications
    - i. PB1P
    - ii. PB1T
    - iii. PB2P
    - iv. PB2T
    - v. PB3T
  - b. Minimum Size
    - i. As scheduled on the drawings. Provide scheduled or larger size.
  - c. Cover Components
    - i. PB1 and PB2 Size: One piece construction
    - ii. PB3 Size: Two piece hinged lids with torsion spring lifters.
  - d. Construction:
    - i. Polymer concrete cover and body.
  - e. Labeling
    - i. Labeling "Communications" in addition to the vault number identified by the University.
  - f. Sidewall Duct Entries with bell end fittings.
  - g. Solid bottom with sump as indicated on the plans.
  - h. Minimum Load Performance:
    - i. PB\*P – where \* is the vault size: ANSI/SCTE 77-2007 Tier 8.
    - ii. PB\*T – where \* is the vault size: At indicated dirt roads, per ANSI/SCTE 77-2007 Tier 22.
  - i. Manufacturers
    - i. Armorcast Polymer Concrete Vaults
    - ii. Oldcastle Enclosure Solutions H-Series
    - iii. New Basis
    - iv. Quazite
    - v. Hubbell Power Systems
    - vi. Or equal.
- C. Miscellaneous Underground Products
1. Cable Warning Tape
    - a. Provide
      - i. 6 inches wide minimum.
      - ii. 5 mil plastic.
      - iii. Metallic backing at least 10 feet o.c.
      - iv. 1 mil metallic foil core.
      - v. Orange in color
      - vi. Suitable for buried applications.

- vii. Continuously imprinted with the words "WARNING - COMMUNICATIONS CABLE BELOW" or similar at not more than 48 inch intervals.
  - b. Manufacturers:
    - i. Carlon Telecom Systems.
    - ii. Monarch Duct & Conduit
    - iii. Vikimatic
    - iv. Or equal.
- 2. Pull Rope
  - a. At least 3/8 inch diameter polyethylene or 3/8" min width woven aramid fiber pulltape.
  - b. 200 pound minimum strength.
  - c. Manufacturers:
    - i. Arnco Dandy-Line
    - ii. Carlon Telecom Systems.
    - iii. Fibertek Pull-line
    - iv. Monarch Duct & Conduit
    - v. Vikimatic
    - vi. Any length marked tape listed elsewhere herein below constructed as a pulltape.
    - vii. Or equal.
- 3. Length Marked Tape
  - a. Provide 1/2 inch flat tape with sequential markings in whole feet.
  - b. Manufacturers:
    - i. Carlon Telecom Systems.
    - ii. Greenlee
    - iii. Fibertek Pulltape or Tracertape
    - iv. Vikimatic
    - v. Or equal.
- 4. Conduit Plugs
  - a. Provide universal blank duct plug type, with eye for tying rope and tape.
  - b. Manufacturers:
    - i. Carlon Telecom Systems Universal Blank Duct Plugs, Simplex, Triplex and Quadplex Duct Plugs
    - ii. Condux International, Inc.
    - iii. Monarch Duct & Conduit Duct Plugs and Multistep Cap Ends
    - iv. GS Industries of Bassett, LLC Expandable Watertight Plugs
    - v. Or equal.
- 5. Conduit Spacer, Trench
  - a. Construction
    - i. Non-metallic.
    - ii. Sized to snap around conduits as shown on Drawings.
    - iii. Interlocking.
  - b. Manufacturers:
    - i. Underground Devices Wunpeece.
    - ii. GS Industries of Bassett, LLC Underground Products Spacer System.
    - iii. Armorcast Products Company
    - iv. Carlon Snap-Loc Spacers
    - v. or equal
- 6. Pulling In Irons
  - a. 7/8" Diameter
    - i. 6" exposed length minimum after embedment
    - ii. RUS approved
  - b. Manufacturer

- i. Cooper Power Systems
    - ii. Or equal by listed vault or maintenance hole manufacturer
    - iii. Or equal.
- 7. *Cable Racks & Supports*
  - a. Construction:
    - i. Steel
    - ii. 12" minimum rack arms
    - iii. Snap into vertical strut sections provided with new manhole, pull boxes and vaults, or into University's existing vaults, where indicated.
  - b. Approvals
    - i. RUS
    - ii. NEMA
  - c. Manufacturers:
    - i. As manufactured by the listed vaults and manhole manufacturers listed herein above.

## PART 3 - EXECUTION

### 3.1 GENERAL

- A. The University's Representative reserves the right to request additional supports where in their sole opinion said supports are required. Any additional supports shall be installed at no additional cost to the University.

### 3.2 EXAMINATION

- A. Thoroughly examine site conditions for acceptance of supporting device installation to verify conformance with manufacturer and specification tolerances. Do not commence with installation until all conditions are made satisfactory.

### 3.3 PREPARATION

- A. Coordinate size, shape and location of concrete pads required for equipment installation with the work of the other trades
- B. Lay out support devices to maintain headroom, neat mechanical appearance and to support the equipment loads.
- C. Where shown on the Drawings or Specifications, install freestanding Electronic Safety and Security equipment on concrete pads.

### 3.4 CONDUIT APPLICATION

- A. General: Install the following types of conduits and fittings in the locations listed, unless otherwise noted in the drawings:

*The following is required only where work includes underground electronic security duct installation*

- 1. [Underground Ductbanks, Concrete Encased
  - a. PVC]
- 2. Exterior, Exposed:
  - a. Type RSC for applications up to 8 feet AFF or to first pull box, whichever is first, applications subject to physical abuse or for applications greater than 4" diameter.
  - b. EMT acceptable in all other applications not noted above up to 4", where used in conjunction with specified Raintight (compression) couplers.

*Replace the above application standards for work at Marine Science Campus and use the following*

- c. [Type 316 Stainless Steel with either watertight EMT or IMC type stainless steel fittings. Provide non-metallic or 316 SS supports.]
- 3. Interior, Exposed, Wet and Damp Locations:
  - a. Type CRSC.
- 4. Interior, Hazardous Locations
  - a. Type RSC
  - b. Type IMC, where permitted by the CEC.
- 5. Interior, exposed or concealed, dry locations:
  - a. RSC, if subject to physical abuse.
  - b. EMT, if not subject to physical abuse.
- 6. Interior, concealed, damp locations, including in masonry walls.
  - a. RSC
- 7. Embedded in Concrete
  - a. RSC or rigid non-metallic conduit.
  - b. PVC Type Schedule 40.
- 8. Transition from walls, floor boxes and monuments to open plan furniture systems:
  - a. Liquidtight

*The next two subsections only apply when the electronic security system includes underground work.*

### 3.5 UNDERGROUND VAULT APPLICATION

Condition	Acceptable vault construction standard		
	AASHTO H-20	ANSI /SCTE 77 2007 Tier 22	Pedestrian/Parkway ANSI /SCTE 77 2007 Tier 8
<i>Pedestrian pathways.</i>	Yes	Yes	Yes
<i>At unpaved roads subject to infrequent vehicle traffic.</i>	Yes	Yes	No
<i>At paved roads and at paved surfaces ordinarily exposed to motor vehicle traffic.</i>	Yes	No	No

### 3.6 UNDERGROUND CONSTRUCTION

#### A. Duct and Conduit Placement.

1. *Duct lines shall have a continuous slope downward toward underground structures and away from buildings with a minimum pitch of 3 inches in 100 feet.*
2. *Depending on the contour of the finished grade, the high-point may be at a terminal, a manhole, a handhole, or between manholes or handholes.*

3. *Excavate trenches along straight lines from structure to structure before ducts are laid or structure constructed so the elevation can be adjusted, if necessary, to avoid unseen obstruction.*
4. *Except at conduit risers, accomplish changes in direction of runs exceeding a total of 10 degrees, either vertical or horizontal, by long sweep bends having a minimum radius of curvature of 25 feet. Sweep bends may be made up of one or more curved or straight sections or combinations thereof. Manufactured bends shall have a minimum radius of 18 inches for use with conduits of less than 3 inches in diameter and a minimum radius of 36 inches for ducts of 3 inches in diameter and larger.*
5. *Short-radius manufactured 90-degree duct bends may be used only for building, pole or equipment risers, unless specifically indicated as acceptable. The minimum manufactured bend radius shall be 450 mm 18 inches for ducts of less than 80 mm 3 inch diameter, and 900 mm 36 inches for ducts 80 mm 3 inches or greater in diameter. Otherwise, long sweep bends having a minimum radius of 7.6 m 25 feet shall be used for a change of direction of more than 5 degrees, either horizontally or vertically. Both curved and straight sections may be used to form long sweep bends, but the maximum curve used shall be 30 degrees and manufactured bends shall be used.*

