



NEW CASTLE COUNTY VO-TECH SCHOOL DISTRICT

PAUL M. HODGSON
VOCATIONAL TECHNICAL HIGH SCHOOL
2575 Glasgow Avenue, Newark, DE 19702

PROJECT MANUAL

BSA+A PROJECT #22.011

Contract No. NCC2401D

Volume 6
Divisions 27 through 33

**BID PACKAGE D – BUILDING ENVELOPE AND FIT OUT
ISSUE FOR BID – ADDENDUM #1**

December 28, 2023

ABHA | BSA+A

PROJECT MANUAL

NEW CASTLE COUNTY VO-TECH SCHOOL DISTRICT PAUL M. HODGSON VOCATIONAL-TECHNICAL HIGH SCHOOL

Contract No. NCC2401D

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**ISSUE FOR BID
December 28, 2023**

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The following previously issued Bid Package documentation is included by reference:

BPB Sitework and Utilities dated 25 May 23
BPB Addendum #1 dated 1 Aug 23
BPB Addendum #2 dated 7 Aug 23
BPB Addendum #3 dated 10 Aug 23
BPC Foundations and Structures 31 Aug 23
BPC Addendum #1 dated 29 Sept 23
BPC Addendum #2 dated 11 Oct 23
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TELECOMMUNICATIONS PATHWAYS AND SPACES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Telecommunications Room Build Out
- B. Pathways for Telecommunications Systems
- C. Grounding and Bonding for Telecommunications

1.02 References

- A. Industry Codes, Standards and Methods shall be observed, including the following:
 - 1. ANSI/TIA-568-C.0: Generic Telecommunications Cabling for Customer Premises.
 - 2. ANSI/TIA-568-C.1: Commercial Building Telecommunications Cabling Standard
 - 3. ANSI/TIA-568-C.2: Balanced Twisted Pair Cabling and Components Standard
 - 4. ANSI/TIA-568-C.3: Optical Fiber Cabling Components Standard
 - 5. ANSI/TIA-569-B: Commercial Building Standard for Telecommunications Pathways and Spaces
 - 6. ANSI/TIA-570-B: Residential Telecommunications Cabling Standard
 - 7. ANSI/TIA-606-A: Administration Standard for Telecommunications Infrastructure of Commercial Buildings
 - 8. ANSI-J-STD-607-D: Commercial Building Grounding and Bonding Requirements for Telecommunications
 - 9. ANSI/TIA-758-A: Customer-Owned Outside Plant Telecommunications Cabling Standard
 - 10. BICSI Telecommunications Distribution Methods Manual (TDMM), Latest Edition
 - 11. National Fire Protection Agency (NFPA-70): National Electrical Code (NEC)
- B. Comply with all local, state and federal codes for telecommunications installations.

1.03 System Description

- A. Design Requirements
 - 1. Contractor shall outfit all telecom rooms according to T Drawings. Termination and distribution fields shall be installed according to manufacturer's guidelines and industry standards.
 - 2. TR and TER layouts shall be approved by Technology personnel prior to installation of cabling, pathways or termination hardware.
- B. Performance Requirements

1. Materials and equipment will be installed in an orderly and precise manner. Clearances between equipment will prevent incidental damage or unsafe conditions.
2. Equipment shall provide proper support and housing of all intended active and non-active components.
3. Refer to Telecom Room Details for precise location of equipment and termination fields.

1.04 Submittals

A. Product Data

1. Provide product data for all equipment listed in Part 2
2. Equipment data must be submitted in a single package and clearly indicated for efficient review. (by specifications section) Equipment submittals not clearly called out will be rejected without question at the contractor's expense for resubmittal.
3. Product data must be approved by designer and owner prior to purchase and installation of equipment.
4. LEED Submittals
 - a. Product data for Credit IEQ 4.1: For adhesives and sealants applied within the building waterproofing envelope, documentation including printed statement of VOC content in g/L.
 - b. Product data for Credit IEQ 4.2: For paints and coatings applied within the building water proofing envelope, documentation including printed statement of VOC content in g/L.
 - c. Product data for Credit IEQ 4.4: For composite wood installed in the building interior as equipment backer boards, documentation indicating no added urea formaldehyde resins.

B. Shop Drawings

1. Provide scaled drawings to show proposed equipment locations, clearances and administrative labeling of Telecom Rooms and equipment. All fields, racks and cabinets shall be methodically documented and permanently labeled agreed upon by school district.
2. Shop drawings must be approved by the designer and owner prior to purchase and installation of any equipment.

C. As-Built Drawings

1. Contractor shall upon completion of the project, provide a complete set of As-Built drawings. These drawings shall identify room numbers and outlet identification numbers for all low voltage cabling systems. Drawings should also include all IDF and MDF locations with a detailed layout of all racks, patch panels, trays, and wall fields.

2. Additional project information shall include Reline Details of all horizontal and backbone cable routes and pathways.
3. As-builts shall be submitted in electronic CAD format and in hardcopy at the end of the project.

1.05 Quality Assurance

A. Regulatory Requirements

1. All equipment shall be installed in a neat and professional manner. All methods of construction that are not specifically described or indicated in the contract documents shall be subject to the control and approval of the school district. Equipment and materials shall be of the quality and manufacturer indicated. The equipment specified is based upon the acceptable manufacturers listed. Where “approved equal” is stated, equipment shall be equivalent in every way to that of the equipment specified and subject to approval.

B. Substitutions

1. Conditions for consideration of “Or Equal” Products: Where products are specified by name and accompanied by the term “or equal”, the proposed “or equal” product will be considered when the following conditions are satisfied.
 - a. If all the following conditions are not satisfied, Design Consultant will return requests without action, except to record noncompliance with these requirements
 - b. Proposed product does not require extensive revisions to the Contract Documents.
 - c. With the exception of the product name or number and manufacturer’s name, proposed product conforms with requirements indicated on the Drawings and in the Specifications in every respect and will produce indicated results.
 - d. Proposed product is fully documented and properly submitted.
 - e. Proposed product is compatible with and has been coordinated with other portions of the Work.
 - f. Proposed product provides specified warranty.
2. If proposed product involves more than one contractor, proposed product has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
3. Submission is accompanied with detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
4. Submission is accompanied with a list of similar installations for completed projects with project names and addresses and names and addresses of design consultants and authorities, if requested.

5. Submission is accompanied with proposed product's Manufacturer signed written statement on Manufacturer's letterhead, certifying that manufacturer complies with requirements in the Contract Documents.

1.06 Warranty

- A. Warranty: Installer must provide manufacturer's warranty without cost to the owner during that time period, including materials, hourly costs, etc.,.
- B. The installer's warranty shall guarantee workmanship for a period of two years, during which time any deficiency in installation shall be repaired or replaced at no additional cost to the school district. Contractor must respond within 2 business days of written notification.

PART 2 - PRODUCTS

2.01 Materials

- A. Adhesives, sealants, paints and coatings applied within the building waterproofing envelope: Comply with low-emitting requirements in Division 01 Section "Indoor Air Quality Requirements."
- B. Composite wood installed in the building interior as equipment backer boards: Contain no added urea formaldehyde resins.
- C. Ladder-Type Aluminum Cable Tray (Ladder Rack)
 1. All TR and TER locations shall receive ladder-rack style cable tray as shown in T-series drawings for cable distribution.
 2. Class 5160 or Chatsworth "TELCO-Style Cable Runway," 12-inch ladder rack from racks/cabinets from corridor or other wire routing space where indicated on drawings.
- D. Basket Cable Tray:
 1. Cablofil EZTray CF 54/300 EZ or approved equivalent.
 2. 12" X 2" with associated mounting hardware.
 3. 12" x 4" with associated mounting hardware.
 4. 18" x 4" with associated mounting hardware.
 5. Provide dual runs of cable tray as shown on T Drawings.
- E. J-Hooks
 1. J-Hooks shall be rated for low voltage cables.
 2. J-hooks shall be provided where cable tray and conduit are not present.
 3. J-hooks shall be installed on 5'-6' centers, not further apart.
- F. Conduit

1. In-wall conduit shall be provided for work in new areas. Refer to T Drawings for conduit details.
2. Conduit bend radii shall follow current ANSI/TIA standards for telecommunications.
3. Refer to T drawings for locations and sizes of all sleeves for telecommunications.

