

## **SECTION 28 05 00 - COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. This section includes general electrical requirements for all Division 28 work and is supplemental and in addition to the requirements of Division 01.
- B. It is the intention of this Division of the Specifications and the Contract Drawings to describe and provide for the furnishing, installing, testing and placing in satisfactory and fully operational condition all equipment, materials, devices and necessary appurtenances to provide a complete electrical system. Provide all materials, appliances and apparatus not specifically mentioned herein or shown on the drawings, but which are necessary to make a complete, fully operational installation of all electrical systems shown on the contract drawings or described herein. Connect equipment and devices furnished and installed under other Divisions of this specification (or the Owner) under this Division.
- C. Workmanship shall be of the best quality and competent and experienced electricians shall be employed and shall be under the supervision of a competent and experienced foreman.
- D. The drawings and specifications are complimentary and what is called for (or shown) in either is required to be provided as if called for in both.

#### **1.3 WORK IN OTHER DIVISIONS**

- A. Refer to Division 27 for Communications and Division 28 for Electronic Safety and Security. System elements of those Divisions require conformance and integration with the work of Division 26.
- B. See all other specifications for other work which includes but is not limited to:
  - Cutting and Patching
  - Door Hardware
  - Fire Protection
  - Mechanical Systems and Control Wiring
  - Painting, Refinishing and Finishes

#### **1.4 CODES, PERMITS, INSPECTION FEES**

- A. The following codes and standards are referenced in the Division 28 specifications. Perform all work and provide materials and equipment in accordance with the latest referenced codes and standards of the following organizations:

1. American National Standards Institute (ANSI)
  2. National Electrical Manufacturer's Association (NEMA)
  3. National Fire Protection Association (NFPA)
  4. Underwriter's Laboratories (UL)
  5. NECA National Electrical Contractor's Association
- B. Install the electrical systems based on the following:
- |         |   |
|---------|---|
| NFPA 70 | National Electrical Code as adopted and amended by the Local Jurisdiction.    |
| IBC     | International Building Code as adopted and amended by the Local Jurisdiction. |
- C. The referenced codes establish a minimum level of requirements. Where provision of the various codes conflict with each other, the more stringent provision shall govern. If any conflict occurs between referenced codes and this specification, the codes are to govern. Compliance with code requirements shall not be construed as relieving the Contractor from complying with any requirements of the drawings or specifications which may be in excess of requirements of the governing codes and rules and not contrary to same.
- D. Obtain and pay for all licenses, permits and inspections required by laws, ordinances and rules governing work specified herein. Arrange for inspection of work by the inspectors and give the inspectors all necessary assistance in their work of inspection.

## 1.5 COORDINATION

- A. Coordination during the bidding and pricing aspects of the contract includes determining where the work of other Divisions relies on the work of this Division for electricity and including the electrical system to match the requirements.
- B. Coordinate work with that of the other Contractors and/or other trades doing work on the project. Examine all drawings and specifications of other trades for construction details and coordination. Make every reasonable effort to provide timely notice of work affecting other trades to prevent conflicts or interference as to space requirements, dimensions, openings, block-outs, sleeving or other matters which will cause delays or necessitate work-around methods.
- C. Obtain submittals and shop drawings of all equipment with electronic safety and security connections furnished under other divisions of the specification and by the Owner.
- D. Provide all wiring in accordance with specific equipment requirements.
- E. Immediately advise the Architect of any changes which may affect the contract price.
- F. Special attention is called to the following items. Coordinate all conflicts prior to installation:
  1. Location of grilles, pipes, sprinkler heads, ducts and other mechanical equipment so that all outlets and other equipment is clear from and in proper relation to these items.

2. Location of cabinets, counters and doors so that electrical outlets and equipment are clear from and in proper relation to these items.
  3. Recessing and concealing electrical materials in CMU walls, concrete construction and precast construction.
- G. Furnish, install and place in satisfactory condition all raceways, boxes, conductors and connections and all other materials required for the electronic safety and security systems shown or noted in the contract documents to be complete, fully operational and fully tested upon completion of the project. Raceways, boxes and ground connections are shown diagrammatically only and indicate the general character and approximate location. The layout does not necessarily show the total number of raceways or boxes for the circuits required, nor are the locations of indicated runs intended to show the actual routing of the raceways.
- H. Consult the architectural drawings for the exact height and location of all electrical equipment not specified herein or shown on the drawings. Make any minor changes (less than 6'-6" horizontal) in the location of the raceways, outlets, boxes, devices, wiring, etc., from those shown on the drawings without extra charge, where coordination requires or if so directed by the Architect before rough-in.
- I. Review system product requirements for outlet boxes prior to roughing in. Where product requirements exceed the requirements of other aspects of this specification, increase the outlet box size to match system requirements. Notify Architect prior to installation if conflicts occur between required box depth and wall thickness.
- J. Provide inserts or sleeves for outlet boxes, conductors, cables and/or raceways as required. Coordinate the installation thereof with other trades.
- K. The Contractor will not be paid for relocation of work, cuttings, patching and finishing required for work requiring reinstallation due to lack of coordination prior to installation.

## **1.6 WARRANTY**

- A. Refer to General Conditions of the Contract.

## **1.7 CORRECTION OF WORK**

- A. Within one year after the date of Substantial Completion of the work, the Contractor shall correct any work found to be not in conformance with the Contract Documents promptly after written notice from the owner to do so, unless the Owner has previously given the Contractor a written acceptance of such condition. This obligation shall survive acceptance of the work under this Contract and termination of the Contract. The Owner shall give such notice promptly after discovery of the condition.

## **1.8 ITEMIZED SCHEDULE OF COSTS**

- A. Complete the Schedule of Values included at the end of this section. This schedule shall be adhered to for the electrical contractor to facilitate analysis and approval of the monthly progress billings. Refer to the Supplementary Conditions of General Contract and Division 1 - General Requirements for details, and conform thereto.

## 1.9 SUBMITTALS AND SHOP DRAWINGS

- A. Submittals shall show:
  - 1. Indicate listing by UL or other approved testing agency.
  - 2. Highlight with yellow or blue marker adequate information to demonstrate materials being submitted fully comply with contract documents.
  - 3. Review and check all material prior to submittal and stamp "Reviewed and Approved".
- B. Shop drawings shall show:
  - 1. Ratings of items and systems.
  - 2. How the components of an item or system are assembled, interconnected, function together and how they will be installed on the project.
  - 3. System layout floor plans with complete device layout, point-to-point wiring connection between all components of the system, wire sizes and color coding.
  - 4. Riser diagrams showing vertical wiring between components.
  - 5. Line diagrams and or logical/control schematics including interface to other systems as applicable. Provide point to point wiring diagrams, indicate terminal identification at item of equipment. Typical diagrams may be used when accompanied by wire schedules that are specific to each product.
  - 6. Coordinate with other division shop drawings and submittals. Identify interface points and indicate method of connection.