#### **B. Duct Bank.**

1. *Duct Entrance Arrangement - Conform to Table 3.33 and applicable arrangement diagrams 3.67-3.74 of 2004 BISCO Customer Owned Outside Plant Design Manual.*
2. *Terminate conduits in end-bells where duct lines enter underground structures.*
3. *Stagger conduit joints by rows and layers to strengthen the duct bank.*
4. *Provide plastic duct spacers that interlock vertically and horizontally. Spacer assembly shall consist of base spacers, intermediate spacers and top spacers to provide a completely enclosed and locked-in duct bank. Install spacers per manufacturer's instructions, but provide a minimum of two spacer assemblies per 10 feet of duct bank. Before pouring concrete or backfilling, as applies, anchor duct bank assemblies to prevent the assemblies from floating. Anchoring shall be done by driving reinforcing rods adjacent to every other duct spacer assembly and attaching the rod to the spacer assembly.*
5. *Partially Completed Duct Banks. Ducts shall be kept clean of concrete, dirt, or foreign substances during construction. During construction wherever a construction joint is necessary in a duct bank, prevent debris such as mud, sand and dirt from entering ducts by providing suitable conduit plugs. Fit concrete envelope of a partially completed duct bank with reinforcing steel extending a minimum of 2 feet back into the envelope and a minimum of 2 feet beyond the end of the envelope. Provide one No. 4 bar in each corner, 3 inches from the edge of the envelope. Secure corner bars with two No. 3 ties, spaced approximately 1 foot apart. Restrain reinforcing assembly from moving during concrete pouring.*
6. *As each section of a duct line is completed from structure to structure, for conduit sizes 3 inches and larger draw a flexible testing mandrel approximately 12 inches long with a diameter less than the diameter of the conduit through a conduit. After which, draw a stiff bristle brush having the same diameter of the conduit through the conduit, until conduit is clear of particles of earth, sand, and gravel; then immediately install end plugs. For conduit sizes less than 3 inches, draw a stiff bristle brush through the conduit, until conduit is clear of particles of earth, sand, and gravel; then immediately install end plugs.*
7. *Field cuts requiring tapers shall be made with proper tools and match factory tapers.*
8. *Joints shall be staggered at least 6 inches vertically. Plastic Duct joints shall be made by brushing a plastic solvent cement on insides of plastic coupling fittings and on outsides of duct ends. Each duct and fitting shall then be slipped together with a quick 1/4-turn twist to set the joint tightly.*
9. *A coupling recommended by the duct manufacturer shall be used whenever an existing duct is connected to a duct of different material or shape.*

10. Unless otherwise noted, exterior communications conduit runs shall be buried a minimum of 24" below finished grade or as required to conform to local utility requirements.
  11. Refer to the details in the plans for additional depth required for PDS communications duct construction.
  12. Where new trenching is required, backfill and compaction requirements shall be as defined Division 33.
  13. Ducts shall be provided with end bells whenever duct lines terminate in manholes or handholes.
  14. Provide concrete encasement of all communications duct runs. Construct underground duct lines of individual conduits encased in concrete. Do not mix different kinds of conduit in any one duct bank. Ducts shall not be smaller than shown. The concrete encasement surrounding the bank shall be rectangular in cross-section and shall provide at least 3 inches of concrete cover for ducts, 8" minimum at PDS conduits. Separate conduits by a minimum concrete thickness of 2 inches, except separate light and power conduits from communications conduits by a minimum concrete thickness of 4 inches. The top of the concrete encasement shall not be less than 18 inches below grade except that under roads and pavement concrete be a minimum of 24 inches below grade.
    - a. Duct line encasements shall be monolithic construction. Where a connection is made to a previously poured encasement, the new encasement shall be well bonded or doweled to the existing encasement. Submit proposed bonding method for approval in accordance with the detail drawing portion of the submittals.
- C. Where conduit runs under existing roads, cut and patch the pavement as indicated on the Civil Plans.
- D. Conduit Plugs and Pull Rope. New conduit indicated as being unused or empty shall be provided with plugs on each end. Plugs shall contain a weephole or screen to allow water drainage. Provide a 3/8 inch nylon pull rope having 3 feet of slack at each end of unused or empty conduits.
- E. Manhole Placement and Connections
1. In unpaved areas, the top of new manhole covers shall be approximately 1/2 inch above the finished grade.
  2. Where existing grades that are higher than finished grades are encountered, concrete assemblies designed for the purpose shall be installed to elevate temporarily the manhole cover to existing grade level.
  3. All duct lines entering manholes must be installed on compact soil or otherwise supported when entering a manhole to prevent shear stress on the duct at the point of entrance to the manhole.
  4. Duct lines entering precast concrete manholes through a precast knockout penetration shall be grouted tight with a portland cement mortar. PVC duct lines entering precast manholes through a PVC endbell shall be solvent welded to the endbell.
  5. A cast metal grille-type sump frame and cover shall be installed over the manhole sump.
  6. Connections to Existing Manholes. For duct line connections to existing structures, break the structure wall out to the dimensions required and preserve steel in the structure wall. Cut steel and bend out to tie into the reinforcing of the duct line encasement. Chip out the structure wall to form a key for the duct line encasement. Grout new bell end entries watertight to the formed opening.
- F. Mark locations of future provision underground raceways by pre-cast reinforced concrete pullbox set flush in ground with stamped brass disk identification plate tied to conduit end with "Ty-Wrap", "Quick-Wrap" or equal.
- G. In existing facilities underground construction, the Contractor shall promptly repair any indicated utility lines or systems damaged by Contractor operations. Damage to lines or

*systems not indicated, which are caused by Contractor operations, shall be brought to the immediate attention of the University's Representative. If the Contractor is advised in writing of the location of a non-indicated line or system, such notice shall provide that portion of the line or system with "indicated" status in determining liability for damages. In any event, the Contractor shall immediately notify the University's Representative of any such damage.*

H. *At twelve inches below grade, place specified warning tape continuously.]*

### 3.7 MOUNTING AND INSTALLATION – DEVICE BOXES

- A. Conform to the more restrictive of NEMA OS 3-2002 and the following.
- B. Provide backboxes at all Electronic Safety and Security systems devices. Installation of device plates directly to wall surface without use of a backbox, unless specifically directed on plans, is unacceptable.
- C. Install boxes at each device, and outlet, and where indicated on the Drawings, complying with CEC. Coordinate box installation with conductor/cable and raceway installation. Coordinate box installation with other trades so that boxes will remain accessible. Outlet boxes shall not be installed back-to-back. Maintain minimum 24" separation between outlet boxes on opposite sides of rated walls, and minimum 6" separation in nonrated walls. Provide knockout closures to cap unused knockout holes where blanks have been removed.
- D. Align boxes plumb with floor and surrounding construction. At door frames, locate 4" from frame. Verify placement with University's Representative details to ensure that box clears all trim, etc.
- E. Support and fasten boxes securely. At stud walls use rigid bar hangers, attached to hanger with stud and nut.
- F. At existing locations, provide cutting, patching and finishing as required to maintain or restore finishes so that resulting installation is integrated into the Architectural decor of the particular location.
- G. Mounting Height: the mounting height of a wall-mounted outlet box is defined as the height from the finished floor to the horizontal center line of the cover plate.
- H. Mount outlet boxes with the long axis vertical. Three or more gang boxes shall be mounted with the long axis horizontal.
- I. Install wiring jacks and outlet devices only in boxes which are clean; free from excess building materials, dirt, and debris.
- J. Install wiring jacks and outlet devices after wiring work is complete.

### 3.8 TERMINAL CABINETS, JUNCTION BOXES AND PULL BOXES

- A. General
  - 1. Thoroughly examine site conditions for acceptance of cabinets and enclosures installation to verify conformance with manufacturer and specification tolerances. Do not commence with installation until all conditions are made satisfactory.
- B. Where termination cabinets are used they shall be installed in or on walls. Each termination cabinet shall have a hinged cover with a lock installed flush with the cover. These locks shall be keyed alike. Each termination cabinet shall be marked with a sign with the words "Sec. Termination Cabinet" attached to the front cover. This sign shall be constructed from red laminated plastic with 1/4" white engraved letters.
  - 1. The distance between pull boxes shall not exceed 150 feet or more than two 90 degree bends.
  - 2. Install exposed junction or pull boxes only in unfinished spaces, unless indicated otherwise on the Drawings.
- C. Set cabinets and enclosures plumb and symmetrical with building lines. Furnish and install all construction channel bolts, angles, etc. required to mount all equipment furnished under this Section of the Specifications.