G. Gang Boxes

1. In-wall Gang Boxes for low voltage
 - a. Single Gang Box: Minimum 2.75" wide X 3.75" high X 1.7" deep with 3/4" and 1" knockouts.
 - b. In-wall Double Gang Box for low voltage: 4 Inch Back Knockout, 4 Inch Side Knockout, 4 Inch End Knockout, Length 3 3/4 Inches, Width 3 25/32 Inches, Depth 3 1/2 Inches or comparable.
2. Extra Deep in-wall gang boxes
 - a. 3 3/4" Deep, 2 3/16" Wide, 3 7/8" High
 - b. 4 Knockouts, 2 Per End

H. Floor Boxes

1. In-floor box
 - a. Coordinate all floor boxes and poke-through devices for telecom equipment with electrical installer.
 - b. Floor box shall meet latest UL standards for scrub water resistance.
 - c. Six-Compartment Combination box similar to Wiremold EFB6s-OG.
 - d. Top of box shall allow for matching floor finish insert and be constructed of metal
 - e. Provide all brackets and accessories for proper telecommunications installation.
2. Poke through
 - a. Unit shall be similar to Wiremold Evolution Series with 5 gangs.

I. Distribution Backboard

1. Plywood
 - a. 3/4" AC-grade plywood shall be provided as shown on T drawing details to line the walls within the TR. The plywood should be provided in 4' x 8' sheets.
 - b. Plywood shall be void free and painted on all sides with two coats of fire-resistant paint.

J. Electrical Protection for Telecommunications

1. Telecommunications Primary Bonding Busbar (PBB) and Telecommunications Secondary Bonding Busbar (SBB)
 - a. Provide one PBB in the Telecommunications Equipment Room as shown on T Drawings.
 - b. Provide a SBB in every Telecommunications Room and distribution cabinet location as shown on T Drawings.
 - c. The telecom grounding and bonding system shall be bonded to the main electrical ground for the facility.
- K. Rack mounted power strip
 1. Provide one 10 port transient, surge protection strip (UL Listed) for each rack or cabinet.

PART 3 - EXECUTION

3.01 Examination

- A. Site Verification of Conditions
 1. Contractor shall ensure that sufficient space has been allocated for the installation of all equipment per T Drawings prior to Installation. Clearances and existing equipment should be taken into consideration. If insufficient space exists, the Design consultant should be notified in writing, before proceeding with Installation.

3.02 Installation

- A. Distribution Racks and Cabinets
 1. Racks shall be assembled such that mounting rails are exactly perpendicular to the base.
 2. Racks shall be secured to the floor using appropriate anchors.
 3. Racks shall be grounded to the TGB or appropriate building ground using a minimum #6 grounding wire.
- B. Distribution Backboard
 1. Securely fasten backboard to wall-framing members to ensure it can support attached equipment.
 2. Mount plywood on all available areas where telecommunications equipment may be located.
 3. Refer to T Drawings for minimum coverage.
- C. Ladder Rack and Cable Tray
 1. Ladder rack and cable tray shall be properly secured using manufacturer recommended anchors and connectors.
 2. Ladder rack and cable tray shall be routed according to T Drawing floor plans.

3. Ladder rack and cable tray shall be bonded to ground according to ANSI/TIA 607.

D. Firestop

1. Provide re-enterable, non-hardening, intumescent putty, rated for floors or wall, UL approved assembly, with approved packing material for fire stopping inside building cable penetrations thru conduits sleeves.
2. The material used for sealing all openings shall have a fire rating equal to or greater than the floor ceiling, wall or partition material.

E. Sleeves and openings

1. The telecommunications contractor shall provide sleeves through all walls and floors to protect cabling and or raceways installed as part of the telecommunications system. All sleeves shall extend through the respective wall or partition and finish with a connector protective bushing.
2. Sleeves through all fire rated structures shall have the appropriate fire stop system.

END OF SECTION

**SECTION 27 10 00
STRUCTURED CABLING**

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Local Area Network (LAN) Cabling
- B. Telephone Cabling
- C. Coaxial Cabling
- D. Termination Equipment for Telecommunications
- E. Faceplates and Outlets

1.02 DEFINITIONS

- A. “Backbone Cabling” refers to telecommunications cabling that provides interconnections between telecommunications rooms, equipment rooms, and entrance facilities.
- B. “Communications Network Outlet (CNO)” refers to a collection of one or more mechanical cable termination device for horizontal cable in the work area.
- C. “Drop” refers to the vertical transition to a location of one or more CNOs.
- D. “Horizontal Cabling” refers to the cabling between and including the work area communications network outlet and the horizontal cross-connect in the telecommunications room.
- E. “Jack” refers to a female-style telecommunication receptacle.
- F. “Telecom Room (TR)” refers to an enclosed space for housing telecommunications equipment, cable terminations, and cross-connects. The room is the recognized cross-connect between the backbone or trunk cabling and horizontal cabling.
- G. “Telecom Equipment Room (TER)” refers to a centralized space for telecommunications equipment that serves the occupants of the building, usually containing the headend equipment for the distribution systems found in the building.

1.03 REFERENCES

- A. Industry Codes, Standards and Methods shall be observed, including the following:
 - 1. ANSI/TIA-568.0-E: Generic Telecommunications Cabling for Customer Premises
 - 2. ANSI/TIA-568.1-E: Commercial Building Telecommunications Cabling Standard
 - 3. ANSI/TIA-568.2-D: Balanced Twisted Pair Cabling and Components Standard
 - 4. ANSI/TIA-568.3-D: Optical Fiber Cabling Components Standard
 - 5. ANSI/TIA-569-E: Commercial Building Standard for Telecommunications Pathways and Spaces
 - 6. ANSI/TIA-606-C: Administration Standard for Telecommunications Infrastructure of Commercial Buildings
 - 7. ANSI/TIA-607-D: Commercial Building Grounding and Bonding Requirements for Telecommunications
 - 8. ANSI/TIA-758-B: Customer-Owned Outside Plant Telecommunications Cabling Standard
 - 9. BICSI Telecommunications Distribution Methods Manual (TDMM), Latest Edition
 - 10. National Fire Protection Agency (NFPA-70): National Electrical Code (NEC)
- B. Comply with all local, state and federal codes for telecommunications installations.

1.04 SYSTEM DESCRIPTION

STRUCTURED CABLING

Bid Pack D – Building Envelope & Fit Out

27 10 00 - 1

Addendum #1 IFB – 12/28/23

A. Design Requirements

1. All systems and equipment must comply with the Delaware State-Wide Information Technology and Architecture Standards, Latest Version.
2. LAN and Telephone Distribution:
 - a. Provide labor, materials, equipment, services and operations required for complete installation of LAN compatible with:
 - i. Ethernet 100Base-FX
 - ii. Ethernet 1000Base-SX
 - iii. Ethernet 1000Base-LX
 - iv. Ethernet 10GBase-S
 - v. Ethernet 10Base-LX4
 - vi. Ethernet 10GBase-L
 - vii. Ethernet 10GBase-LRM
 - viii. Fibre Channel 100-MX-SN-I
 - ix. Fibre Channel 100-SM-LC-L
 - x. Fibre Channel 200-MX-SN-I
 - xi. Fibre Channel 200-SM-LC-L
 - xii. Fibre Channel 400-MX-SN-I
 - xiii. Fibre Channel 400-SM-LC-L
 - xiv. Fibre Channel 1200-MX-SN-I
 - xv. Fibre Channel 1200-SM-LL-L
 - xvi. FDDI PMD ANSI X3.166
 - xvii. FDDI SMF-PMD ANSI X3.184
 - b. All wiring including copper and fiber optic employs a star topology.
 - i. Category 6/6a UTP wiring terminates on Category 6/6a RJ-45 jack at workstation and on Category 6 rack-mounted patch panel in telecommunications room. Connections wired per ANSI/TIA-568A.
 - ii. Multi-strand composite fiber optic cable connects distribution racks between telecommunications rooms and terminates on rack-mounted fiber optic patch panel.
 - c. Network cables routed from distribution racks throughout the building as shown on T-Drawings. Drop to outlet installed in conduit and wall box, to communications outlet in classrooms, offices, or other locations indicated on T-Drawings.