## 1.10 PROJECT CLOSE-OUT

- A. Coordinate with close-out provisions in Division 01 - General Requirements.
- B. Request For Final Punchlist
  - 1. To request a final electrical punch list, forward a letter to the Architect stating: "The electrical work on this project is complete, all punch list items to date are complete, items a. - i. in the Punchlist Procure paragraph in Section 280500 - Common Work Results For Electronic Safety and Security are complete and the project is ready for final punch list observation."
  - 2. Project Punchlist Procedure: Perform the following procedures for project closeout of electrical portions of work.
    - a. Provide engraved nameplates on equipment.
    - b. Refinish equipment finishes which are damaged.
    - c. Obtain final electrical permit inspection. Include copies in O & M manual.
    - d. Provide written warranty in O & M per the General Conditions of the Contract.
    - e. Furnish Record Drawings per this section. Obtain signature on Job Completion Form.
    - f. Furnish O & M Manuals per this section. Obtain signature on Job Completion Form.

- g. Give instruction periods to owner's personnel per this section. Obtain signature on Job Completion Form.
- h. To request final acceptance of project, fill out Job Completion Form in this section and forward to the Architect. Note: If inspectors have not signed form, a copy of signed-off permits will suffice.
- i. Include with Job Completion Form, a copy of the final punch list with the word "DONE", and the date and Contractor's initials after each item on the list.

#### **1.11 ELECTRICAL EQUIPMENT OPERATION AND MAINTENANCE (O&M) MANUALS**

- A. Provide O&M manuals required in Division 01 - General Requirements for all equipment furnished under Division 28 - Electronic Safety and Security specifications.
- B. The information included must be the exact equipment installed. Where sheets show the equipment installed and other equipment, the installed equipment shall be neatly and clearly identified on such sheets.
- C. These O&M manuals shall contain all the information needed to operate and maintain all systems and equipment provided in the project. Present and arrange information in a logical manner for efficient use by the Owner's security and operating personnel. The information provided shall include but not be limited to the following:
  - 1. Equipment manufacturer, make, model number, size, nameplate data, etc.
  - 2. Description of system configuration and operation including component identification and interrelations. A master control schematic drawings(s) may be required for this purpose.
  - 3. Dimensional and performance data for specific unit provided as appropriate.
  - 4. Manufacturer's recommended operation instructions.
  - 5. Manufacturer's recommended preventative maintenance program and service instructions for the system as a whole and for each component, function, and operation in detail.
  - 6. Complete parts list including reordering information, recommended spares and anticipated useful life (if appropriate). Parts lists shall give full ordering information assigned by the original parts manufacturer. Relabeled and/or renumbered parts information as reassigned by equipment supplier not acceptable.
  - 7. Shop drawings.
  - 8. Wiring diagrams.
  - 9. Signal equipment submittals shall contain step-by-step circuit description information designed to acquaint maintenance personnel with equipment operation in each mode of operation.
  - 10. A complete list of local (nearest) manufacturer representative and distributor contacts for each type of equipment and manufacturer. Include name, company, address, phone, fax, e-mail address, and web site.

11. Trouble-shooting guide for each system including a list of troubles, causes, and recommended remedies.
  12. A recommended spare parts list for owner consideration.
- D. Furnish complete wiring diagrams for each system for the specific system installed under the contract. "Typical" line diagrams will not be acceptable unless revised to indicate the exact field installation.
- E. Group the information contained in the manuals in an orderly arrangement by specification index. Provide a typewritten index and divider sheets between categories with identifying tabs. Bind the completed manuals with hard board covers not exceeding 5" thick. (Provide two or more volumes if required.) Signal and communication systems shall be in separate volumes. Imprint the covers with the name of the job, Owner, Architect, Electrical Engineer, Contractor and year of completion. Imprint the back edge with the name of the job, Owner and year of completion. Hard board covers and literature contained may be held together with screw post binding.

### 1.12 INSTRUCTION PERIODS

- A. After substantial completion of the work and 20 days after the O&M manuals have been delivered to the owner and after all tests and final inspection of the work by the Authority(s) Having Jurisdiction; demonstrate the electrical systems and instruct the Owner's designated operating and maintenance personnel in the operation and maintenance of the various electrical systems. The Contractor shall arrange scheduled instruction periods with the Owner. The Contractor's representatives shall be superintendents or foremen knowledgeable in each system and suppliers representatives when so specified. When more than one training session is specified, the second session shall be 30 to 90 days after the first as agreed to by the Owner.
- B. Include in each instruction session an overview of the system, presentation of information in maintenance manuals with appropriate references to drawings. Conduct tours of the building areas with explanations of maintenance requirements, access methods, servicing and maintenance procedures, equipment cleaning procedures and adjustment locations.
- C. Include the following scheduled instruction periods. Reference other Division 28 Specification Sections as noted:
- |                            | 1 <sup>st</sup> Session | 2 <sup>nd</sup> Session |
|----------------------------|-------------------------|-------------------------|
| 1 Fire Detection and Alarm | 2 hours                 | 2 hours                 |
- D. Manufacture certified representatives shall provide instruction for each of the sessions listed above.
- E. Provide one professionally produced digitally recorded or video tape of each training session in DVC. Furnish two (2) copies to the owner.

### 1.13 RECORD DRAWINGS

- A. Continually record the actual electrical system(s) installation on a set of prints kept readily available at the project during construction. These prints shall be used for this purpose alone.

1. Mark record prints with red erasable pencil. Mark the set to show the actual installation where the installation varies substantially from the work as originally shown.
2. Accurately locate with exact dimensions all underground and underslab raceways and stub-outs.
3. Note changes of directions and locations, by dimensions and elevations, as utilities are actually installed.
4. Include addenda items and revisions made during construction.
5. Erase conditions not constructed or "X-out" and annotate "not constructed" to clearly convey the actual "as constructed" condition.

#### 1.14 FINAL ACCEPTANCE REQUEST

- A. Comply with Division 01.

#### 1.15 ABBREVIATIONS AND DEFINITIONS

- A. When the following abbreviations and definitions are used in relation to the work for Division 28 they shall have the following meanings:

<u>Item</u>	<u>Meaning</u>
AHJ	Authority Having Jurisdiction.
Boxes	Outlet, Junction or Pull Boxes.
Code	All applicable codes currently enforced at project location.
Compression	Compressed using a leverage powered (hydraulic or equivalent) crimping tool.
Connection	All materials and labor required for equipment to be fully operational.
Exterior Location	Outside of or penetrating the outer surfaces of the building weather protective membrane.
Fully Operational	Tested, approved, and operating to the satisfaction of the AHJ, manufacturer and contract documents.
Furnish	Deliver to the jobsite
Install	To enter permanently into the project and make fully operational.
Kcml	Thousand circular mils (formerly MCM).
Mfr.	Manufacturer.
NEC	National Electrical Code, National Fire Protection Association, Publication #70.
Noted	Shown or specified in the contract documents.
Provide	Furnish and install.
Required	As required by code, AHJ, contract documents, or manufacturer for the particular installation to be fully operational.
Shown	As indicated on the drawings or details.
Wiring	Raceway, conductors and connections.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- A. All materials and equipment installed shall have been tested and listed by Underwriters Laboratories or other approved testing organization and shall be so labeled unless otherwise permitted by the Authority Having Jurisdiction (Inspector).
- B. All materials to be new, free from defects and not less than quality herein specified. Materials shall be designated to insure satisfactory operation and operational life in the environmental conditions which will prevail where they are being installed.
- C. Each type of materials furnished shall be of the same make, be standard products of manufacturers regularly engaged in production of such materials and be the manufacturer's latest standard design.
- D. All materials, equipment and systems furnished that include provisions for storing, displaying, reporting, interfacing, inputting, or functioning using date specific information shall perform properly in all respects regardless of the century. Any interface to other new or existing materials, equipment or systems shall function properly and shall be century compliant, both in regards to information sent and received.