- D. Cabinets and enclosures shall be anchored and braced to withstand seismic forces calculated in accordance with standards in this Section.
- E. "Train" interior wiring, bundle and clamp using specified plastic wire wraps. Separate power and signal wiring.
- F. Replace doors or trim exhibiting dents, bends, warps or poor fit that may impede ready access, security or integrity.
- G. Terminate conduit in cabinet with lock nut and grounding bushing.
- H. Cleaning
  - 1. Touch-up paint any marks, blemishes or other finish damage suffered during installation.
  - 2. Vacuum clean cabinet on completion of installation.

3.9 SUPPORT

- A. Provide supports for raceways as specified in this Section.
- B. All raceways installed in exposed dry locations shall be grouped in a like arrangement and supported by means of conduit straps, wall brackets or trapeze hangers in accordance with Code and the requirements of this Section. Fasten all hangers from the building structural system.
- C. Provide supports and mounting attachments per the most restrictive of Code and the following. Install no more than one coupling or device between supports.

Raceway Size (inches)	No of cables in run	Location	Support Spacing (feet)	
			RSC	EMT
<b>Horizontal Runs</b>				
½, ¾	1-2	Flat Ceiling Wall Runs	5	5
½, ¾	1-2	Where Access Limited To Building Structure	7	7
½, ¾	3≥	Any Location	7	7
1≥	1-2	Flat Ceiling Or Wall	6	6
1≥	1-2	Where Access Limited To Building Structure	10	10
1≥	3≥	Any Locations	10	10
Any	Any	Concealed	10	10
<b>Vertical Runs</b>				
½, ¾	Any	Exposed	7	7
1, 1.25	Any	Exposed	8	8
1.5 or ≥	Any	Exposed	10	10

- D. The University's Representative reserves the right to request additional supports where in their sole opinion said supports are required. Any additional supports shall be installed at no additional cost to the University.

### 3.10 SUPPORT INSTALLATION

- A. Furnish and install supporting devices as noted throughout the Electronic Safety and Security Systems work.
- B. Electronic Safety and Security device and conduit supports shall be independent of all other system supports that are not structural elements of the building, unless otherwise noted.
- C. Fasten hanger rods, conduit clamps, outlet and junction boxes to building structure using powder actuated tools, precast inserts, expansion anchors, preset inserts or beam clamps.
- D. Use powder actuated tools, self-drilling anchors, expansion anchor, or preset inserts on concrete surfaces.
- E. Use sheet metal screws in sheet metal studs and wood screws in wood construction. F. Do not fasten supports to piping, ductwork, mechanical equipment, conduit, or acoustical ceiling suspension wires.
- F. Do not drill structural steel members unless first approved in writing by the University's Representative.
- G. Fabricate supports from structural steel or steel channel, rigidly welded or bolted to present a neat appearance. Use hexagon head bolts with spring lock washers under all nuts.
- H. Install surface-mounted cabinets with minimum of four anchors. Provide additional support backing in stud walls prior to sheet rocking as required to adequately support cabinets and panels.
- I. Bridge studs top and bottom with channels to support flush mounted cabinets and panelboards in stud walls.

### 3.11 ERECTION OF METAL SUPPORTS

- A. Cut, fit, and place miscellaneous metal fabrications accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- B. Field Welding: Comply with AWS "Structural Welding Code."

### 3.12 WOOD SUPPORTS

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorage accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

### 3.13 RACEWAY INSTALLATION, GENERAL

- A. Raceway runs are shown schematically – Contractor to provide design and implementation of complete pathway system. Install concealed unless specifically shown otherwise. Supports, pull boxes, junction boxes and similar are generally not indicated. Provide where designated in addition to those required by the Contractor's design.

END OF SECTION 28 05 28

Section 28 31 00  
FIRE ALARM SYSTEM

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**TABLE 1 – CSFM FIRE ALARM SYSTEM SUBMITTAL CHECKLIST**

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This is the University's Standard Specification Section 28 31 00 Fire Alarm System. This specification shall be modified by the qualified Design Professional to meet each specific project's requirements and in conjunction with project specific Schematic Floor Plan Drawings showing the type, quantity and locations of new fire alarm system devices shall constitute the minimum acceptable fire alarm system design submittal (Bid Documents). An electronic copy (MS Word document) is available, contact the University's Representative.

A qualified Design Professional for the design or modification of fire detection, fire alarm, or fire suppression systems shall be a Fire Protection Engineer, defined as an individual meeting one of the following conditions:

- a. An engineer having a Bachelor of Science or Masters of Science Degree in Fire Protection Engineering from an accredited university engineering program, plus a minimum of 2 years' work experience in fire protection engineering.
- b. A registered professional engineer (P.E.) in fire protection engineering.
- c. A registered PE in a related engineering discipline and Member grade status in the Society of Fire Protection Engineers.

## **PART 1.00 - GENERAL**

### **1.01 DEFINITIONS LIST - Partial**

AHJ: Authority Having Jurisdiction.

DCFM: Designated Campus Fire Marshal

FACU: Fire Alarm Control Unit (Main) – previously known as fire alarm control panel

FM: Factory Mutual

NAC: Notification Appliance Circuit

NICET: National Institute for Certification in Engineering Technologies

SLC: Signal Line Circuit

NCC: Network Command Center

NRTL: Nationally Recognized Testing Laboratory

UL: Underwriters Laboratories

### **1.02 DESCRIPTION OF WORK**

- A. Summary: The fire alarm system shall be a Siemens XLS system to be fully compatible with the existing Siemens NCC monitoring system at the UCSC Campus Dispatch Center. The Siemens XLS system shall be fully capable of being controlled and monitored by the existing NCC system in place at the UCSC Dispatch Center.
- B. Scope: The base bid work includes providing all supervision, engineering, design, labor and materials necessary to install a new XLS main fire alarm control unit [and new remote fire alarm control units with displays,] new field devices, boxes, raceway, supports, wire and cable, auxiliary power supplies, 120 VAC power, interface connections, etc., to provide complete fire alarm systems at the [Building Name (#7xxx)]

and [Building Name (#7xxx)] as shown schematically on the Drawings. Commission and test new devices and demo existing equipment, wiring, and raceway not reused.

1. New Work Phasing: The work shall be conducted in sequential phases:
    - a. [Building Name (#7xxx)]
    - b. [Building Name (#7xxx)]
    - c. [Building Name (#7xxx)]
  2. Provide [as required]
  3. Modify [as required]
  4. Remove [as required]
- C. Existing System: Existing fire detection devices and notification appliances not reused shall remain operational until after acceptance of the new fire alarm systems by the University.
- D. Demolition of Existing Fire Alarm Devices: Existing fire alarm systems shall be removed and disposed of by the Contractor only after written acceptance of the new system by the University. All damaged surfaces shall be restored to match adjoining surfaces. All boxes not reused shall be covered with blank plates painted to match the adjacent existing surface finishes.

### 1.03 REQUIREMENTS

- A. Compliance: The entire fire detection and alarm system shall be designed in accordance with this specification.
1. All material and equipment used shall be listed or approved by UL, FM or another nationally recognized testing agency, and approved by the University Representative, for their intended use and service.
  2. Approved Shop Drawings: Installation of the fire detection and alarm system shall not be started until complete shop drawings and calculations have been approved in accordance with this specification, and General Requirements Section 01 33 00 – Submittal Procedures and Section 01 33 23 - Shop Drawings, Product Data, & Samples.
  3. Impairments: [This space will be occupied during construction.] The Contractor shall coordinate all work with the University Representative to minimize interruptions to occupants. Existing building functions shall not be interrupted without prior written approval of the University Representative.
- B. Any reference to "authority having jurisdiction" shall be interpreted to mean the UCSC Designated Campus Fire Marshal (DCFM).
- C. Contractor Requirements:
1. Design shall be performed and certified/stamped by a full-time employee of the Contractor who shall be either a NICET Level III or IV Fire Alarm Technician or a California Registered Professional Fire Protection Engineer and/or Ca. Licensed Electrical Engineer with at least 5-years of fire alarm design and engineering experience.