- i. Refer to notes on each drawing to determine exact installation methods.
 - ii. Note and record all cable lengths to the nearest foot.
 - iii. Replace any cable exceeding 90 meters (295 feet) and route to reduce length to a minimum of 90 meters. Complete all cable rerouting for compliance at no additional cost to School district.
 - iv. Identify to Design consultant prior to installation of any cables that cannot be reduced to 90 meters or less in total length (rise and run).
 - v. Strictly adhere to most current version of ANSI/TIA Telecommunications cabling standards.
 - vi. Unless otherwise noted on T-Drawings, provide ladder-type cable tray from corridor to distribution racks and termination fields in telecommunication rooms.
 - vii. Install “waterfall” device providing sweep from cable tray to data rack/cabinet and other vertical transitions.
 - d. Data and Telephone outlets: Category 6/6A rated RJ-45 type connectors with all four copper pairs terminated and tested in accordance with the 568B wiring standard.
 - e. Fiber Optic Horizontal and Backbone Cables: Terminate on panels in each rack and connectors with ceramic sleeves. Terminate and test all strands unless otherwise noted.
 - f. Permanently identify and label all cables and termination devices, at distribution rack and workstation in accordance with ANSI TIA 606 Standard or as agreed by Design consultant and school district.
 - g. Remove and replace any cables failing to meet end-to-end testing requirements; do not abandon cable in place. All cable shall be terminated at both ends, unless noted in T-Drawings.
- B. Performance Requirements
- 1. Comply with applicable requirements in Local, State and Federal Codes, ANSI/TIA Standards, and BICSI methodology.

1.05 SUBMITTALS

- A. Comply with requirements of Division 0 and Division 1 - Submittals and as modified below.
- B. Product Data: Submit manufacturer’s product literature, technical specifications and similar information for the following items demonstrating compliance with the specified requirements.
 - 1. Communications outlets, faceplates, and accessories.
 - 2. Fiber optic cable, patch cables and terminations.
 - 3. Copper cable, patch cables and termination devices.
 - 4. Rack configurations and wiring diagrams.
 - 5. Network cabling test equipment and process (routines).
 - 6. Equipment Racks
 - 7. Outlets

- C. Samples:
 - 1. Provide samples of outlets and assemblies as described below, prior to installation, for approval by designer.
 - 2. Telecommunications outlets – Submit samples of telecommunications outlets to be provided including following components and characteristics:
 - a. Flush mounted and Raceway outlets – Completely assembled faceplate and wall box with each type of outlet to be mounted in faceplate, including blank covers, dust covers, labeling field, cabling, and adapter plates and bezels required.
 - b. Sample characteristics:
 - i. Provide all components in colors selected by Design consultant.
 - ii. Provide multiple outlet samples where required to accurately represent the range of outlets to be provided.
- D. Shop Drawings
 - 1. The Contractor shall submit floor plan and wiring detail shop drawings of all systems showing all components of the systems. Submit wiring diagrams showing connections for all systems and equipment.
- E. Quality Control Submittal
 - 1. Test Reports: Submit complete sample test data and reports with exact labels used on cables, patch panels and faceplates.
 - 2. Certificates
 - a. Manufacturer Certification: Submit certification from manufacturer of products to be installed under this contract certifying that Installer is authorized by manufacturer to install specified products.
 - b. Installer Experience Listing: Submit list of at least 5 completed projects as specified below in “Quality Assurance – Qualifications – Installer.”
- F. Contract Closeout Submittal: Comply with requirements of Division 0, including submission of operating and maintenance instructions as item in “Operation and Maintenance Data” manual described in that Section.

1.06 QUALITY ASSURANCE

- A. All Work shall be installed in a first class, neat and workmanlike manner by skilled Technicians. The quality of the workmanship shall be subject to inspection and approval by authorized school district personnel. Any work found to be of inferior quality and/or workmanship shall be replaced and/or reworked until the approval of the school district is obtained.
- B. Installer Qualifications: Qualified to cable, terminate and test data network cabling system specified in this Section, certified by manufacturer of products to be installed, and completed at least 5 computer network installations of similar size, nature and complexity as specified for this project.
- C. Conditions for Consideration of "Or Equal" Products: Where products are specified by name and accompanied by the term "or equal", the proposed "or equal" product will be considered when the following conditions are satisfied. If all the following conditions are not satisfied, Design Consultant will return requests without action, except to record noncompliance with these requirements:
 - 1. Proposed product does not require extensive revisions to the Contract Documents.

2. With the exception of the product name or number and manufacturer's name, proposed product conforms with requirements indicated on the Drawings and in the Specifications in every respect and will produce indicated results.
3. The proposed product is fully documented and properly submitted.
4. The proposed product has received necessary approvals of authorities having jurisdiction.
5. The proposed product is compatible with AND has been coordinated with other portions of the Work.
6. Proposed product provides specified warranty.
7. If proposed product involves more than one contractor, proposed product has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
8. The submission is accompanied with detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
9. The submission is accompanied with a list of similar installations for completed projects with project names and addresses and names and addresses of design consultants and authorities, if requested.
10. The submission is accompanied with the proposed product's Manufacturer signed written statement on Manufacturer's letterhead, certifying that manufacturer complies with requirements in the Contract Documents.

1.07 WARRANTY

- A. Installer's Warranty: Provide manufacturer's system warranty against electrical or mechanical defects for two years from date of final acceptance.
- B. A fifteen (15) year Extended Product Warranty and Systems Assurance Warranty for this wiring system shall be provided by the Manufacturer as follows:
 1. Extended Product Warranty: The Extended Product Warranty shall ensure against product and workmanship defects, that all approved cabling components exceed the specifications of ANSI/TIA 568B and Addenda for fiber link/channels and copper components, for a fifteen (15) year period. The warranty shall apply to all passive components, including both cable and connecting hardware as a combined system. Any claims cover replacement costs on any defective product, both material and labor. Extended warranties beyond fifteen (15) years will be considered.
 2. System Assurance: The System Assurance shall cover the failure of the wiring system to support the application which it was designed to support as well as additional application(s) introduced in the future by recognized standards or user forums that use the ANSI/TIA 568B component and link/channel specifications for cabling, for a fifteen (15) year period.
 3. System Certification: Upon successful completion of the installation and subsequent inspection, the School district shall be provided with a numbered certificate, from the manufacturing company, registering the installation.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. All materials shall be new and unused.
- B. All cables shall be plenum rated.