### **2.2 SUBSTITUTION OF MATERIALS**

- A. Comply with Division 01.

### **2.3 NAMEPLATES**

- A. Provide nameplates per Section 260553 - Identification for Electrical Systems.

## **PART 3 - EXECUTION**

### **3.1 PRODUCT DELIVERY, STORAGE AND HANDLING**

- A. Deliver, store, and handle products according to the manufacturer's recommendations, using means and methods that will prevent damage, deterioration, and loss, including theft. Handle all equipment carefully to prevent damage, breakage, denting, and scoring of finishes. Do not install damaged equipment.
- B. Store products subject to damage by the elements above ground, undercover in a weather tight enclosure, with ventilation adequate to prevent condensation. Maintain temperature and humidity within range required by manufacturer's instruction.

### **3.2 CUTTING BUILDING CONSTRUCTION**

- A. Obtain permission from the Architect and coordinate with other trades prior to cutting. Locate cuttings so they will not weaken structural components. Cut carefully and only the minimum amount necessary. Cut concrete with diamond core drills or concrete saws except where space limitations prevent the use of such tools.
- B. All construction materials damaged or cut into during the installation of this work must be repaired or replaced with materials of like kind and quality as original materials by skilled labor experienced in that particular building trade.



### **3.3 PENETRATION OF BUILDING ELEMENTS**

- A. General:
  - 1. Penetrations of building elements by electrical systems shall not compromise the performance and integrity of the building element (structural, fire, smoke, waterproof, etc.)
- B. Fire and smoke rated elements:
  - 1. Electrical penetrations of fire and smoke rated floor and wall assemblies shall maintain fire-resistance or smoke barrier rating of the assembly. Firestopping materials and installation requirements are specified in Division 7 section "Firestopping".

### **3.4 PAINTING**

- A. Items furnished under this Division that are scratched or marred in shipment or installation shall be refinished with touchup paint selected to match installed equipment finish.

### **3.5 EQUIPMENT CONNECTION**

- A. For equipment furnished under this or other Divisions of the specifications, or by owner, provide all electrical connections necessary to serve such equipment and provide required control connections to all equipment so that the equipment is fully operational upon completion of the project. Provide disconnect switch as required by code whenever an equipment connection is shown on the drawings.
- B. Investigate existing equipment to be relocated and provide new connections as required.
- C. Obtain rough-in requirements for equipment furnished under other divisions of this specification prior to roughing-in. Review shop drawings and submittals of other Divisions to determine requirements.

### **3.6 CLEAN UP**

- A. Contractor shall continually remove debris, cuttings, crates, cartons, etc., created by his work. Such clean up shall be done daily and at sufficient frequency to eliminate hazard to the public, other workmen, the building or the Owner's employees. Before acceptance of the installation, Contractor shall carefully clean cabinets, panels, lighting fixtures, wiring devices, cover plates, etc., to remove dirt, cuttings, paint, plaster, mortar, concrete, etc. Blemishes to finished surfaces of apparatus shall be removed and new finish equal to the original applied.
  - 1. Wipe surfaces of electrical equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.

### **3.7 TESTING AND DEMONSTRATION**

- A. Demonstrate that all electrical equipment operates as specified and in accordance with manufacturer's instructions. Perform tests in the presence of the Architect, Owner or Engineer. Provide all instruments, manufacturer's operating instructions and personnel required to conduct the tests. Repair or replace any electrical equipment that fails to operate as specified and or in accordance with manufacturer's requirements.

DIVISION 28 ELECTRONIC JOB COMPLETION FORM

PROJECT NAME: OSU Weight Room Refresh  
PROJECT LOCATION: Oregon State University  
DATE: \_\_\_\_\_

A. Electrical Inspectors Final Acceptance (Copy of certificate attached.)

Name	Agency	Date
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B. Fire Marshal's Final Acceptance of Fire Alarm System (Copy of certificate attached.)

Name	Agency	Date
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C. The following systems have been demonstrated to Owner's representative.

1. Fire Detection and Alarm	Owner's Rep	Date
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D. Record Drawings

Attached Transmitted previously to \_\_\_\_\_  
Date

E. O & M Manuals

Attached Transmitted previously to \_\_\_\_\_

F. Test Reports

Attached Transmitted previously to \_\_\_\_\_  
Date

G. The work is complete in accordance with contract documents and authorized changes except for

\_\_\_\_\_ and the architect/engineer's representative is requested to meet with  
\_\_\_\_\_ at \_\_\_\_\_ on \_\_\_\_\_  
Supervisor of Electrical Work Time Date

\_\_\_\_\_  
Contractors Rep. Signature Date

**Division 28 Schedule of Values for OSU Sports Performance Center**

<b>Description of Work</b>	<b>Amount</b>
Device Rough-in (boxes and raceways) - Labor and Materials	
Circuit Conductors - Labor and Materials	
Fire Detection and Alarm - Labor and Materials	
Testing, Demonstration (AHJ approvals)	
Training	
Close Out (Record Drawings, O&M, etc.) - Materials & Labor	
TOTAL DIVISION 28	

**END OF SECTION 28 05 00**



## **SECTION 28 05 13 - CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The requirements of Section 280500 – Common Work Results for Electronic Safety and Security apply to this section.
- C. All Division 28 Specification Sections in this Specification Manual must be coordinated to and integrated with this Section. Refer to the Specification Manual Table of Contents for a Complete listing of Division 28 Specification Sections.
- D. SUMMARY
- E. Section Includes:
  - 1. UTP cabling.
  - 2. 50/125 micrometer, multimode optical fiber cabling.
  - 3. Coaxial cabling.
  - 4. RS-232 cabling.
  - 5. RS-485 cabling.
  - 6. Low-voltage control cabling.
  - 7. Control-circuit conductors.
  - 8. Fire alarm wire and cable.
  - 9. Identification products.

#### **1.2 DEFINITIONS**

- A. Basket Cable Tray: A fabricated structure consisting of wire mesh bottom and side rails.
- B. BICSI: Building Industry Consulting Service International.
- C. Channel Cable Tray: A fabricated structure consisting of a one-piece, ventilated-bottom or solid-bottom channel section.
- D. EMI: Electromagnetic interference.
- E. IDC: Insulation displacement connector.
- F. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).
- G. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.
- H. Open Cabling: Passing telecommunications cabling through open space (e.g., between the studs of a wall cavity).

- I. RCDD: Registered Communications Distribution Designer.
- J. Solid-Bottom or Non-ventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal side rails, and a bottom without ventilation openings.
- K. Trough or Ventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal rails and a bottom having openings sufficient for the passage of air and using 75 percent or less of the plan area of the surface to support cables.
- L. UTP: Unshielded twisted pair.