2. Installation shall be performed by Fire Alarm Technicians with a NICET Level II or higher certification. The services of a NICET Level II or higher Fire Alarm Technician provided by the control equipment manufacturer or factory authorized distributor shall be provided to supervise installation, adjustments, and conduct all tests of the system.
  3. Installation shall be performed by a California C-10 licensed electrical contractor experienced in the design and installation of fire detection and alarm systems (minimum 5 years). Installer shall have an office, which has been in existence for at least 3 years, within a 160 kilometer (100 mile) radius of the jobsite. The University may reject any proposed installer who cannot show evidence of such qualifications.
- D. Service Organization: The Contractor shall furnish, to the University Representative, evidence that there is an experienced and effective service organization which carries a stock of repair parts for the system in order to readily effect repairs throughout the warranty period. Should the Contractor fail to comply with the service requirements of this section, the University will then have the option to make the necessary repairs and back charge the Contractor without any loss of warranty or guarantee as provided by the contract documents.
- E. Project Superintendent: The Contractor shall provide one full-time, on-site staff member designated as the "Project Superintendent". The duties of the Project Superintendent are to supervise execution of all aspects of this specification, including safety on the job site. That clause incorporates into the contract, by reference, the Secretary of Labor's OSH Standards (29 CFR Part 1926). The Project Superintendent shall be thoroughly familiar with all contract obligations and shall be capable of making all contractual decisions with regards to their project scope of work on behalf of the Contractor. The Project Superintendent shall be responsible for making sure that quality control review has been performed on all submittals prior to the submission to the University Representative. The Project Superintendent shall also be responsible for ensuring that all submittals are accurate and fully coordinated. The Project Superintendent shall have a cell phone and be accessible to the University Representative during business hours.
- F. Guarantee: The Contractor shall guarantee labor, materials, and equipment provided under this contract against defects for a period of one year after the date of final acceptance of this work by the University. Final Acceptance includes, but is not limited to, the receipt of as-built record drawings and operation and maintenance manuals. See Division 1, Section 01 78 30 - Guarantees, Bonds, Services and Maintenance.
- G. Codes and Standards: Provide a fire detection and alarm system conforming to the latest adopted editions of codes and standards of the State of California as defined in the University Of California Office of the President Facilities Manual. As of 2022-5-20, and by agreement with the OSFM, the effective code compliance date for a University project is the date of the first submittal of Preliminary Drawings (at the end of the Design Development Phase) to the Designated Campus Fire Marshal (DCFM). The UCOP facilities manual can be found at this link:  
<https://www.ucop.edu/construction-services/facilities-manual/>
1. International Code Council (ICC):

Title 24, Part 2 - California Building Code  
Title 24, Part 3 - California Electrical Code  
Title 24, Part 9 - California Fire Code

2. National Fire Protection Association (NFPA), including all amendments and appendices:

Standard No. NFPA-72 National Fire Alarm and Signalling Code

3. Underwriters Laboratories Inc.  
UL-FPED –Fire Protection Equipment Directory (latest edition)
4. Other standards or requirements of the California State Fire Marshal’s Office.  
California State Fire Marshal: CSFM Building Materials Listing (BML)

#### **1.04 RELATED WORK DESCRIBED ELSEWHERE**

- A. Division 26 – Electrical
- B. Division 21- Fire Protection

#### **1.05 SYSTEM DESCRIPTION**

- A. Supervised non-coded 24 VDC (limited energy) system.
- B. Provide devices as per the Drawings and Specifications.
- C. The fire detection and control system shall include:
  1. New XLS main FACU and remote fire alarm control panels with displays, modules, and connections to the new and existing fire alarm system devices. Remote fire alarm control panels shall operate in a degraded alarm mode if network circuit connection to main XLS panel is unavailable.
  2. New auxiliary power supply panels with addressable HCP control modules for activation, or XLS panel ZIC circuits, and addressable HTRI-S modules for trouble monitoring.
  3. New single mode FN2013-U1 fiber optics transceiver module(s) for monitoring connection to the existing NCC panel in the Dispatch Center.
  4. Smoke detectors, duct smoke detectors, heat detectors, and remote test switches.
  5. Manual pull stations with weatherproof covers.
  6. Addressable interface modules for existing waterflow and valve supervision switches.
  7. Audible and visual alarm notification appliances.
  8. Weatherproof exterior water flow alarm bell.
  9. Warning signs and device labels.
  10. Provide AC power surge suppression on the XLS FACUs and auxiliary power supplies.
  11. Provide surge suppression on all DLC and SLC circuits in the XLS FACUs.
  12. New single mode FN2013-U1 fiber optics transceiver modules for two dedicated new fiber optic network circuit connections between the new XLS main [and remote] fire alarm control units at the [Building Name, Building Name and Building Name.]

13. New underground dedicated raceways and cables for a new DLC signaling line circuit and a new notification appliance circuit connections between [Building Name and Building Name.]
  14. New fiber optic patch cables with ST and LC connectors and inner ducts for connections between FN2013-U1 transceiver modules and fiber termination enclosures.
- D. Each automatic detector, manual station, water flow switch or valve supervisory switch shall be supervised as an individual point with a unique address.
  - E. The XLS FACU shall transmit signals to the existing NCC panel via University furnished fiber optics media in the existing fiber termination enclosure using a new contractor installed patch cable connected to new contractor installed fiber optics interface in the XLS FACU.
  - F. Sound an audible alarm to indicate alarm or trouble, as indicated on Drawings.
  - G. Initiating device circuit pathways shall be of Class B operation and survivability level 1.
  - H. Signaling line circuit (SLC) pathways shall be of Class B operation and survivability level 1. The SLC pathways used for FACU data and audio networking shall be of Class A operation and survivability level 2.
  - I. Notification appliance circuit pathways shall be of Class B operation and survivability level 1.
  - J. No notification appliance circuit shall be initially loaded in excess of 75% of its rated ampere capacity.
  - K. Power supply for the FACUs and all remote power supply panels shall be 120 volts, 60 Hz from an emergency branch circuit.
    1. The 24 volts, DC power for all system supervisory and control functions shall be provided by the Fire Alarm Control Unit power supply.
    2. Notification appliance circuits shall be powered from either the FACU or a remote power supply panel.
  - L. Upon loss of normal building power the entire system shall operate on battery power for 24 hours and then be capable of operation in alarm mode for 30 minutes.
  - M. Conduit Routing: All new conduit to be run concealed in walls, under floors or above ceilings in all finished areas. No exposed conduit shall be permitted in finished spaces without prior written permission from the University Representative.

#### 1.06 QUALITY ASSURANCE

- A. All equipment supplied shall be listed by a nationally recognized fire equipment test laboratory (UL and/or Factory Mutual) and if required, listed by the jurisdiction having authority.
- B. The Contractor shall have experience in installing three addressable Siemens systems in the last three years and shall submit with the bid the following for verification of qualifications: Prior to installation, submit documentation, to the University Representative, showing that the Contractor has successfully installed automatic fire alarm systems of comparable size, type and design as specified herein. The data shall

include the names and locations of the installations where the Contractor installed such systems, the contact person familiar with work and telephone numbers. The Contractor shall certify that each system has performed satisfactorily for a period of not less than one year.

- C. The NCC and XLS system software shall be supplied an authorized Siemens distributor and programmed by a factory trained technician.

## 1.07 SUBMITTALS

- A. General: Conform to the requirements of Division 1 Section 01 33 00 – Submittal Procedures and Section 01 33 23 - Shop Drawings, Product Data, and Samples. Submit one (1) electronic PDF file copy of submittals (drawings and calculations) for approval prior to start of installation. Partial submittals will not be acceptable and will be returned without review. Before any work is commenced, the submittal must be approved by the University Representative, the UCSC Designated Campus Fire Marshal (DCFM) and the UCSC Physical Plant Fire Alarm Shop.
  1. Shop drawings with material data sheets are a deferred submittal. Schematic bid drawings are not to be used for construction. Contractor is advised that the schematic bid drawings are diagrammatic in nature and are not intended to show all details.
  2. Shop drawings shall be clearly drafted and shall not be photocopies of bid set documents.
  3. Shop drawings shall include unique complete floor plans for each building with unique device addresses, etc. Typical floor plans are not permitted.
  4. The signature and seal of a registered Professional Fire Protection Engineer, a registered Professional Engineer with a minimum of two years fire protection design experience, or the signature of a NICET Level III or IV Fire Alarm Technician shall be affixed to all drawings and calculations.
- B. Shop Drawings: Submit detailed shop drawings, in accordance with NFPA 72, the California Fire Code Section 1001.3, and Division 1 Section 01 33 23 - Shop Drawings, Product Data, and Samples, electronically in PDF and AutoCAD DWG formats, to the University Representative for review and approval. Shop drawings shall be prepared using AutoCAD 2018 or newer software. Survey the existing field conditions to coordinate all new conduit and materials with existing conditions prior to the start of design. Coordinate location of new piping and materials with those installed by other trades. The following information is required for approval:
  1. Complete equipment arrangement, device addresses and conduit routing on building floor plans, point-to-point panel and device wiring diagrams, voltage drop calcs for notification appliance circuits, FACU battery back-up calcs, sequence of operation I/O matrix, location of existing smoke/fire barriers on plans, schedule for all cabling, and a list of the English language zone descriptions to be programmed.
  2. Indicate all system components, quantities, size of components, location, addresses, and provide full schematic of wiring system showing building and operation details.
  3. Provide complete system wiring diagrams for components connected to the system and interfaces to equipment supplied by others. Indicate all points of

interface with other systems, including but not limited to the building FACU, fire/smoke dampers and the HVAC control system.