- C. System wiring and equipment installation shall be in accordance with good engineering practices as established by ANSI/TIA and the NEC. Wiring shall meet all state and local electrical codes. All wiring shall test free from all grounds and shorts.
- D. Velcro straps shall be used for bundling wires. Wires shall be bundled loosely. Permanent cable ties are not acceptable.
- E. Wiring system shall consist of the following:
 - 1. Accessories and Appurtenances
 - 2. Cable Management Devices
 - 3. Fiber Optic Cable and Terminators (as indicated on drawings)
 - 4. Copper and Fiber Patch cables
 - 5. Remote Jacks
 - 6. Termination/Patch Panels
 - 7. Twisted Pair Data Cables
 - 8. The Cable Infrastructure Project requires a structured cabling system, or equivalent single-manufacturer solution. The Category 6/6a portion of the cabling system shall comply with the link and channel performance requirements of ANSI/TIA for 4-pair 100 Ohm Category 6/6a Cabling”. The cabling system shall be backed by a 15-Year System Warranty.
 - 9. The work includes the provision for a complete and operable Local Area Network Building Data System consisting of active and non-active components. The cabling system and all wiring components shall meet and comprise an ANSI/TIA Category 6/6a Wiring System. With master and remote data equipment the completed system shall provide 1Gbs Fiber Optic Fast Ethernet communications backbone support to the edge switches and Ethernet 1000 BASE-T to the workstation data jacks. The system shall provide such services as computer networking, data transmission, graphics and other multi-media offerings.
 - 10. Provide one home run cable from each data/voice jack to appropriate wiring closet.
 - 11. Cable length of home run cable shall not exceed 90 meters.
 - 12. All Modular jack panels shall be wired to ANSI/TIA 568B.

2.02 J-HOOKS

- A. Cooper B-Line BCM-21, 23 or 64.
 - 1. Provide in sufficient quantity for 15% future expansion.
 - 2. Installed no more than 6’ apart.
 - 3. Install in any areas without cable tray above false ceilings.

2.03 RACKS / CABINETS

- A. Distribution Racks and Cabinets
 - 1. Floor Mounted Free Standing 2 Post Racks
 - a. Racks shall be UL Listed and of aluminum construction with a black polyurethane or mil finish. They shall be 84” tall with a 15” base depth. Rack base shall be pre-drilled for securing rack to the floor. Racks shall have 12/24 mounting screws included in the package.
 - b. Rack rails shall be spaced for 19” mounting rail-to-rail and shall be of a U-shaped construction with 12/24 pre-tapped holes in the 310-D standard hole pattern providing 45 rack spaces on both the front and rear. Rails shall have a

- universal side-drilling pattern to allow racks to be bolted together or attachment of accessories. Racks shall be secured to the floor with anchor bolts.
- c. Vertical cable management channels shall be provided for each rack. Channels should allow for and facilitate orderly routing of distribution cables.
 - d. Acceptable racks: 10” Mighty Moe,
 - i. Or approved equivalent.
2. Floor Mounted Free Standing 4 Post Racks
- a. Four post aluminum frame with ANSI/TIA rails
 - b. 45 Rack Units
 - c. Black
 - d. Similar to APC AR203A
 - i. Or approved equivalent.
3. Floor Mounted Equipment Cabinet
- a. The cabinet frame shall be constructed of four cold rolled steel components – top, bottom, left and right welded to form a self-supporting framework. The top and bottom shall be fabricated from 14ga cold rolled steel. The vertical uprights shall have integral cable management channels with provisions for hook and loop or traditional cable ties. The frame shall be bolted to the floor, and side by side to other frames.
 - b. The side covers shall be constructed of 19ga cold rolled steel with double bent flanges along the entire perimeter. The side covers shall lift off easily via grip handles assembled to the covers. The side cover shall have clusters of rectangular perforation to accommodate ventilation for equipment providing greater than 100 sq. in. of ventilation.
 - c. The front door shall be perforated and assembled to the frame via spring-loaded hinges at the top and bottom. The door shall be locking with a unique operator’s key. The operator’s key shall operate the front door only. The latch shall be flush to the door. The window shall be a .125” acrylic panel secured to a reinforced steel frame.
 - d. The rear door shall be a steel door assembled to the frame via spring-loaded hinges at the top and bottom. The door shall be locking with a unique service personnel key. The service personnel key shall operate both the rear and front doors. The latch shall be push button operated. The rear door shall be reinforced and have a cluster of rectangular perforations for ventilation.
 - e. The top shall have a removable panel in the center, designed to be replaced with a cooling fan, and six 3” diameter cable entry knockouts; three along each side to route cables directly into vertical cable organizers minimizing the number of bends to the cables.

- f. The bottom panel shall be similarly configured with 6 knockout locations. The cabinet bottom shall also be provided with holes for securing the cabinet to the floor.
 - g. The top cover shall accept the mounting of a 250 CFM cooling fan.
 - h. The cabinet shall be pre-configured for 19” mounting with universal hole spacing per ANSI/TIA 310 D. The cabinet shall feature three sets of rails, front, center, and rear. The rear and center rails shall be the full internal height. The recess of all three sets of rails shall be adjustable forward and back. The rails shall be tapped for a #10-32 screw. The center rails shall be formed in a ‘C’ profile, 3” deep tapped on both the front and rear flanges so as to provide the functionality of an open frame rack. The front and rear rails shall be an L shape.
 - i. The entire enclosure shall be finished with a durable polyurethane powder coat – medium texture and shall be available in black.
 - j. APC AR3157
 - 4. Remote Equipment Box
 - a. Hubbell Rebox RE4
 - b. Hubbell Rebox RE4X
 - 5. All racks and cabinets shall be capable of supporting the weight and space of existing and proposed equipment. 30% growth capacity shall be provided in addition to detailed requirements.
 - 6. Racks, cabinets and other termination equipment shall be properly secured to the floor with appropriate anchors and bonded to Telecommunications Grounding System.
- B. Cable Management
- 1. Horizontal Cable Management
 - a. Horizontal wire management panels are required for patch panels in certain racks. (See drawings for rack diagrams.)
 - b. Horizontal cable management shall occupy 1 or 2 rack units, as shown on T Drawings.
 - c. Similar to OR-MM6HMF1RU
 - i. or approved equivalent
- C. Vertical Cable Management
- a. Vertical Cable management shall be provided for all racks. Provide 2 for each rack or cabinet.
 - b. Cable management shall be – Ortronics OR-60400510
 - c. Or approved equivalent.
- D. Electrical Protection for Telecommunications
- 1. Telecommunications Grounding Busbars

- a. Each rack/cabinet shall have a horizontal or vertical rack/cabinet grounding busbar and shall be bonded to the grounding system.
- b. The telecom grounding and bonding system shall be bonded to the main electrical ground for the facility.

2.04 HORIZONTAL CABLES

- A. Category 6a 100-ohm UTP 23 AWG Wireless cables shall have a distinctive color. Submit for approval from design team.
 1. Hubbell C6ASxx
 2. Or approved equal from
 - a. Belden
 - b. Berk-Tek
 - c. Systimax
- B. Category 6 100-ohm UTP Voice, Data, Wireless and Security cables shall each have a distinctive color. Submit for approval from design team.
 1. Hubbell HC6RPExx
 2. Hubbell HC6RRxx
 3. Hubbell C6SOPBK
 4. Or approved equal from
 - a. Hitachi
 - b. Belden
 - c. Berk-Tek
 - d. Systimax
- C. RG-6 Coaxial Cable
 1. Quad Shield 75 Ohm
 2. Plenum rated

2.05 BACKBONE CABLES

- A. Multi-pair Cat 5e Riser Cables
 1. Hitachi 30093-50
 2. Hitachi 30172-100
 3. Or approved equal from
 - a. Mohawk
 - b. Belden
 - c. Berk-Tek
- B. SingleMode Fiber Optic Cables
 1. 12 Strand Hitachi 61459
 2. Or approved equal from
 - a. Corning
 - b. Berk-Tek
 - c. Hubbell

2.06 TERMINATION FIELDS

- A. Category 6a 48-Port Patch Panels. Patch panels shall be segregated for POE switches and non-POE switches.
 1. Provide 15% spare capacity
 2. Hubbell HP6A48
 3. Hubbell Rear Cable Manager
 4. Or approved equal from
 - a. Ortronics
 - b. Panduit