### **1.3 SUBMITTALS**

- A. Provide submittal information in accordance with Division 01 and supplementary requirements described in this specification.
- B. Remaining paragraphs are defined in Division 01 Section "Submittal Procedures" as "Informational Submittals."
- C. Qualification Data: For qualified layout technician, installation supervisor, and field inspector.
- D. Source quality-control reports.

### **1.4 QUALITY ASSURANCE**

- A. Testing Agency Qualifications: An NRTL.
  - 1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
- B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: 25 or less.
  - 2. Smoke-Developed Index: 50 or less.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

### **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Test cables upon receipt at Project site.
  - 1. Test optical fiber cable to determine the continuity of the strand end to end. Use optical loss test set.
  - 2. Test optical fiber cable on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector; include the loss value of each. Retain test data and include the record in maintenance data.
  - 3. Test each pair of UTP cable for open and short circuits.

### **1.6 PROJECT CONDITIONS**

- A. Do not install conductors and cables that are wet, moisture damaged, or mold damaged.

1. Indications that wire and cables are wet or moisture damaged include, but are not limited to, discoloration and sagging of factory packing materials.
- B. Environmental Limitations: Do not deliver or install UTP, optical fiber, and coaxial cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

## **PART 2 - PRODUCTS**

### **2.1 UTP CABLE**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Superior Essex Inc.
  2. Description: 100-ohm, 4-pair UTP, formed into 25-pair binder groups covered with a blue thermoplastic jacket.
  3. Comply with ICEA S-90-661 for mechanical properties.
  4. Comply with TIA/EIA-568-B.1 for performance specifications.
  5. Comply with TIA/EIA-568-B.2, Category 6.
  6. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
    - a. Communications, General Purpose: Type CM or CMG.
    - b. Communications, Plenum Rated: Type CMP], complying with NFPA 262.
    - c. Communications, Riser Rated: Type CMR, complying with UL 1666.
    - d. Communications, Limited Purpose: Type CMX .
    - e. Multipurpose: Type MP or MPG.
    - f. Multipurpose, Plenum Rated: Type MPP, complying with NFPA 262.
    - g. Multipurpose, Riser Rated: Type MPR, complying with UL 1666.

### **2.2 UTP CABLE HARDWARE**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Ortronics
- B. Type of connecting hardware depends on the equipment to which cable is connected. Retain first paragraph below if UTP cable terminations are not specified with connected equipment. Specifying connecting hardware here permits testing of cables before they are connected to the equipment.
- C. UTP Cable Connecting Hardware: IDC type, using modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of the same category or higher.

- D. Connecting Blocks 110-style for Category 6. Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.

### 2.3 OPTICAL FIBER CABLE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Corning Incorporated; Corning Cable Systems.
  2. Description: Multimode, 50/125-micrometer, fiber count per plans, tight buffer, optical fiber cable.
  3. Comply with ICEA S-83-596 for mechanical properties.
  4. Comply with TIA/EIA-568-B.3 for performance specifications.
  5. Comply with[TIA/EIA-492AAAA-B for detailed specifications.
  6. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
    - a. General Purpose, Nonconductive: Type OFN or OFNG.
    - b. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
    - c. Riser Rated, Nonconductive: Type OFNR complying with UL 1666.
    - d. General Purpose, Conductive: Type OFC or OFCG.
    - e. Plenum Rated, Conductive: Type OFCP complying with NFPA 262.
    - f. Riser Rated, Conductive: Type OFCR, complying with UL 1666.
  7. Conductive cable shall be steel armored type.
  8. Maximum Attenuation: 3.50 dB/km at 850 nm; 1.5 dB/km at 1300 nm.
  9. Minimum Modal Bandwidth: 160 MHz-km at 850 nm; 500 MHz-km at 1300 nm.
- B. Jacket:
1. Jacket Color: Aqua.
  2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA/EIA-598-B.
  3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).

### 2.4 OPTICAL FIBER CABLE HARDWARE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ortronics
- B. Cable Connecting Hardware: Meet the Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA/EIA-604-2, TIA/EIA-604-3-A, and TIA/EIA-604-12. Comply with TIA/EIA-568-B.3.



1. Quick-connect, simplex and duplex, Type SC connectors. Insertion loss not more than 0.75 dB.
2. Type SFF connectors may be used in termination racks, panels, and equipment packages.

## 2.5 COAXIAL CABLE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Alpha Wire Company.
  2. Belden CDT Inc.; Electronics Division.
  3. Coleman Cable, Inc.
  4. CommScope, Inc.
  5. Draka Cableteq USA.
- B. General Coaxial Cable Requirements: CCTV type, recommended by cable manufacturer specifically for analog video transmission applications. Coaxial cable and accessories shall have 75-ohm nominal impedance with a maximum loss of 6 dB/100ft at 700MHz.
- C. RG-6/U: NFPA 70, Type CM.
  1. No. 18 AWG, solid, copper-covered steel conductor; gas-injected, foam-PE insulation.
  2. Single shielded with 95% bare copper braid.
  3. Jacketed with black PVC or PE.
  4. Suitable for indoor installations.
- D. RG6/U (Plenum Rated): NFPA 70, Type CMP.
  1. No. 18 AWG, solid, copper-covered steel conductor; foam fluorinated ethylene propylene insulation.
  2. Single Shielded with 95% bare copper braid.
  3. Copolymer jacket.

## 2.6 COAXIAL CABLE HARDWARE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Alpha
  2. Belden
  3. Coleman Cable
  4. General Cable
- B. Coaxial-Cable Connectors: Type BNC, 75 ohms.

## 2.7 RS-232 CABLE

- A. Standard Cable: NFPA 70, Type CM.
  1. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.

2. Polypropylene insulation.
  3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
  4. PVC jacket.
  5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
  6. Flame Resistance: Comply with UL 1581.
- B. Plenum-Rated Cable: NFPA 70, Type CMP.
1. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
  2. Plastic insulation.
  3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
  4. Plastic jacket.
  5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
  6. Flame Resistance: Comply with NFPA 262.

## 2.8 RS-485 CABLE

- A. Standard Cable: NFPA 70, Type CM[ or CMG].
1. Paired, 2 pairs, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors.
  2. PVC insulation.
  3. Unshielded.
  4. PVC jacket.
  5. Flame Resistance: Comply with UL 1581.
- B. Plenum-Rated Cable: NFPA 70, Type CMP.
1. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
  2. Fluorinated ethylene propylene insulation.
  3. Unshielded.
  4. Fluorinated ethylene propylene jacket.
  5. Flame Resistance: NFPA 262, Flame Test.

## 2.9 LOW-VOLTAGE CONTROL CABLE

- A. Paired Lock Cable: NFPA 70, Type CMG.
1. 1 pair, twisted, No. 16 AWG, stranded (19x29) tinned copper conductors.
  2. PVC insulation.
  3. Unshielded.
  4. PVC jacket.
  5. Flame Resistance: Comply with UL 1581.