4. Provide riser diagram with new device addresses.
  5. Clearly show and differentiate all new (N), existing (E), and equipment to be removed (D) on all sheets.
- C. Technical Information: Submit manufacturer's descriptive literature identifying components, including UL and CSFM listing for all system components, installation instructions (including outlet box or black box requirements for each piece of equipment), operating instructions, and maintenance and repair data. Manufacturer's data shall be annotated to show the specific model, type and size of each item to be furnished.
- D. Submit ZEUS (Custom Software Generator - XLS) printout and .pdf format for approval prior to installing the program into the memory of the FACU.
- E. Submittals shall comply with CSFM guidelines as shown in Table 1 at the end of this document.
- F. As-Built Record Drawings: Prepare and submit to the University Representative detailed "As-Built Record Drawings" within two weeks after the final acceptance test of the system in accordance with Division 1 Section 01 77 00 – Closeout Procedures.
1. The as-built record drawings shall show the system as installed, including all deviations from both the contract drawings and the approved shop drawings.
  2. The as-built record drawings shall also include all information as required by NFPA 72.
  2. Provide a full-size copy of the as-built record drawings on bond paper in the document cabinet at the fire alarm control unit. The document cabinet (or drawing storage box) shall:
    - a. Be constructed of 18 gauge cold rolled steel (CRS), it shall be painted with a durable red powder coat paint. Over all dimensions 37" tall 5 ½ wide and 4 ¼" deep. The access door shall be lettered on 2 angled sides of the cabinet providing 180 degrees of viewing. "FIRE ALARM DOCUMENTS" in White indelible letters minimum of 1" in height. The door shall have a stainless steel continuous piano hinge. The door of the DSB shall be locked with a keyed lock ¾" barrel. Inside the cabinet shall have a strap to secure drawing in cabinet that is adjustable for size of rolled drawings. Location to hold keys and secure emergency contact information safely inside cabinet for easy access. (Space Age Electronics, Inc. AcerBox DSB or equal)
    - b. Document cabinet shall be mounted to wall as close as possible to FACU.
  4. Submit a copy of the AutoCAD DWG files on a CD-ROM with all references, special fonts, shapes, plot styles, etc. for use in printing an exact copy of the paper as-built record drawings.
- G. Operation and Maintenance (O & M) Manuals in accordance with Division 1 Section 01 77 00 – Closeout Procedures:
1. Each manual shall include an index, copies of all approved shop drawings and submittal materials (updated to asbuilt), calculations, a complete parts list of all components, and the necessary information for ordering replacement parts.

3. The parts list shall include, for each item furnished:
  - a. manufacturer's name
  - b. serial number
  - c. model or part number
  - d. a catalog cutsheet, diagram, drawing or other descriptive data providing a physical description of the part
  - e. complete instructions, covering the proper testing, operation, and maintenance
  
3. The Contractor shall provide a copy of the O & M Manuals, with as-built record drawings and calculations in a locked wall mounted cabinet at the FACP. The cabinet keys shall be furnished to the University Representative.

## 1.08 COORDINATION

- A. The Contractor shall coordinate location of flow and tamper switches with existing fire sprinkler system.
  
- B. The Contractor shall coordinate the installation of the new fire alarm system with the existing fire alarm system raceway, wiring, and field devices.
  1. New system wiring may be installed in existing conduits, subject to authorization from the Owner's Representative and compliance with the referenced codes and standards.

## PART 2.00 - PRODUCTS

### 2.01 FIRE ALARM SYSTEM

- A. The control panel will supervise, receive alarm, supervisory and trouble signals from the detectors, manual stations and interface devices listed below. The control panel shall be capable of reading and displaying the sensitivity of remote addressable photoelectric detector, at the control panel. The control panel shall be Siemens Model XLS with current software revision.
  1. The detection system shall remain 100% operational and capable of responding to an alarm condition while in the routine maintenance mode. Any quantity of addressable detection devices shall be in alarm at any time up to the total number connected to the system.
  
  2. Dynamic supervision of system electronics, wiring, detection devices, and software shall be provided by the control panel. Failure of the system hardware or wiring shall be indicated by type and location on the alphanumeric annunciator. Software and process operation shall be monitored by an independent hardware watch-dog circuit, which will indicate their failure.
  
  3. The control panel shall provide fail-safe operation, i.e., incoming alarms shall automatically override all other modes of operation, and the panel shall automatically return to normal operating mode from any operator initiated mode.
  
  4. Addressable photoelectric detector sensitivity shall be reported to the control panel when requested. It shall be possible to change the detector sensitivity

from the control panel within maximum and minimum values as defined by the UL listings of the detectors.

5. The FACU annunciator shall be a 80-character alphanumeric display, which shall provide optional user definable messages associated with each detection device or zone. It shall be possible to display up to (127) alarms and up to (127) trouble indications, one at a time, on the digital annunciator.
6. Addressable/programmable initiating circuits shall be provided in the quantity as indicated on the Drawings. There shall be four (4) circuits on each module. The module shall be system interconnected by a card edge connector, and shall be operated by the control panel. Each initiating circuit shall allow multiple T-taps and not require any end-of-line devices. Each initiating circuit shall accommodate up to (60) addressable devices. Each circuit shall be capable of Class "A" or Class "B" wiring. The module shall be Siemens Model DLC, MLC or XDLC.
7. An output circuit for operation of DC audible devices shall be provided in the quantity as indicated on the Drawings. The module shall be system interconnected by a card edge connector, and shall be operated by the control panel. The module shall be capable of operating audible devices, supervised extinguishing circuits, and lease line auxiliary trip. Each circuit shall be programmed to operate as the system requires. The module shall be Siemens Model ZIC-4A or ZIC-8B.
8. Programmable relay modules shall be provided to perform functions as indicated in Specifications and Drawings. The module shall be system interconnected by a card edge connector, and shall be operated by the control panel. The module shall be Siemens Model CRC-6.
9. The power supply/battery charger shall provide power to operate the system as specified and be capable of keeping the back-up batteries at their full potential. The battery charger shall be a microprocessor controlled variable rate device. The power supply/battery charger shall be Siemens Model PSC-12 with battery pack.
10. Software shall be provided by the Contractor so that a functional and operational system results that meets the requirements of the UCSC Designated Campus Fire Marshal (DCFM). Based on direction by UCSC, the following minimum information shall be entered into the system: Descriptors, set points, sequence of operation, etc. Smoke detectors shall be configured so that 10 polls occur before an alarm occurs.
  - a. Descriptors shall be created in the following format: Building asset number if panel serves more than one building, General Location on the floor (e.g. NE), floor or room #'s if applicable, further location information if room # not provided, device type abbreviation. The abbreviation O/S (outside) and a room number is often used for a hall location. (Floor # not needed if room # is provided.)

Device type abbreviations:

HD	Heat detector
WF	Water flow

MS	Manual station
TS	Tamper
SD	Smoke detector
DD	Duct smoke detector

Examples

145 4FL W HALL SD  
227 3FL S STAIRS MS  
136 RM 380 SD

- b. Separate audibles, stair door releases, smoke damper and air handler shutdown override function key buttons shall be installed and programmed at the FACU per University requirements to allow these functions to be bypassed during testing. Alternatively, one of the FACU function keys shall be configured to disable horn and strobe operation when testing.
  - c. Contractor shall submit programming worksheets for review by University's representative and the UCSC Designated Campus Fire Marshal (DCFM) before creating the program and shall submit the program for review before "burning".
  - d. Sequence of operation - In general, all notification appliances will be activated by an alarm in that building only. Fire/smoke dampers shall be closed when smoke is detected by the associated duct detector or by hallway smoke detectors. For non-fume hood equipped buildings, fans will be shutdown when smoke is detected by any smoke detector in the building.
11. The system shall be capable of being programmed in the field via a laptop computer. All programmed information shall be stored in non-volatile memory. System programming shall include full upload and download capability.
- B. New unacknowledged alarms and troubles shall be distinctively displayed on both visual display and differentiated from previous alarms and troubles. The system shall be capable of providing a hard copy written record consisting of: all alarms, troubles, system activity and to print detection device designations, as well as, location messages by means of temporarily attaching full carriage width printer capable of a single line of up to (128) characters, wherein (32) are reserved for device or zone custom identification.
  - C. Ionization smoke detectors shall not be used.
  - D. The addressable photoelectric smoke detector shall be UL listed. The automatic gain control circuit is capable of maintaining correct sensitivity by compensating for detector aging and dirt accumulation. It is possible to adjust and/or electronically measure the sensitivity of the addressable detectors from the FACU. The addressable photoelectric detectors will provide complete supervision of the detector optics. The detector shall be capable of comparing the fire characteristics with pre-programmed profiles to assist in rapid identification of a fire. The detectors shall be supervised for any critical reduction in the light output of the LED, or complete failure of the LED light source. This condition may be caused by excessive dirt, which would not be compensated for by the automatic gain control circuit. The detector relay shall be capable of operating from the detector or

from the FACU. The detector shall be Siemens Model FDO421 with base Model DB-11 or relay base Model DB2-HR or audible sounder base Model ABHW-4S.