STRUCTURED CABLING

- c. Systimax
 - d. Leviton
- B. Category 6 48-Port Patch Panels. Patch panels shall be segregated for POE switches and non-POE switches.
 - 1. Provide 15% spare capacity
 - 2. Hubbell P6E48U
 - 3. Hubbell PCBLMGT Rear Cable Manager
 - 4. Or approved equal from
 - a. Ortronics
 - b. Panduit
 - c. Systimax
 - d. Leviton
- C. Fiber Enclosure
 - 1. Hubbell 2U FCR350SP36R
 - 2. Hubbell 2U FCR350SP54R
 - 3. Hubbell 3U FCR525SPR
 - 4. Hubbell 4U FCR700SP
 - 5. Or approved equal from
 - a. Ortronics
 - b. Panduit
 - c. Systimax
 - d. Leviton
- D. Fiber Adaptor Panels
 - 1. Hubbell FSPLCDM6AQ
 - 2. Hubbell FSPLCQM6AQ
 - 3. Hubbell FSPLCDS6
 - 4. Hubbell FSPLCQS3
 - 5. Or approved equal from
 - a. Ortronics
 - b. Panduit
 - c. Systimax
 - d. Leviton
- E. Fiber Connector
 - 1. Hubbell FCLC900K50GM12 9/125 UPC
 - 2. Or approved equal from
 - a. Ortronics
 - b. Panduit
 - c. Systimax
 - d. Leviton
- F. 110 Blocks
 - 1. Hubbell 110BLK50FTK5
 - 2. Hubbell 110BLK100FTK5
 - 3. Hubbell 110BLK300FTK5
 - 4. Or approved equal from
 - a. Ortronics
 - b. Panduit
 - c. Systimax
 - d. Leviton
- G. Coaxial Components
 - 1. Bi-Directional Amplifiers

2. 8 port taps
3. 4 port taps
4. Splitters

2.07 OUTLETS

- A. Category 6a Wireless Jacks
 1. Hubbell HJ6Axx (replace xx with specified colors)
 2. Or approved equal from
 - a. Ortronics
 - b. Panduit
 - c. Systimax
 - d. Leviton
- B. Category 6 Voice and Data Jacks
 1. Hubbell HXJ6xx (replace xx with specified colors)
 2. Or approved equal from
 - a. Ortronics
 - b. Panduit
 - c. Systimax
 - d. Leviton
- C. Faceplates
 1. Grommeted Opening
 2. Brushed Opening
 3. Hubbell IFP11xx
 4. Hubbell IFP12xx
 5. Hubbell IFP13xx
 6. Hubbell IFP14xx
 7. Hubbell IFP16xx
 8. Hubbell IFP26xx
 9. Hubbell IFP29xx
 10. Hubbell IFP212xx
 11. Or approved equal from
 - a. Ortronics
 - b. Panduit
 - c. Systimax
 - d. Leviton
- D. Frames
 1. Hubbell ISF2xx
 2. Hubbell ISF3xx
 3. Hubbell ISF4xx
 4. Hubbell ISF6xx
 5. Hubbell NS620xx
 6. Or approved equal from
 - a. Ortronics
 - b. Panduit
 - c. Systimax
 - d. Leviton

2.08 PATCH CORDS

- A. Cat 6a UTP Copper Patch Cords
 1. Hubbell HC6Axx03

2. Hubbell HC6Axx05
 3. Hubbell HC6Axx07
 4. Hubbell HC6Axx010
 5. Hubbell HC6Axx15
 6. Hubbell HC6Axx20
 7. Hubbell HC6Axx25
 8. Or approved equal from
 - a. Ortronics
 - b. Panduit
 - c. Systimax
 - d. Leviton
- B. Cat 6 UTP Copper Patch Cords
1. Hubbell HC6xx03
 2. Hubbell HC6xx05
 3. Hubbell HC6xx07
 4. Hubbell HC6xx010
 5. Hubbell HC6xx15
 6. Hubbell HC6xx20
 7. Hubbell HC6xx25
 8. Or approved equal from
 - a. Ortronics
 - b. Panduit
 - c. Systimax
 - d. Leviton
- C. Fiber Patch Cords
1. Hitachi Singlemode
 2. Or approved equal from
 - a. Ortronics
 - b. Panduit
 - c. Systimax
 - d. Leviton

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verification of Conditions: Examine conditions under which telecommunications cabling and equipment and related components are to be installed in coordination with Installer of materials and components specified in this Section and notify affected Prime Contractors and Design consultant in writing of any conditions detrimental to proper and timely installation. Do not proceed with installation until unsatisfactory conditions have been corrected to ensure a safe and timely installation.
1. When the installer confirms conditions as acceptable to ensure proper and timely installation and to ensure requirements for applicable warranty or guarantee can be satisfied, submit to Design consultant written confirmation from applicable Installer. Failure to submit written confirmation and subsequent installation will be assumed to indicate conditions are acceptable to the installer.
 2. Visit Site to identify and become familiar with existing field conditions and specific requirements of each Site.
 3. Verify all dimensions in field and confirm condition of existing hardware to be utilized.

4. Confirm space requirements and physical confines of all work areas to ensure that all materials can be installed in indicated spaces.
5. Confirm all outlet locations and cable pathways and advise Design consultant in writing of any discrepancies or issues in Design described in Contract Documents.

3.02 PREPARATION

- A. Protection: Provide adequate protection of equipment and hardware before and after installation.
- B. Existing Communications Services: Ensure all telecommunications systems (voice, video and data) remain operational throughout the project.
 1. Identify any additional telecommunications outlets, circuits, and wiring at the site not shown on T-Drawings and interfering with installation of specified equipment.
 2. Contact local telephone, network and CATV company to identify all circuits providing existing services.
 3. Remove all accessible portions of abandoned communications cabling per NEC 800.52. Tag all communications cabling not terminated at both ends but retained for future use.

3.03 INSTALLATION

- A. Distribution Racks and Cabinets
 1. Racks shall be assembled such that mounting rails are exactly perpendicular to the base.
 2. Racks shall be secured to the floor using appropriate anchors.
 3. Racks shall be grounded to the PBB/SBB or appropriate building ground using a minimum #6 grounding wire.
- B. Provide and install all components necessary to install complete telecommunications cabling and equipment systems, including (but is not limited to) connectors, patch cables, terminators, etc...
 1. Cable runs shall be continuous and unbroken from end to end. Splicing of any Telephone, LAN, or coaxial video distribution cable is prohibited. Horizontal cabling for LAN and telephone shall end in rack-mounted patch panels.
 2. Secure all horizontal cables within ceiling cavities to the building structure.
 3. Loosely bundle all cables and support from structure at unequal intervals from 5 to 6 feet with spring steel fasteners and cable clip rated for use with high performance cables where cable tray or other support structure has not been provided as indicated on Drawings. All mounting clips shall be seismic type as per BOCA.
 4. Do not violate manufacturer's recommended loadings. Leave 30% capacity for future use of pathway.
 5. Verify all horizontal cable run lengths prior to installation. Re-distribute horizontal cabling to maintain distance requirements and maintain pathway route accessibility.
 6. Do not support cables from ceiling grid T-Bars, grid wire supports or bridle rings. Do not allow cables to touch the ceiling grid.
 7. Do not secure cables with permanent cable ties. Do not tighten cable bundles in such a way as to cause jacket deformation or damage.
 8. Provide a 10-foot service loop in all fiber optical cables to permit future cable splice and repair at all building entrance points and termination points.