- B. Plenum-Rated, Paired Lock Cable: NFPA 70, Type CMP.
  - 1. 1 pair, twisted, No. 16 AWG, stranded (19x29) tinned copper conductors.
  - 2. PVC insulation.
  - 3. Unshielded.
  - 4. PVC jacket.
  - 5. Flame Resistance: Comply with NFPA 262.
- C. Paired Lock Cable: NFPA 70, Type CMG.
  - 1. 1 pair, twisted, No. 18 AWG, stranded (19x30) tinned copper conductors.
  - 2. PVC insulation.
  - 3. Unshielded.
  - 4. PVC jacket.
  - 5. Flame Resistance: Comply with UL 1581.
- D. Plenum-Rated, Paired Lock Cable: NFPA 70, Type CMP.
  - 1. 1 pair, twisted, No. 18 AWG, stranded (19x30) tinned copper conductors.
  - 2. Fluorinated ethylene propylene insulation.
  - 3. Unshielded.
  - 4. Plastic jacket.
  - 5. Flame Resistance: NFPA 262, Flame Test.

## 2.10 CONTROL-CIRCUIT CONDUCTORS

- A. Class 1 Control Circuits: Stranded copper, Type THHN-THWN, in raceway complying with UL 83.
- B. Class 2 Control Circuits: Stranded copper, Type THHN-THWN, in raceway complying with UL 83.
- C. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type TW or TF, complying with UL 83.

## 2.11 FIRE ALARM WIRE AND CABLE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Comtran Corp.
  - 2. Draka Cableteq USA.
  - 3. Genesis Cable Products; Honeywell International, Inc.
  - 4. Rockbestos-Suprenant Cable Corporation.
  - 5. West Penn Wire/CDT; a division of Cable Design Technologies.
- B. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.

- C. Signaling Line Circuits: Twisted, shielded pair.
- D. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation.
  - 1. Low-Voltage Circuits: No. 16 AWG, minimum.
  - 2. Line-Voltage Circuits: No. 12 AWG, minimum.

## 2.12 IDENTIFICATION PRODUCTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Brady Corporation
  - 2. HellermannTyton.
  - 3. Kroy LLC.
  - 4. Panduit Corp.
- B. Comply with UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- C. Comply with requirements in Section 260553 Identification for Electrical Systems.

## 2.13 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Factory test UTP and optical fiber cables on reels according to TIA/EIA-568-B.1.
- C. Factory test UTP cables according to TIA/EIA-568-B.2.
- D. Factory test multimode optical fiber cables according to TIA/EIA-526-14-A and TIA/EIA-568-B.3.
- E. Factory sweep test coaxial cables at frequencies from 5 MHz to 1 GHz. Sweep test shall test the frequency response, or attenuation over frequency, of a cable by generating a voltage whose frequency is varied through the specified frequency range and graphing the results.
- F. Cable will be considered defective if it does not pass tests and inspections.
- G. Prepare test and inspection reports.

## PART 3 - EXECUTION

### 3.1 WIRING METHOD

- A. Install wiring in metal raceways and wireways. Conceal raceway except in unfinished spaces and as indicated. Minimum conduit size shall be 3/4 inch (21 mm). Control and data transmission wiring shall not share conduit with other building wiring systems.
- B. Install wiring in raceways except in accessible indoor ceiling spaces and in interior hollow gypsum board partitions where cable may be used. Conceal raceways and wiring except in unfinished spaces and as indicated. Minimum conduit size shall be 3/4 inch (21 mm). Control and data transmission wiring shall not share conduit with other building wiring systems.
- C. Install cable, concealed in accessible ceilings, walls, and floors when possible.

- D. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Use lacing bars and distribution spools. Separate power-limited and non-power-limited conductors as recommended in writing by manufacturer. Install conductors parallel with or at right angles to sides and back of enclosure. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with intrusion system to terminal blocks. Mark each terminal according to system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.
- E. Boxes and enclosures containing security system components or cabling, and which are easily accessible to employees or to the public shall be provided with a lock. Boxes above ceiling level in occupied areas of the building shall not be considered accessible. Junction boxes and small device enclosures below ceiling level and easily accessible to employees or the public shall be covered with a suitable cover plate and secured with tamperproof screws.
- F. Install end of the line resistors at the field device location and not at the controller or panel location, unless otherwise noted.

### 3.2 INSTALLATION OF CONDUCTORS AND CABLES

- A. Comply with NECA 1.
- B. General Requirements for Cabling:
  - 1. Comply with TIA/EIA-568-B.1.
  - 2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
  - 3. Install 110-style IDC termination hardware unless otherwise indicated.
  - 4. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
  - 5. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
  - 6. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
  - 7. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
  - 8. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
  - 9. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
- C. UTP Cable Installation: Install using techniques, practices, and methods that are consistent with Category 6 rating of components and that ensure Category 6 performance of completed and linked signal paths, end to end.
  - 1. Comply with TIA/EIA-568-B.2.
  - 2. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.

- D. Optical Fiber Cable Installation:
  - 1. Comply with TIA/EIA-568-B.3.
  - 2. Cable shall be terminated on connecting hardware that is rack or cabinet mounted.
- E. Outdoor Coaxial Cable Installation:
  - 1. Install outdoor connections in enclosures complying with NEMA 250, Type 4X. Install corrosion-resistant connectors with properly designed O-rings to keep out moisture.
  - 2. Attach antenna lead-in cable to support structure at intervals not exceeding 36 inches (915 mm).
- F. Open-Cable Installation:
  - 1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
  - 2. Suspend copper cable not in a wireway or pathway a minimum of 8 inches (200 mm) above ceilings by cable supports not more than 60 inches (1525 mm) apart.
  - 3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.
- G. Installation of Cable Routed Exposed under Raised Floors:
  - 1. Install plenum-rated cable only.
  - 2. Install cabling after the flooring system has been installed in raised floor areas.
  - 3. Coil cable 72 inches (1830 mm) long shall be neatly coiled not less than [12 inches (300 mm)] in diameter below each feed point.
- H. Separation from EMI Sources:
  - 1. Comply with BICSI TDMM and TIA/EIA-569-A recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
  - 2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
    - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
    - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
    - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (600 mm).
  - 3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
    - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
    - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).

- c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).
4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
  - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
  - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (75 mm).
  - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).
5. Separation between Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
6. Separation between Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

### 3.3 FIRE ALARM WIRING INSTALLATION

- A. Comply with NECA 1 and NFPA 72.
- B. Wiring Method: Install wiring in metal raceway according to Section 260533 Raceway and Boxes for Electrical Systems.
  1. Fire alarm circuits and equipment control wiring associated with the fire alarm system shall be installed in a dedicated raceway system. This system shall not be used for any other wire or cable.
- C. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.
- D. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.
- E. Color-Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and another for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.

### 3.4 POWER AND CONTROL-CIRCUIT CONDUCTORS

- A. 120-V Power Wiring: Install according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables" unless otherwise indicated.
- B. Minimum Conductor Sizes:
  1. Class 1 remote-control and signal circuits, No. 14 AWG.
  2. Class 2 low-energy, remote-control and signal circuits, No. 16 AWG.

3. Class 3 low-energy, remote-control, alarm and signal circuits, No. 12 AWG.

### 3.5 CONNECTIONS

- A. Comply with requirements in Section 281300 Access Control for connecting, terminating, and identifying wires and cables.
- B. Comply with requirements in Section 282300 Video Surveillance for connecting, terminating, and identifying wires and cables.
- C. Comply with requirements in Division 28 Section "Digital Addressable Fire-Alarm System" for connecting, terminating, and identifying wires and cables.