- E. The addressable thermal fire detector shall be of the 135 oF rate compensation/ fixed temperature type. The detector shall plug into a standard base and have a lamp to indicate alarm initiation. The detector shall also be capable of operating one remote lamp or auxiliary relay. This detector shall be capable of being mixed on the same circuit as addressable ionization, photoelectric detectors, addressable manual stations and addressable interface modules. The detector shall be Siemens Model FDT421 with base Model DB-11 or relay base Model DB2-HR.
- F. The remote conventional zone module shall be UL listed. This unit is designed to provide interface for direct shorting contact devices to the system. This unit is used for water flow switches, OS&Y tamper switches, low profile heat detectors, manual stations, kitchen hood, and duct systems. The interface module shall be Siemens Model HTRI-S or HTRI-M. Siemens Model HTRI-D interface modules shall not be used.
- G. The air duct detector shall be UL listed. The air duct detector shall operate on a cross-sectional air sampling principle to overcome stratification and the "skin effect." The air duct detector shall consist of a standard addressable detector mounted in an air duct sampling assembly and sampling tube that protrudes across the duct of the ventilating system. The air duct detector features of the addressable (ionization/photoelectric detector, choose one) and be installed in the ducts as indicated by the manufacturer's instructions. The duct detector shall be Siemens Model FDBZ492-HR, with addressable smoke detector FDO421. The sampling tubes shall be either Model ST-10, 25, 50 or 100 (size to fit duct). The detector shall be interlocked with the associated fan starter so that it shuts down when smoke is detected. For exterior locations use weatherproof housing.
- H. Non-addressable heat detectors shall be rate of rise, low profile, 135 degrees, Siemens Model DT - 135R, Gamewell, or equal. Mechanical rooms shall utilize fixed temperature 200-degree type. They shall be connected to an HTRI-S module.
- I. Separate HTRI-S modules shall be used to indicate water flow alarm and tamper switches. Each tamper switch shall have its own unique address.
- J. Notification Appliances
  - 1. The audio/visual notification appliance shall provide an indication of a fire condition.
  - 2. The horn shall be an electronic type. Audible devices shall provide temporal coded output as required by NFPA 72. Bells shall be CSFM listed and meet UL 464. Audible signals shall be synchronized within a building. The highest sound level shall produce 99 dB UL Sound Pressure Level (SPL) at 10'. Audible devices shall have a field selectable SPL.
  - 4. The strobe shall use LEDs to produce light intensity to meet ADA requirements. The strobe shall provide polar distribution complying with UL 1971 of at least 15 cd. Visual notification devices shall be synchronized when two or more can be seen from a single location. Multiple candela field selectable strobes shall be used.
  - 5. The bell shall be a surface mounted weatherproof min. 6-inch diameter red bell suitable for use in an electrically supervised circuit. Bells shall be CSFM listed and meet UL 464. All bells shall be capable of installation on standard 100 mm (4 inch) square weatherproof electrical boxes.
  - 6. The notification appliances shall be Siemens or Wheelock.
  - 7. Notification appliances located outdoors shall be UL listed as weatherproof.

- K. Addressable manual fire station shall be U.L listed, non-coded, and shall operate on any addressable detection circuit. The addressable manual station shall be individually annunciated at the FACU. It shall be Siemens HMS-D. Addressable manual stations exposed to rain shall be protected by a weatherproof cover such as Safety Technology International, Inc. Weatherstopper II or equal.
- L. Power Supply - Provide 24 VDC power supply and batteries to provide power to the smoke detector audible bases and standalone carbon monoxide detectors. Power supply to have 24 VDC output, with less than 2 volts ripple. Siemens PAD-5 for notification appliances or Altronix Maximal for carbon monoxide detector power, to match campus standard.

## **2.02 FIRE ALARM MONITORING SYSTEM**

- A. Both the existing Siemens Network Command Center (NCC) in the Fire Alarm Shop at Baskin Engineering and the existing NCC in the ERC shall be used to monitor the new fire alarm control units and devices.
  - 1. The existing NCC system shall remain 100% operational and capable of responding to an alarm condition while any new equipment is being added.
  - 2. Dynamic supervision of system electronics, wiring, detection devices, and software shall be provided.
  - 3. The existing NCC standard software shall be updated for the monitoring of the new equipment (new panels and new devices on existing panels).
  - 4. The system shall be programmed in the field. All programmed information shall be stored in non-volatile memory. System programming shall include full upload and download capability.
- B. Upgrade the existing NCC software and hardware as required based upon the additional fire alarm system devices installed and to convert the existing copper based communication media to a fiber optic based communication media.
  - 1. The existing NCC system shall remain 100% operational and capable of responding to an alarm condition while any new equipment is being added.
  - 2. Dynamic supervision of system electronics, wiring, detection devices, and software shall be provided.
  - 3. Provide FN2013-U1 transceivers at each XLS FACU and at the existing NCC, with power supplies, and a NIC-C network interface module.
  - 4. The system shall be programmed in the field. All programmed information shall be stored in non-volatile memory. System programming shall include full upload and download capability.
- C. All NCC software and components shall be fully supervised and be both UL and CSFM listed as a proprietary and a remote station monitoring system.

## **2.03 SURGE SUPPRESSION**

- A. All 120 VAC power circuits to new fire alarm control units and auxiliary power supplies shall be protected with UL listed surge suppressors. New surge suppressors shall be Danaher/Current Technology LoadGuard (part #MSU50-120-1G-24A-3) surge suppressor to match existing installed on campus.
- B. All Siemens DLC/XDLC, MLC and SLC network circuits that travel between or outside of buildings shall be protected with manufacturer approved, UL and CSFM listed, fire alarm addressable circuit surge suppressors, Siemens Transtector 24VDC silicon surge suppression (part #CP2297) or equal.

#### **2.04 MULTI-CONDUCTOR CABLE**

- A. Underground cables shall be UL listed min. #16 AWG solid twisted pair copper conductors with a polyethylene jacket. DLC/SLC cables shall have an overall copper tape shield with twisted pair conductors - IMSA spec. No. 20-2-1984. Other cables shall be IMSA spec. No. 20-1-1984. Alternately, type TC cables may be used.
- B. Above ground cables shall be UL listed Power Limited Fire Protection Signaling cable in accordance with NEC Article 760. Cables shall consist of 2 or more conductors in an overall red jacket. DLC/SLC circuits shall be min. #16 AWG solid twisted pair cable. NAC circuits shall be min. #14 AWG solid twisted pair copper, with speaker circuits in shielded cable. IDC circuits shall be min. #16 AWG solid conductors.

#### **2.05 CARBON MONOXIDE DETECTOR**

- A. The new carbon monoxide detector shall operate from a 24 VDC power supply, and shall be a System Sensor Model CO1224TR, to match existing campus standard.

#### **2.06 DIGITAL ALARM COMMUNICATOR TRANSMITTER [West Research Park or Coastal Science Campus only]**

- A. Listed and labeled according to UL 632 and compatible with existing Siemens fire alarm system, to match existing campus standard.
- B. Functional Performance: Unit receives an alarm, supervisory, or trouble signal from the FACP, and automatically captures primary or back-up telephone line and dials a preset number for a remote central station. When contact is made with the central station(s), the signal is transmitted.
- C. Secondary Power: If not powered from the FACU, unit shall have an integral power supply with automatic charger and rechargeable battery. Battery capacity to be min. 48 hrs, or in accordance with NFPA 72 requirements, whichever is greater.
- D. Self-Test: Conducted automatically every 24 hours with report transmitted to central station

#### **2.07 REMOTE POWER SUPPLIES**

- A. The new remote carbon monoxide detector remote power supplies shall be UL listed. The power supply panel shall have internal space for the back-up batteries. The power supply shall be Altronix model MaxFit FE series or model Maximal 37E to match campus standard.