9. Place cables in compliance with ANSI/TIA-568.B standards and BICSI recommended methods.
10. Tight 90-degree bends are unacceptable and use of plastic “cinch-type” tie-wraps are not permitted, in order to prevent damage to cable jacket and compromise the cable’s electrical or optical characteristics.
11. Cable bundles shall be neatly routed with a service loop to provide 10 feet of slack at the cross-connect end and as noted in the T-drawings. Cable bundles shall be secured using only black Velcro cable wraps.
12. 3 feet of service loop shall be provided in the ceiling at each workstation. Contractor shall not secure service loop in coils, but route in such a manner as to minimize EMI.
13. Wireless outlet locations
 - a. Wireless locations shown on T-series drawings shall be installed outside of a faceplate.
 - b. The ceiling shall be marked and as-builts shall reflect the location of all terminated ends and service loops as directed by SCHOOL DISTRICT personnel.
 - c. Cable shall be terminated in a female RJ-45 female jack and left with a service loop as described in T-series drawings. Cable shall be tested and documented per previous requirements.
 - d. After completion of wireless site survey, outlet shall be re-terminated for connection to Wireless Access Point.
- C. Determine allowable cable proximity to other electrical power sources of 480 Volts or less using ANSI/TIA-569A “Cabling Pathway Standard” for UTP cable separations from sources of EMI:
 1. Minimum separation distance from Power Source at 480 V or less:

CONDITION	<u>< 2kVA</u>	<u>2-5 kV</u>	<u>> 5 kVA</u>
a. Unshielded power lines or electrical equipment in proximity to open or non-metal pathways	6 in.	12 in.	24 in.
b. Unshielded power lines or electrical equipment in proximity to open or non-metal pathways	3 in.	6 in.	12 in.
c. Power lines enclosed in a grounded metal conduit (or equivalent shielding) in proximity to grounded metal conduit pathway	3 in.	6 in.	12 in.
d. Transformers & Elec. Motors	40 in.	40 in.	40 in.
e. Fluorescent Lighting	12 in.	12 in.	12 in.
- D. Interior Fiber Optical Cable Installation Requirements
 1. Install all outdoor rated communications cables not rated for plenum placement in interior environments in metallic conduit, according to NEC Articles 770 and 800.

2. Install Max Cell for fiber optic cabling in all conduits, as necessary for proper support of cables, or where required to assure pull-in tension not exceeding manufacturer's recommendations.
 3. Provide pull strings or ropes in all conduits used for communications cables.
- E. Cabling System
1. Where not provided as part of the electrical work or the data/voice work, the Contractor shall furnish and install necessary conduit, raceways, pull boxes, outlet boxes and cable to provide a complete system as herein specified. All wiring shall be tested for continuity and freedom of all grounds and short-circuits. All outlet boxes shall be as specified for other wiring devices; size as required by the equipment manufacturer.
 2. Cables shall be installed in raceways or EMT, as detailed on the drawings and/or as specified, above non-accessible ceilings, where exposed, and wherever it may be subject to physical damage. Where not provided as part of the electrical work or the data/voice work, the Contractor shall provide a raceway (conduit) from each outlet to above the accessible ceiling. Otherwise, cable shall be installed above accessible suspended tile ceilings and attached to building structure with approved bridle rings or J-hooks, cable is not permitted to rest on ceiling. The cable routes used shall avoid steam lines, power wiring and other utilities that may adversely affect the system's performance or result in damage to the cable. If the routes required place the cable in proximity to these utilities, the cable shall be suitably protected. Under no circumstances shall cable be run in hangers used for pipes or electric conduits nor shall the cable be supported in any way by attachment to these pipes, conduits or ceiling hangers.
 3. During the installation work, improper bending, stretching, twisting, kinking, pinching or any other improper handling must not deform the cable. All cable runs shall contain "S" loops or other means to accommodate expansion and contraction. Coaxial cables shall not bend at any point of installation to a radius of less than ten times the diameter of the cable or less than the value recommended by the cable manufacturer. Cable connected to electronic equipment in the system shall be tagged to show its function and the location of its other end. All labels shall be of durable material and securely fastened to the cable.
 4. All cables shall be fastened securely with suitable hardware so as to avoid sharp bends and to prevent rubbing against sharp corners and in a manner to prevent injury or physical distortion.
 5. Wiring for all wall-mounted equipment shall be concealed in raceway (conduit) from outlet to above removable ceilings, unless noted otherwise.
 6. Wiring installed above removable ceilings shall be installed on bridle rings. No cables shall be installed on the roof or exterior of building.
 7. Infrastructure properly terminated on backboard, neatly arranged in orderly fashion and accurately identified.
 8. Equipment cabinet(s) anchored to wall or floor utilizing an approved method.
 9. Install all exposed cabling in surface raceway by Wiremold, Hubbell or Panduit where in-wall conduit has not been provided. Follow all manufacturers' guidelines requirements regarding bending radius and slack. All bends, offsets and fittings shall be appropriately sized to provide 30% capacity after installation.
- F. Install all cables in accordance with National, state and local codes and ANSI/TIA Standards, and BICSI methods.
1. Follow manufacturer's guidelines and requirements for all cable termination.

2. Install and connect #6 AWG to bond all equipment racks, conduits and cable trays to busbar in each telecom room. Each telecom room shall be interconnected to TER with #3 AWG bonding backbone to PBB per Telecommunications Grounding Diagram. It shall be left to licensed electrician to interconnect PBB with lowest point of building ground. Contractor shall verify PBB has been bonded to building ground before declaring completion.
- G. Permanently identify all system components following ANSI/TIA-606A “Administration Standard for Commercial Telecommunications Infrastructure” with identification format:
 1. Identification: Provide permanent identification labels for outlets, faceplates, patch panels, access panels and entrance facilities.
 2. Each individual cable shall be labeled on both ends of cable terminations regardless of cable intended use. Labels must be machine printed with permanent black ink on laminated white label material. Contractors must check with appropriate school district personnel for appropriate labeling scheme. The intended format and labeling material must be approved by school district Technology Department before labeling begins.

3.04 TESTING

- A. LAN and Telephone
 1. Upon completion of work, all parts of the telecommunications installation shall be tested by the Telecommunications Contractor and demonstrated free of any defects. Preliminary testing will be permitted but shall not be accepted in lieu of obtaining final test results. Final test results shall be accomplished by the use of proper test equipment for the system being tested.
 2. Re-terminate and re-test any cables or pairs of cables failing end-to-end testing requirements. Replace any faulty cables/pairs or termination devices. Remove all defective cables completely from pathways.
- B. As-Built
 1. Accurate as-built drawings shall be provided in electronic and hard copy format.
 - a. Drawings shall accurately show and describe all cable routing and equipment location in redline format.
 - b. 3 copies of electronic (CAD) drawings shall be distributed on appropriate media: 1 to construction management, 1 to designers and 1 to the school district.
 - c. 3 hard copies of CAD drawings shall be plotted on full size sheets and test results of every installed cable have been given to the construction management for appropriate distribution.

3.05 ACCEPTANCE

- A. The contractors work shall be considered complete after the following conditions have been met:
 1. Cable installation is complete and all cable runs have been tested and documented to be installed according to specifications and drawings.
 2. A school district Technology representative has successfully tested the “LIVE” system.
 3. All punch list items have been reconciled.
 4. All disturbed ceiling panels, firestopping materials, covers, etc. have been properly reinstalled.
 5. All materials and trash have been removed from the site.

6. A 2-Year Installers warranty has been given to the owner.
7. A 15-year channel warranty has been given to the owner.
8. Submit Manufacturers Extended Warranty Application.

END OF SECTION

**SECTION 272000
NETWORK EQUIPMENT**

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. LAN Electronics (Owner Furnished, Contractor Installed)
- B. Wireless Electronics (Owner Furnished, Contractor Installed)
- C. Power Protection Equipment (CFCI)

1.02 DEFINITIONS

- A. “Backbone Cabling” refers to telecommunications cabling that provides interconnections between telecommunications rooms, equipment rooms, and entrance facilities.
- B. “Communications Network Outlet (CNO)” refers to a collection of one or more mechanical cable termination device for horizontal cable in the work area.
- C. “Horizontal Cabling” refers to the cabling between and including the work area communications network outlet and the horizontal cross-connect in the telecommunications room.
- D. “Telecom Room (TR)” refers to an enclosed space for housing telecommunications equipment, cable terminations, and cross-connects. The room is the recognized cross-connect between the backbone or trunk cabling and horizontal cabling.
- E. “Telecom Equipment Room (TER)” refers to a centralized space for telecommunications equipment that serves the occupants of the building, usually containing the headend equipment for the distribution systems found in the building.