### 3.6 FIRESTOPPING

- A. Comply with requirements in Division 07 Penetration Firestopping.
- B. Comply with TIA/EIA-569-A, Firestopping Annex A.
- C. Comply with BICSI TDMM, "Firestopping Systems" Article.

### 3.7 GROUNDING

- A. For low-voltage wiring and cabling, comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems."

### 3.8 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Section 260553 Identification for Electrical Systems.

### 3.9 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Tests and Inspections:
  1. Visually inspect UTP and optical fiber cable jacket materials for UL or third-party certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance with TIA/EIA-568-B.1.
  2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
  3. Test UTP cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross connection.
    - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
  4. Optical Fiber Cable Tests:



- a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
- b. Link End-to-End Attenuation Tests:
  - 1) Multimode Link Measurements: Test at 850 or 1300 nm in 1 direction according to TIA/EIA-526-14-A, Method B, One Reference Jumper.
  - 2) Attenuation test results for links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA/EIA-568-B.1.
- C. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.
- D. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

**END OF SECTION 28 05 13**



## **SECTION 28 31 11 - DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. All Division 28 Specification Sections must be coordinated with and integrated into this Section.
- C. Section 08 71 00 – Door Hardware
- D. Section 21 10 00 – Water Based Fire Suppression Systems
- E. Division 23 – Heating Ventilation and Air Conditioning (HVAC)
- F. Section 25 30 00 – Integrated Automation Instrumentation and Terminal Devices
- G. Division 26 Electrical

#### **1.2 DEFINITIONS**

- A. LED: Light-emitting diode.
- B. NICET: National Institute for Certification in Engineering Technologies.

#### **1.3 SYSTEM DESCRIPTION**

- A. Noncoded addressable system, with automatic sensitivity control of certain smoke detectors and multiplexed signal transmission, dedicated to fire-alarm service only.

#### **1.4 PERFORMANCE REQUIREMENTS**

- A. Seismic Performance: Fire-alarm control unit and raceways shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
  - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
- B. System shall comply with the latest adopted edition of the following codes and standards:
  - 1. Oregon Structural Specialty Code (OSSC)
  - 2. Oregon Fire Code (OFC)
  - 3. National Fire Alarm and Signaling Code – NFPA 72
  - 4. Oregon Electrical Specialty Code (OESC)
  - 5. Factory Mutual (FM) Global Data Sheet 5-40 – Fire Alarm Systems

## 1.5 CONTRACTOR DESIGN

- A. The contract drawings indicate the general nature of the fire alarm system, but do not necessarily show all components or system aspects required by this specification. The drawings are intended to aid the contractor in providing the complete fire alarm system.
- B. Notification device performance: The locations of fire alarm notification devices shown on the drawings indicate the rooms and spaces to be covered by the indicated types of devices, but not necessarily the total quantity of devices required in each room or space to meet the applicable codes, as device performance varies among manufacturers. Contractor shall provide design calculations based on vendor device performance characteristics for each space and notification method indicating compliance with applicable codes and criteria.
- C. Raceways, routing and wiring are not shown on the drawings and it shall be the responsibility of the contractor to design raceway routing and wiring and to show the same on shop drawings.
- D. Shop drawings shall be stamped by the vendor's professional engineer registered in the State of Oregon who shall serve as the engineer of record for the fire alarm system.

## 1.6 SUBMITTALS

- A. Provide submittal information in accordance with Division 01 and supplementary requirements described in this specification.
  - 1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect.
  - 2. Submittals will be reviewed by the design team AND the OSU Facilities Alarms Shop.
  - 3. Shop Drawings shall be prepared by persons with the following qualifications:
    - a. Trained and certified by manufacturer in fire-alarm system design.
    - b. NICET-certified fire-alarm technician, Level IV minimum.
- B. Product Data: For each type of product indicated.
- C. Shop Drawings: For fire-alarm system. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.
  - 2. Include performance parameters and installation details for each detector, verifying that each detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
  - 3. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale and coordinating installation of duct smoke detectors and access to them. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators. Locate detectors according to manufacturer's written recommendations.
  - 4. Drawings showing the location of each addressable device and each notification device with details as needed to comply with listing conditions of the device.
  - 5. Floor plans showing size and route of cable and raceways.

- D. Design Calculations: To comply with codes, performance requirements and design criteria, include analysis:
  - 1. Battery sizing calculations
  - 2. Voltage drop calculations
  - 3. Visible and audible notification device performance demonstrating compliance with NFPA 72 and local building code.
- E. Input/Output Matrix
  - 1. Submit matrix showing for each system input the appropriate system response including control unit annunciation, notification appliance activation, fire safety controls, and supplementary actions.

### 1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Seismic Qualification Certificates: For fire-alarm control unit, accessories, and components, from manufacturer.
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Field quality-control reports.

### 1.8 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
  - 1. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
  - 2. Provide "Record of Completion Documents" according to NFPA 72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.
  - 3. Record copy of site-specific software.
  - 4. Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 article of the same name and include the following:
    - a. Frequency of testing of installed components.
    - b. Frequency of inspection of installed components.
    - c. Requirements and recommendations related to results of maintenance.
    - d. Manufacturer's user training manuals.
  - 5. Provide permanently mounted updated zone map adjacent to each FACP and FAA (Fire Alarm Annunciator). Maps sized to be clearly visible without magnification.

6. Manufacturer's required maintenance related to system warranty requirements.
- B. Software and Firmware Operational Documentation:
  1. Software operating and upgrade manuals.
  2. Program Software Backup: On magnetic media or compact disk, complete with data files.
  3. Device address list.
  4. Printout of software application and graphic screens.

## 1.9 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  1. Lamps for Remote Indicating Lamp Units: Quantity equal to 10 percent of amount installed, but no fewer than 1 unit.
  2. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but no fewer than 1 unit.
  3. Smoke Detectors, Heat Detectors: Quantity equal to 6 percent of amount of each type installed, but no fewer than 1 unit of each type.
  4. Detector Bases: Quantity equal to 2 percent of amount of each type installed, but no fewer than 1 unit of each type.
  5. Manual Pull Stations: Quantity equal to 2% of amount installed, but no fewer than one.
  6. Keys and Tools: One extra set for access to locked and tamperproofed components.
  7. Interior Audible and Visual Notification Appliances: Quantity equal to 4% of amount of each type installed, but no fewer than One of each type installed.
  8. Exterior Audible and Visual Notification Appliances: Quantity equal to 2% of amount of each type installed, but no fewer than One of each type installed.
  9. Fuses: Two of each type installed in the system.
  10. Intelligent Modules: Quantity equal to 4% of each type installed, but no fewer than one of each type installed.

## 1.10 QUALITY ASSURANCE

- A. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level II technician.
- B. Source Limitations for Fire-Alarm System and Components: Obtain fire-alarm system from single source from single manufacturer. Components shall be compatible with, and operate as, an extension of the existing EST Quickstart QS4 system.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. NFPA Certification: Obtain certification according to NFPA 72 by an NRTL or UL-listed alarm company.