### **PART 3.00 - EXECUTION**

### **3.01 REQUIREMENTS DESCRIBED ELSEWHERE**

- A. Refer to Section 26 05 02 for execution requirements.

### **3.02 INSTALLATION**

- A. All equipment, terminals, sensors, etc. shall be located and installed to be readily accessible for operation and maintenance. Manufacturer's instructions shall be followed in all cases.
- B. The building FACU shall be installed adjacent to the electric metering panel that serves the FACU. The AC power required for the system shall be obtained from the emergency power system. Connection to the power source shall be made via separate locked fused safety disconnect switch with a "Fire Alarm" nameplate on the cover. The power disconnect switch shall be painted red. AC power wiring and installation shall conform to the appropriate portions of Division 26 of this specification.
- C. Insulated bushings shall be installed on all conduits entering panels, control cabinets, terminal cabinets, outlet and junction boxes. Bushings shall be O.Z. Type B for rigid conduit, or Type A for EMT; T & B; or equal.
- D. Installation, workmanship, fabrication, assembly, erection, inspection and testing shall be in accordance with NFPA 70 and NFPA 72, except as modified herein.
- E. Installation shall be accomplished in a professional manner by qualified personnel regularly engaged in and experienced in this type of work.
- F. Wall mounted audible/visual notification appliances are to be mounted with the bottom of the device back box at 80 inches above finished floor level.
- G. Manual pull stations are to be mounted with the operable portion at 48 inches above finished floor level.
- H. Provide all addressable control relays, conduit and wiring from each air handling unit to fire alarm control unit for control of HVAC shutdowns. Provide all addressable control relays, conduit and wiring at each fire/smoke damper for shutdown. The University will make all final connections to existing hardware for HVAC and fire/smoke damper shutdown.
- I. Impairments: Work involving connections to existing systems shall be scheduled a minimum of four (4) weeks in advance in writing to the University Representative. The Contractor shall not shut-off any sprinkler system control valves at any time or disconnect any existing fire alarm devices. System impairments shall be limited to a maximum duration of one 8 hr. shift at a time. All overtime costs required to oversee and restore the impaired systems for longer than one 8-hour shift will be backcharged to the Contractor.
- J. Field Changes: The Contractor shall not make field changes in device layout or wire and conduit sizes from that shown on the approved shop drawings without the prior written approval of the University Representative.

### **3.03 WIRING**

- A. When required, network wiring between the XLS (XLSV) and XLSR (XLSVR) panel shall be a 4 conductor minimum #16 AWG solid twisted pair cable. For lengths greater than 500 feet between XLS (XLSV) and XLSR (XLSVR) panels minimum #14 AWG solid twisted pair shall be used. Wiring between addressable devices and the XLS/XLSR panel (DLC/SLC circuit) shall be 2 or 4 conductor #16 AWG solid twisted pair cable. DLC circuit wiring shall be a Class B supervisory system. Notification appliance circuit (NAC) wiring shall be minimum #14 AWG solid twisted pair cable, except speaker circuit wiring shall be minimum #16 AWG solid twisted pair shielded cable. NAC circuit wiring shall be a Class B supervisory system. Wiring between contact closure devices and HTRI modules shall be minimum #16 AWG solid two or four conductor cable. All wiring to meet fire alarm system manufacturer's specifications.
1. All conductors shall be color coded. Color coding shall be by wire insulation, not taping or banding. The numbering and color coding shall be continuous for each circuit wire. Color coding shall be as follows (polarity shown in alarm condition):
    - a. CIRCUIT: Signaling Line Circuits; COLOR CODE: Red & Black unshielded twisted pairs
    - b. CIRCUIT: Horns, 24VDC; COLOR CODE: Yellow (+) and Black
    - c. CIRCUIT: Strobes, 24VDC; COLOR CODE: White (+) and Purple
    - d. CIRCUIT: Horn/strobes; 24VDC; COLOR CODE: Orange (+) and Black
    - e. CIRCUIT: Initiating Device Circuits; COLOR CODE: Blue and Brown
    - f. CIRCUIT: Valve Supervision; COLOR CODE: Orange and Yellow
    - g. CIRCUIT: DC Power; COLOR CODE: Red (+) and Black
    - h. CIRCUIT: System AC Power; COLOR CODE: Black and White
- B. Multi-conductor cable shall be installed in 3/4" minimum conduit and shall be installed concealed in walls and above ceilings. Underground wiring shall be installed in PVC conduit as specified in the appropriate portions of Division 26 of this specification. The minimum size of underground conduit shall be 4". All other alarm system wiring shall be installed in minimum 3/4" conduit raceways. The NEC maximum fill ratio of conduits is 40%. However UCSC Fire Alarm conduits shall be sized to provide 25% spare cross sectional area for future cables. This equates to a total fill of 30% of conduit area. All wiring not terminating in a FACU shall be routed via wiring gutters, junction boxes and/or conduit as appropriate. UCSC makes no representation as to availability of existing spare capacity in existing conduits that may be reused.
- C. Wiring shall be continuous from device to device; with permission of the University Representative, any splicing shall be accomplished by use of terminal blocks, in locked cabinets or junction boxes (keyed Siemens T45). Provide separate terminal strips for notification and activation wiring. No splices in the underground system. If the voltage loss at the last device on a loop exceeds 2.4V DC, a larger size wire will be required.
- D. All conduits containing fire alarm wiring shall be dedicated fire alarm conduits and shall not contain wiring for any other purpose.
- E. Coordinate routing and connection of the network communication fiber optic cable between the XLS FACU and the building patch panel in the IT room. Connection to the patch panel will be by others.
- F. Route wiring continuous between devices without splices.

- G. General: Firestop all holes for piping, or other penetrations which pass through floor slabs, fire-rated walls, partitions with fire-rated doors, vertical service shafts, or any fire-rated assemblies with a listed firestopping system equal to the existing fire assembly rating and as approved by the UCSC Designated Campus Fire Marshal (DCFM). Submit manufacturer's data in accordance with Division 1 Section 01 33 00 – Submittal Procedures.

### **3.04 LABELING**

- A. Cable labeling shall be the DLC, MLC or SIM-16 number and XLS/XLSR number or device description. The numbering and color coding shall be continuous for each circuit wire. Individual conductors shall be numbered at each connection, termination, and junction point.
- B. Each group of cables or conductors shall be tagged with its destination at each panel, terminal box, or junction box using a slip over write on wire markers. Attach the tag to each group of wires where they enter and leave the panel, terminal box, junction box or other enclosure.
- C. All conduits entering and leaving terminal cabinets and junction boxes shall be numbered in a logical and consecutive manner. Upon completion, a riser diagram shall be supplied by the Contractor showing all conduits, junction boxes, terminal cabinets, and devices, with all conduit numbers indicated.
- D. Print the address on the back of all devices with a felt marking pen.
- E. All field devices shall be labeled on the base or exterior of the device visible from the floor.
  - 1. All notification appliances (horns, speakers, strobes, horn/strobes, speaker/strobes, etc.) shall have an embossed white label with black letters indicating the NAC circuit number(s) and serial device number(s).
  - 2. All initiating devices shall have an embossed white label with black letters indicating the loop and address number
  - 3. For addressable monitor modules and control relay modules (HTRI modules), install an embossed white nameplate with the loop and address number, and the module function.
- F. For devices installed above a suspended ceiling, install a nameplate with the loop and address number. Attach to t-bar metal frame.

### **3.05 SUPERVISION AND TESTING**

- A. After "rough-in" is completed and prior to connection of equipment, the manufacturer's representative shall meet with the Contractor to review the installation and connection requirements. Upon completion of the installation, the Contractor shall have the manufacturer's engineer assist the Contractor on pre-testing, final testing, and inspection and shall certify that the entire installation was tested and performed satisfactorily.