1.03 SYSTEM DESCRIPTION

- A. Design Requirements
 - 1. Provide labor, materials, equipment, services and operations required for complete installation of LAN compatible with Ethernet 10Base-T (10Mbps), Fast Ethernet 100Base-T (100Mbps), 155Mbps ATM and Gigabit Ethernet 1000 Base-T (1000Mbps) with single mode fiber optic backbone cable and Category 6/6a copper horizontal (station) wiring.
 - 2. Chassis Switch in TER shall be connected to access switches located in Telecommunication Rooms (TR/IDF) by the fiber backbone. Access switches shall distribute data throughout the network over twisted-pair cable.
 - 3. Network devices must be able to accommodate 100% of network outlets, with at least 15% spare ports in aggregate for future use.
 - 4. Network equipment shall be capable of supporting multiple Virtual Local Area Networks (VLAN), VoIP protocols, ATM protocols and Gigabit Ethernet.
 - 5. Permanently identify and label all cables and termination devices, at distribution rack and workstation in accordance with ANSI TIA-606-A Standard or as agreed by Design consultant and Authority.

B. Performance Requirements

1. Comply with applicable requirements in Local, State and Federal Codes, ANSI/TIA Standards, and BICSI methodology. Industry Codes, Standards and Methods shall be observed, including the following:
2. ANSI/TIA-568.0-E: Generic Telecommunications Cabling for Customer Premises
3. ANSI/TIA-568.1-E: Commercial Building Telecommunications Cabling Standard
4. ANSI/TIA-568.2-D: Balanced Twisted Pair Cabling and Components Standard
5. ANSI/TIA-568.3-D: Optical Fiber Cabling Components Standard
6. ANSI/TIA-569-E: Commercial Building Standard for Telecommunications Pathways and Spaces
7. ANSI/TIA-606-C: Administration Standard for Telecommunications Infrastructure of Commercial Buildings
8. ANSI/TIA-607-D: Commercial Building Grounding and Bonding Requirements for Telecommunications
9. ANSI/TIA-758-B: Customer-Owned Outside Plant Telecommunications Cabling Standard
10. BICSI Telecommunications Distribution Methods Manual (TDMM), Latest Edition
11. National Fire Protection Agency (NFPA-70): National Electrical Code (NEC)

1.04 SUBMITTALS

- A. Comply with requirements of Division 1 - Submittals and as modified below.
- B. Product Data: Submit manufacturer's product literature, technical specifications and similar information for the following items demonstrating compliance with the specified requirements.
1. Network Switch Equipment
 2. Patch Cables/Jumpers
 3. UPS Equipment
 4. Wireless Access Controller
 5. Wireless Access Points
- C. Shop Drawings
1. The Contractor shall submit detailed line drawings of all systems showing major components of the systems. Submit wiring diagrams showing connections for all systems and equipment. Submittals will be rejected without detailed line drawings.
 2. The shop drawings shall be submitted in hardcopy and electronic format. Provide quantities called out in Division 1.
- D. Quality Control Submittal
1. Test Reports: Submit complete sample test data and reports.
 2. Certificates

- a. Manufacturer Certification: Submit certification from manufacturer of products to be installed under this contract certifying that Installer is authorized by manufacturer to install specified products.
 - b. Installer Experience Listing: Submit list of at least 5 completed projects as specified below in “Quality Assurance – Qualifications – Installer.”
- E. As-Built Drawings and Test Results
- 1. Comply with requirements of Division 1, including submission of operating and maintenance instructions as item in “Operation and Maintenance Data” manual described in that Section.
 - 2. Provide test results for all communications circuits installed, including UTP channel performance and fiber optic backbone cabling and terminations.
 - 3. Accurate as-built drawings shall be provided in electronic and hard copy format.
 - a. Drawings shall accurately show and describe all cable routing and equipment location in redline format.
 - i. Location of outlets and equipment on building floorplans
 - ii. Identification of labeling used for outlets and distribution racks.
 - iii. Cable routing and pathways for telephone and LAN cabling.
 - b. 3 copies of electronic (CAD) drawings shall be distributed on appropriate media: 1 to construction management, 1 to designers and 1 to district technology staff.
 - c. 3 hard copies of CAD drawings shall be plotted on full size sheets and test results of every installed cable have been given to the construction management for appropriate distribution.

1.05 QUALITY ASSURANCE

- A. All Work shall be installed in a first class, neat and workmanlike manner by skilled Technicians. The quality of the workmanship shall be subject to inspection and approval by authorized district personnel. Any work found to be of inferior quality and/or workmanship shall be replaced and/or reworked until the approval of district staff is obtained.
- B. Installer Qualifications: Certified by equipment manufacturer for installation of equipment. Instructor must be qualified at the appropriate level to validate equipment warranty.
- C. Conditions for Consideration of "Or Equal" Products: Where products are specified by name and accompanied by the term "or equal", the proposed "or equal" product will be considered when the following conditions are satisfied. If all the following conditions are not satisfied, Design Consultant will return requests without action, except to record noncompliance with these requirements:
 - 1. The proposed product does not require extensive revisions to the Contract Documents.

2. With the exception of the product name or number and manufacturer's name, proposed product conforms with requirements indicated on the Drawings and in the Specifications in every respect and will produce indicated results.
3. The proposed product is fully documented and properly submitted.
4. The proposed product has received necessary approvals of authorities having jurisdiction.
5. The proposed product is compatible with AND has been coordinated with other portions of the Work.
6. Proposed product provides specified warranty.
7. If proposed product involves more than one contractor, proposed product has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
8. The submission is accompanied with detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
9. The submission is accompanied with a list of similar installations for completed projects with project names and addresses and names and addresses of design consultants and authorities, if requested.
10. The submission is accompanied with the proposed product's Manufacturer signed written statement on Manufacturer's letterhead, certifying that manufacturer complies with requirements in the Contract Documents.

1.06 WARRANTY

1. All manufacturer warranties shall be activated and passed on to the Owner. The warranty shall commence from time of substantial completion for a period of two years.

1.07 OPERATION AND MAINTENANCE MANUALS

1. All applicable materials shall be given to the owner during training in electronic and hardcopy format if available.
2. Any password or key for specific systems shall be given to the owner as part of the operation and maintenance manuals.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

1. All networking switching electronics shall be based on Cisco Meraki or owner's preference at the time of construction.
2. Catalog and part numbers must be from the most current vendor catalogs available at the time of installation.