### 1.11 SERVICE INTERRUPTION

- A. Do not interrupt fire-alarm service to facilities occupied by Owner or others unless permitted under the following conditions
  - 1. Notify Architect no fewer than fourteen days in advance of proposed interruption of fire-alarm service.
  - 2. Do not proceed with interruption of fire-alarm service without Architect's written permission.
  - 3. Provide "fire watch" or similar temporary guard service to affirm the same role as the fire alarm system in protecting the facility's occupants and the owner's property. Obtain approval from the authority having jurisdiction for the proposed method.

### 1.12 SEQUENCING AND SCHEDULING

- A. Existing Fire-Alarm Equipment: Maintain existing equipment fully operational until new equipment has been tested and accepted. As new equipment is installed, label it "NOT IN SERVICE" until it is accepted. Remove labels from new equipment when put into service and label existing fire-alarm equipment "NOT IN SERVICE" until removed from the building.
- B. Equipment Removal: After acceptance of new fire-alarm system, remove existing disconnected fire-alarm equipment and wiring.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following to extent/expand the existing system:
  - 1. GE/Edwards EST

### 2.2 SYSTEM OPERATIONAL DESCRIPTION

- A. Non-coded, UL-certified addressable system, with multiplexed signal transmission and horn/strobe evacuation.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Fire-alarm signal initiation shall be by one or more of the following components:
  - 1. Manual stations.
  - 2. Smoke detectors.
  - 3. Duct smoke detectors.
  - 4. Automatic sprinkler system water flow.
- D. Fire-alarm signal shall initiate the actions identified and as required by code. For each required action refer to appropriate discipline drawings (for example architectural for door locks, mechanical for fans and dampers, etc) and determine the quantity, rating, and location of interface modules required to initiate the action. The actions are:
  - 1. Identify alarm at fire-alarm control unit and remote annunciators.

2. Transmit an alarm signal to the remote alarm receiving station.
3. Activate alarm notification appliances in accordance with facility requirements.
4. Door Controls:
  - a. Unlock electric door locks in designated egress paths.
  - b. Release fire and smoke doors held open by magnetic door holders.
  - c. Provide alarm contact closure for security system interface
5. HVAC System Interface
  - a. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
  - b. Return Air Fan Shut Down: Shutdown systems conveying 2000 CFM or more via signal from associated smoke detector.
  - c. Smoke Dampers
    - 1) Close smoke dampers in accordance with smoke control requirements of the International Building Code.
    - 2) Closure shall be initiated by a smoke detector(s) in the duct, or as otherwise permitted by code.
6. Record events in the system memory.
- E. Supervisory signal initiation shall be by one or more of the following devices and actions:
  1. Valve supervisory switch.
  2. Low-air-pressure switch of a dry-pipe sprinkler system.
- F. System trouble signal initiation shall be by one or more of the following devices and actions:
  1. Open circuits, shorts, and grounds in designated circuits.
  2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
  3. Loss of primary power at fire-alarm control unit.
  4. Ground or a single break in fire-alarm control unit internal circuits.
  5. Abnormal ac voltage at fire-alarm control unit.
  6. Break in standby battery circuitry.
  7. Failure of battery charging.
  8. Abnormal position of any switch at fire-alarm control unit or annunciator.
  9. Addressable device missing, non-functional, improper, or unconfigured at programmed address. Multiple devices at same address.
  10. Low-air-pressure switch operation on a dry-pipe sprinkler system.
- G. System Trouble and Supervisory Signal Actions: Initiate notification appliance and annunciate at fire-alarm control unit and remote annunciators. Record the event on system printer.



### 2.3 FIRE-ALARM CONTROL UNIT (FACU)

- A. General Requirements for expanding and interfacing with existing Fire-Alarm Control Unit:
1. Integrate all system components in accordance with the System Operational Description.
  2. Existing panel is field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864 and listed and labeled by an NRTL.
    - a. Provide modular labeling of new/revised components.
  3. Addressable initiation devices that communicate device identity and status.
    - a. Smoke sensors shall additionally communicate sensitivity setting and allow for adjustment of sensitivity at fire-alarm control unit.
  4. Cabinetry:
    - a. NEMA 1 with transparent, keyed, hinged outer door
    - b. Internal buttons for alarm acknowledge, testing, alarm silence,
- B. User Interface: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.
1. Printout of Events: On receipt of signal, print alarm, supervisory, and trouble events. Identify zone, device, and function. Include type of signal (alarm, supervisory, or trouble) and date and time of occurrence. Differentiate alarm signals from all other printed indications. Also print system reset event, including same information for device, location, date, and time. Commands initiate the printing of a list of existing alarm, supervisory, and trouble conditions in the system and a historical log of events.
- C. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory, and print out the final adjusted values on system printer.
- D. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.
- E. Testing: The system shall meet NFPA 72 testing and maintenance requirements without the need to manually remove and test each smoke detector.
- F. Audible Notification Circuits:
1. Notification shall sound in a pattern acceptable to the Fire Marshall and Owner.
- G. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory and digital alarm communicator transmitters powered by 24-V dc source.
1. Provide surge protection on incoming power
  2. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.

3. Provide visual and remote indication when the FACP loses power and is on battery backup. Remote indication/alarm shall be on 90 second delay to allow for generator testing without creating nuisance alarms.
- H. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.
1. Batteries: Sealed, valve-regulated, recombinant lead acid. Sized to sustain and operate system as required by local codes, but no less than for 24 hours in standby mode followed by 15 minutes in alarm mode.
  2. Battery charger shall completely recharge batteries within 48 hours.

## 2.4 CIRCUITS

- A. Initiating Device, Notification Appliance, and Signaling Line Circuits: NFPA 72, Class B.
1. Signaling Line Circuits: Style 4
  2. Install no more addressable devices on each signaling line circuit than 70% of the signaling line circuit capacity. Circuits shall not be shared between floors or smoke control zones.
  3. Power supplies shall have 30% spare capacity.
  4. Provide isolation modules on Signaling Line Circuits (SLC) serving multiple floors or more than 50 devices on a single floor.
- B. Wire
1. Non-Power-Limited Circuits: Conductors shall be 600-V rated, 75 deg. C, color-coded insulation.
    - a. Low-Voltage Circuits: No. 16 AWG, minimum, stranded copper (maximum of seven strands).
    - b. Line-Voltage Circuits: No. 12 AWG, minimum, solid or stranded copper.
  2. Power-Limited Circuits: NFPA 70, Types FPL, FPLR, or FPLP, as recommended by manufacturer.
- C. Raceways, Outlets, and Junction Boxes
1. All fire alarm wiring shall be in conduit, 3/4" minimum with minimum 4" square junction boxes for junctions and termination.
  2. Shall conform to specification sections "Raceways" and "Outlet and Junction Boxes".
  3. Provide 5" square by 2-2/7" deep outlet boxes with plaster ring for all flush mounted notification appliances.

## 2.5 SYSTEM SMOKE DETECTORS

- A. General Requirements for System Smoke Detectors:
1. Comply with UL 268; operating at 24-V dc, nominal.
  2. Detectors shall be two-wire type for power limited circuits.

3. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
  4. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
  5. Integral Visual-Indicating Light: LED type indicating detector has operated and power-on status.
  6. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.
    - a. Provide multiple levels of detection sensitivity for each sensor.
- B. Photoelectric Smoke Detectors:
1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
  2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
    - a. Primary status.
    - b. Device type.
    - c. Present average value.
    - d. Present sensitivity selected.
    - e. Sensor range (normal, dirty, etc.).
- C. Duct Smoke Detectors: Photoelectric type complying with UL 268A.
1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
  2. Detectors address shall be visible without having to remove it from the duct.
  3. Shall operate at 300 to 400 feet per minute
  4. Shall initiate a supervisory alarm when activated.
  5. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
    - a. Primary status.
    - b. Device type.
    - c. Present average value.
    - d. Present sensitivity selected.
    - e. Sensor range (normal, dirty, etc.).
  6. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector.
  7. Each sensor shall have multiple levels of detection sensitivity.

8. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
9. Provide remote indicator lights for duct smoke detectors.

## 2.6 NOTIFICATION APPLIANCES

- A. General Requirements for Notification Appliances: Connected to notification appliance signal circuits, zoned as indicated, equipped for mounting as indicated and with screw terminals for system connections.
  1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated and with screw terminals for system connections.
- B. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet (3 m) from the horn, using the coded signal prescribed in UL 464 test protocol.
- C. Visible Notification Appliances: Xenon strobe lights comply with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- (25-mm-) high letters on the lens.
  1. Rated Light Output:
    - a. 15/30/75/110 cd, selectable in the field.
  2. Mounting: Wall mounted unless otherwise indicated.
  3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
  4. Flashing shall be in a temporal pattern, synchronized with other units.
  5. Strobe Leads: Factory connected to screw terminals.
  6. Mounting Faceplate: Factory finished, red.

## 2.7 REMOTE ANNUNCIATOR

- A. Description: Annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing.
  1. Mounting: Flush cabinet, NEMA 250, Type 1.
  2. Location: Annunciators mounted outdoors shall be rated for the environment.
- B. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

## 2.8 ADDRESSABLE INTERFACE DEVICES

- A. Description: Microelectronic monitor module, NRTL listed for use in providing a system address for alarm-initiating or supervisory/reporting devices, for wired applications. .
- B. In NEMA 1 enclosure with exterior label. Internal label with I/O point(s) identification.

- C. Integral Relay: Capable of providing a direct signal with appropriate contact ratings to system interface, or receiving signal from system interface, including but not limited to:
  - 1. Fan shutdown motor controller
  - 2. Door holders/lock release.
  - 3. Security system
  - 4. Pre-action sprinkler system
- D. Smoke Dampers:
  - 1. Smoke damper interface modules and relays shall be enclosed in a NEMA 1 cabinet with hinged door and handle latch. Door interior shall contain circuit diagram for each module/relay and its associated dampers. Provide one cabinet per each smoke compartment and at least one per floor.
  - 2. Relays contacts shall be suited to the load. Relay contacts shall be loaded to no more than 70% of their rating.

## 2.9 OVERVOLTAGE AND SURGE PROTECTION

- A. All equipment connected to alternating current circuits shall be protected from surges in accordance with IEEE C62.41.1/IEEE C62.41.2 B3 combination waveform and NFPA 70. Fuses shall not be used for surge protection. The surge protector shall be rated for a maximum let thru voltage of 350 Volts ac (line-to-neutral) and 350 Volt ac (neutral-to-ground).

## PART 3 - EXECUTION

### 3.1 EQUIPMENT INSTALLATION

- A. Comply with NFPA 72 for installation of fire-alarm equipment.
  - 1. Mount signaling and notification devices within the more stringent of the restrictions imposed by NFPA 72 and the restrictions imposed by device manufacturer.
- B. Wiring
  - 1. Install all wiring in raceways dedicated to the fire alarm system
  - 2. Wiring in panels, cabinets, and other enclosures shall be neatly bundled and channeled. Provide channel routing to all I/O and neatly fan wiring to terminus.
  - 3. Ground per code.
- C. Equipment Mounting: Install wall-mounted equipment, with tops of cabinets not more than 72 inches (1830 mm) above the finished floor.
  - 1. Comply with requirements for seismic-restraint devices specified in Division 26 Section "Seismic Controls for Electrical Systems."
- D. Connecting to Existing Equipment: Verify that existing fire-alarm system is operational before making changes or connections.
  - 1. Connect new equipment to existing control panel in existing part of the building.
  - 2. Connect new equipment to existing monitoring equipment at the supervising station.

3. Expand, modify, and supplement existing control and monitoring equipment as necessary to extend existing control and monitoring functions to the new points. New components shall be capable of merging with existing configuration without degrading the performance of either system.
- E. Smoke- Detector Spacing:
  1. Comply with NFPA 72.
  2. HVAC: Locate detectors not closer than 3 feet (1 m) from air-supply diffuser or return-air opening.
  3. Lighting Fixtures: Locate detectors not closer than 12 inches (300 mm) from any part of a lighting fixture.
- F. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct.
- G. Remote Status and Alarm Indicators: Install near each smoke detector and each sprinkler water-flow switch and valve-tamper switch that is not readily visible from normal viewing position.
- H. Audible Alarm-Indicating Devices: Install not less than 6 inches (150 mm) below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.
- I. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn, unless it is integral with audible alarm indicating device. Install wall mounted devices such that the bottom of the lens is not less than 80 inches above the finished floor. Ceiling mount devices allowed where shown and shall be approved for ceiling application. More than two visible notification devices in the same room or adjacent space within the field of view shall flash in synchronization. Synchronization of devices not in the same field of view is allowed. In corridors where there are more than two devices in any field of view, they shall be spaced a minimum of 55' apart or they shall flash in synchronization.
- J. Device Location-Indicating Lights: Locate in public space near the device they monitor.
- K. Annunciator: Install with top of panel not more than 72 inches (1830 mm) above the finished floor.
- L. Fan Shut down relays: Install within 5 feet of the motor controller.
- M. Smoke Damper Relay cabinets: Wall mount in electrical room on same floor as smoke dampers.

### 3.2 CONNECTIONS

- A. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 3 feet (1 m) from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
  1. Smoke dampers in air ducts of designated air-conditioning duct systems.
  2. Supervisory connections at valve supervisory switches, including exterior Post Indicator Valve.
  3. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.

### 3.3 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- B. Provide labeling of all devices and appliances with their respective system address. Label to be produced from an electronic labeling system visible from the floor without magnification. Hand written labels are not acceptable.
- C. Provide labeling of all conductors and cables at termination points in panels, cabinets, and junction boxes. Label to be produced from an electronic labeling system. Hand written labels are not acceptable.

### 3.4 GROUNDING

- A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

### 3.5 FIELD QUALITY CONTROL

- A. Field tests shall be witnessed by authorities having jurisdiction.
- B. Perform tests and inspections.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
  - 1. Visual Inspection: Conduct visual inspection prior to testing.
    - a. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.
    - b. Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.
  - 2. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
  - 3. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
- D. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.
- E. Fire-alarm system will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

### **3.6 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system. Training to be provided for both Operator and Technician levels and training hours distributed accordingly. Operator training to include all control panel functions and creation of reports. Technician training to include hardware repair and maintenance by University Personnel of all building panels, devices, and appliances, diagnostic procedures, system expansion and maintenance techniques.

**END OF SECTION 28 31 11**