1. Contractor shall schedule a meeting with the UCSC Fire Alarm Shop and the field technician responsible for programming the new FACU, prior to the programming being started.
  2. Contractor shall provide their own personal computer to initially enter the program into the FACU.
  3. Contractor shall provide the DPU for programming intelligent devices.
  4. Contractor shall provide a temporary printer to the XLS FACU that is capable of printing alarm / trouble information on-site during check-out.
- B. Connections to the campus system shall be made by the contractor under the supervision of a trained manufacturer's representative and the UCSC Designated Campus Fire Marshal (DCFM).
1. Prior to connecting and testing, the Contractor shall perform a clearance test of all systems to insure that the systems are clear of opens, grounds, and defects.
- C. The Contractor shall perform a 100% pre-test of the completed fire alarm system. Audible and visual notification appliance testing may need to occur during weekends or semester breaks.
1. Coordinate pre-testing two-weeks in advance with the University Representative and the UCSC Fire Alarm Shop.
  2. Demonstrate that the entire system operates in accordance with the specifications. Provide a pre-test log containing a description of the device tested including device address, location, test method, result of test and the name of the tester. Perform test as follows:
    - a. Test each detector, pull station, tamper switch and alarm indicating device. Verify that for each test the appropriate pilot light at the control and annunciator panels responds.
    - b. Test smoke detectors with smoke or other aerosol acceptable to the manufacturer to demonstrate that smoke can enter the chamber and initiate an alarm.
    - c. Test restorable heat detectors by exposing the detector to a heat source, such as a hair dryer or a shielded heat lamp, until it responds. After each heat test the detector shall reset.
    - d. Test flow switches by producing water flow in the system by operation of the system test valve.
    - e. Test valve tamper switch by three open-close cycles.
    - f. Test the battery back-up system by turning off the primary power. After twenty-four hours initiate an alarm condition and verify that alarm signal devices operate for five minutes. Restore system to normal operating conditions and restore primary power.
  3. Contractor shall provide a temporary printer and submit a copy of the pre-test report one-week in advance of the final acceptance test with the University Representative and the UCSC Fire Alarm Shop.
- D. Upon completion of the installation of the fire alarm system satisfactory test of the entire system shall be made in the presence of the DCFM. Audible and visual notification

appliance testing may need to occur during weekends or semester breaks. Coordinate testing two-weeks in advance with the University Representative and the DCFM.

1. Prior to scheduling testing with the University Designated Campus Fire Marshal (DCFM), Contractor shall supply a completed pre-test matrix form to the University Representative. This matrix will list all devices and provide a check-off box for contractor to indicate successful pre-testing of the device including confirmation of correct descriptor wording.
  2. Contractor shall schedule final tests with adequate time to accommodate the availability of the UCSC Designated Campus Fire Marshal (DCFM) to witness the acceptance test. A 48 hours minimum notice after receipt of pre-test documentation is required.
- E. Contractor shall provide sound meter, chemical smoke, ladder, extensions devices, printer, ZEUS listing and the services of at least two technicians for the final acceptance test.

### 3.06 TESTS AND REPORTS

- A. Contractor shall have system tests performed only by an individual who has attended a manufacturer's seminar for testing the systems as specified above. Testing of the system shall be performed with the test instruments as required by the manufacturer. Testing by means other than the manufacturer's procedures will not be acceptable unless agreed to by the UCSC Designated Campus Fire Marshal (DCFM), the University Representative and the manufacturer.
- B. Pre-test and Acceptance Test reports shall be printed at the new FACU on the contractor's temporary printer and include, but not be limited to:
1. A complete list of equipment installed.
  2. Indication that all equipment is properly installed and functions and conforms to these specifications.
  3. Test of individual zones as applicable.
  4. List serial numbers, locations by zone and device number, and model number for each detector installed.
  5. A hard copy printout of the voltage (sensitivity) settings for each photoelectric smoke detector, measured in place with the HVAC system operating.
  6. List method of testing thermal and flame detectors, as well as manual stations.
  7. Technician's name, company represented, and date.
- C. Final acceptance will require the Contractor to deliver three copies of the following in a manual type binder:
1. Operating and maintenance manuals.
  2. A statement of guarantee including date of termination and the name and phone number of the person to be called in the event of an equipment failure.

3. Complete record drawings of wiring and conduits.
  4. Detailed catalog data on all installed system components.
  5. Copy of the test reports described in paragraph 3.06B.
  6. A current hard copy and electronic file on a USB thumb drive of the installed program. The electronic version of the program, sufficient for the University to change sequences of operation if desired, shall be provided.
  7. A completed NFPA 72 Record of Completion.
- D. One hundred percent (100%) of the new devices and functions shall be field tested. Testing from the system keyboard is not acceptable.
- E. A 24-hr. standby battery back-up test followed by alarm activation period as specified herein shall also be performed.

### **3.07 SPARE PARTS**

- A. The Contractor shall provide one (1) new spare for each manual pull station type, and two (2) new spares for every other type of field device, i.e., automatic detectors, detector bases, carbon monoxide detectors, control relay interface modules, input zone monitor modules, visual notification appliances, audible notification appliances, power supervisory relays, etc.

**Table 1 - CALIFORNIA STATE FIRE MARSHAL FIRE ALARM SYSTEM SUBMITTAL CHECKLIST (CFC 907.1.2)**

The following information is to be provided in the fire alarm shop drawings submitted to the Fire Marshal for review.

I.	ADMINISTRATIVE	<u>REFERENCE</u>
A.	Installing contractors name, address, and phone number.	2016 NFPA 72 7.4.4
B.	Basis for system installation / Building code occupancy classification.	2016 NFPA 72 7.4.4
C.	Building owner and/or tenant.	2016 NFPA 72 7.4.4
II.	<b>FIRE ALARM EQUIPMENT</b>	
A.	Manufacturer's specification sheet.	2016 NFPA 72 7.4.4
B.	Equipment application per listing/approvals.	2016 NFPA 72 7.4.4
C.	CSFM building materials listing sheet/numbers.	2019 CFC 907.1.3 & Title 19
III.	<b>GENERAL INFORMATION</b>	
A.	Appropriate codes & standards, including edition.	2016 NFPA 72 7.4.4
B.	Type of system or service involved.	2016 NFPA 72 7.4.4
C.	Voice evacuation message/language(s), if involved.	2016 NFPA 72 7.4.4
D.	Written sequence of operation or matrix table.	2016 NFPA 72 7.4.9
E.	Combination systems specific additional uses.	2016 NFPA 72 7.4.4
F.	HVAC locations > 2000 cfm.	CMC, Section 608
G.	Special system features/operations.	2016 NFPA 72 7.4.4
H.	Required placarding.	2016 NFPA 72 7.4.4
IV.	<b>PLANS &amp; DRAWINGS</b>	
A.	Scaled floor plans, reflected ceiling plans and wall elevation details, including north reference	2016 NFPA 72 7.4.5
B.	Completed title block with site address and issuing contractor's business address.	2016 NFPA 72 7.4.5
C.	Identification of each room's use.	2016 NFPA 72 7.4.5
D.	Location of all components, including, end-of-line devices, if involved.	2016 NFPA 72 7.4.5
E.	Symbol legend, including quantities, mfg name, model, etc.	2016 NFPA 72 7.4.5
F.	Identification of circuit styles, designations and methods.	2016 NFPA 72 7.4.5
G.	Description of zone assignments/device addresses.	2016 NFPA 72 7.4.5
H.	Complete building cross section, include attic, soffit, or ceiling details.	2016 NFPA 72 7.4.5
I.	Location of sprinkler system test valve.	2016 NFPA 72 7.4.5
J.	Specifications and details of through-penetration fire stopping, if required.	UL Fire Resistance Directories
K.	Device Mounting heights for manual boxes and visible notification appliances.	2016 NFPA 72 7.4.5
L.	Primary power supply details.	2016 NFPA 72 7.4.4
M.	Secondary power supply calculations in Excel spreadsheet format.	2016 NFPA 72 7.4.10
N.	Voltage drop calculations in Excel spreadsheet format.	2016 NFPA 72 7.4.10
O.	UCSC PPDO Project Number	
P.	Date of issue and sheet number (or ID) on each page.	
V.	<b>SINGLE LINE (RISER) DIAGRAM</b>	
A.	Conductor information, including size, stranding, insulation type, etc.	CEC, Article 760
B.	Conduit fill calculations or NEC reference.	CEC, Table #4
C.	Location of end-of-line devices.	2016 NFPA 72 7.4.4

**TABLE 2 – LIST OF DRAWINGS**

SHEET FA-1	TITLE SHEET, CODE ANALYSIS, AND SYMBOLS LEGEND
SHEET FA-2	SITE PLAN
SHEET FA-3	FIRE ALARM DEVICE FLOOR PLAN
SHEET FA-4	FIRE ALARM DEVICE FLOOR PLAN (AS REQUIRED)
SHEET FA-5	FIRE ALARM SINGLE LINE (RISER) DIAGRAM
SHEET FA-6	FIRE ALARM SYSTEM OPERATION MATRIX AND DETAILS

**END OF SECTION**