3. Wireless Equipment shall be from Cisco Meraki or owner's preference at the time of construction.

2.02 EQUIPMENT

- A. Router (Owner Furnished, Contractor Installed)
 1. Cisco / Meraki
 - a. Cisco 3850-24XS-E
- B. Access Layer Switches (Owner Furnished, Contractor Installed)
 1. Fast Ethernet POE Stackable Switches and components
 - a. Cisco Meraki MS225-24P-HW
 - b. Cisco Meraki LIC-MS225-24P-10YR
 - c. Cisco Meraki MS225-48FP-HW
 - d. Cisco Meraki LIC MS225-48FP-10YR
 - e. Cisco Meraki MA-CBL-40G-50CM
 - f. Cisco Meraki MA-CBL-40G-1M
 - g. Cisco Meraki MA-CBL-40G-3M
 - h. Cisco Meraki MA-CBL-TA-3M
 - i. Cisco Meraki SFP-10G-LRM
 - j. Cisco Meraki MA-SFP-10GB-LRM
 - k. Cisco Meraki Single Mode LC-LC 3 Meter
 - l. Provide all with power supplies.
 - m. Provide all with stacking cables.
 - n. Provide all with 10 Gig Transceivers.
 2. Maintenance and Warranty
 - a. Per device
- C. Power Protection Equipment (Contractor Furnished, Contractor Installed)
 1. Preferred Alternate
 - a. APC
 2. Acceptable Substitutes
 - a. Tripplite
 - b. Eaton

3. UPS Equipment

- a. APC SMTL3KRM2UCLNC with PDU (Lithium Batteries)
 - i. Eaton PDUMVR30NETLX

2.03 WIRELESS EQUIPMENT

- A. The exact quantity of wireless access points shall be determined by the wireless site survey at the time of installation.
- B. The wireless controller shall be sized appropriately based on the exact number of installed wireless access points.
- C. Wireless Controller (Owner Furnished, Contractor Installed)
 - 1. Meraki Cloud Management
- D. Wireless Access Point (Owner Furnished, Contractor Installed)
 - 1. Meraki MR44
 - a. With Access Point License.
 - b. With Grid Mount Kit
 - c. With Wall Mount Kit
 - 2. Meraki MR56 (Large Spaces, Gyms, Cafés, Auditoriums)
 - a. With Access Point License.
 - b. With Grid Mount Kit
 - c. With Wall Mount Kit

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verification of Conditions: Examine conditions under which telecommunications cabling and equipment and related components are to be installed in coordination with Installer of materials and components specified in this Section and notify affected Prime Contractors and design consultant in writing of any conditions detrimental to proper and timely installation. Do not proceed with installation until unsatisfactory conditions have been corrected to ensure a safe and timely installation.
 - 1. When the installer confirms conditions as acceptable to ensure proper and timely installation and to ensure requirements for applicable warranty or guarantee can be satisfied, submit to Design consultant written confirmation from applicable Installer. Failure to submit written confirmation and subsequent installation will be assumed to indicate conditions are acceptable to the installer.
 - 2. Visit Site to identify and become familiar with existing field conditions and specific requirements of each Site.

3. Verify all dimensions in field and confirm condition of existing hardware to be utilized.
4. Confirm space requirements and physical confines of all work areas to ensure that all materials can be installed in indicated spaces.
5. Confirm all outlet locations and cable pathways and advise design consultant in writing of any discrepancies or issues in design described in Contract Documents.

3.02 INSTALLATION

A. Power Protection Equipment

1. UPS shall be mounted in equipment racks according to manufacturer's specifications and as shown on T-series drawings.
2. Coordinate location of twist-lock electrical power with UPS equipment in all telecom rooms.
3. All network equipment in telecom rooms shall utilize UPS power, except as noted in T-series drawings or individual spec sections.
4. Provide sufficient battery capacity for equipment in individual telecom rooms.

B. Switching Electronics

1. Contractor shall securely mount switches in distribution racks as shown on T-series drawings.
2. Equipment shall utilize UPS power, through multi-outlet power strips.
3. The contractor shall verify and provide test results showing 100% functionality of switch ports.
4. Switches shall be interconnected using manufacturer recommended patch cords, transceivers and equipment cords.
5. Wireless Equipment
 - a. Contractor shall perform a wireless site survey to provide complete building coverage at a minimum of 1 Gb/sec in all locations.
 - b. Utilize W type drops located above the ceiling grid throughout the facility.
 - c. The wireless system shall be completely operational and programmed through wireless controllers located in equipment racks.
6. Network Architecture
 - a. The contractor shall maximize singlemode cabling between head end and telecom rooms, so that most switches are directly fed into core switch. When stacking is required due to limited availability of fiber, contractor shall verify in writing to Architect.
 - b. All PoE switches shall be connected through singlemode fiber optic cabling directly to core switch.

- c. The contractor shall verify configuration of switches with School District personnel and reserve up to 16 hours to coordinate installation with School District employees.

C. Network Server

1. Server shall be installed per manufacturer's specifications in distribution rack in Equipment Room.
2. Coordinate installation and configuration of server directly with School District employees.
3. Provide all patch and equipment cords necessary for full installation.

3.03 LABELING

- A. Permanently identify all system components following ANSI/TIA-606A "Administration Standard for Commercial Telecommunications Infrastructure" with identification format:
 1. Each individual patch cord shall be labeled on both ends regardless of cable intended use. Labels must be machine printed with permanent black ink on laminated white label material. Contractors must check with appropriate district personnel for appropriate labeling scheme. The intended format and labeling material must be approved by the district Technology Department before labeling begins.
 2. Equipment shall be given a unique identifier, corresponding to as-built drawings.
 3. Refer to T-Drawings for naming conventions.

3.04 TESTING

- A. Upon completion of work, all parts of the telecommunications installation shall be tested by the Telecommunications Contractor and demonstrated free of any defects. Preliminary testing will be permitted but shall not be accepted in lieu of obtaining final test results. Final test results shall be accomplished by the use of proper test equipment for the system being tested.

3.05 ACCEPTANCE

- A. The contractors work shall be considered complete after the following conditions have been met:
 1. Network, Wireless and VoIP Equipment has been provided, installed and tested for functionality.
 2. Switching equipment has been demonstrated to allow a "ping" from any point on the LAN to equipment outside of LAN. Contractor shall coordinate with School District to schedule demonstration of network equipment.
 3. Patch cords have been properly installed. Any patch cords not employed in the network shall be assembled and turned over to school district.
 4. All punch list items have been reconciled.

5. All disturbed ceiling panels, firestopping materials, covers, etc. have been properly reinstalled.
6. A two-year warranty has been provided to the owner.
7. All materials and trash have been removed from the site.
8. Manufacturers' Warranty Certificates and product materials have been given to the Owner.

END OF SECTION

SECTION 27 40 00
CLASSROOM AND CONFERENCE ROOM A/V EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes
 - 1. Audio Visual Cabling and Equipment (Contractor Furnished, Contractor Installed)
 - 2. Electronic Displays (Owner Furnished, Contractor Installed)

1.02 Definitions

- A. “Communications Network Outlet (CNO)” refers to a collection of one or more mechanical cable termination devices for horizontal cable in the work area.
- B. “Drop” refers to the vertical transition to a location of one or more CNOs.
- C. “Horizontal Cabling” refers to the cabling between and including the work area communications network outlet and the horizontal cross-connect in the telecommunications room.
- D. “Jack” refers to a female-style telecommunication receptacle.

1.03 System Description

- A. Design Requirements
 - 1. A/V switching and routing within the classroom. System must handle analog and digital sources.
- B. Performance Requirements
 - 1. Comply with applicable requirements in Local, State and Federal Codes, ANSI/TIA Standards, and BICSI methodology.
 - 2. Specified cabling system derived from recommendations in approved telecommunications industry codes, standards and methods, including the following documents:
 - a. Articles 250, 725, 760, 770, 800, 810 and 820 of the current National Electrical Code.
 - b. ANSI/TIA-568.0-E: Generic Telecommunications Cabling for Customer Premises
 - c. ANSI/TIA-568.1-E: Commercial Building Telecommunications Cabling Standard
 - d. ANSI/TIA-568.2-D: Balanced Twisted Pair Cabling and Components Standard
 - e. ANSI/TIA-568.3-D: Optical Fiber Cabling Components Standard

- f. ANSI/TIA-569-E: Commercial Building Standard for Telecommunications Pathways and Spaces
- g. ANSI/TIA-606-C: Administration Standard for Telecommunications Infrastructure of Commercial Buildings
- h. ANSI/TIA-607-D: Commercial Building Grounding and Bonding Requirements for Telecommunications
- i. BICSI Telecommunications Distribution Methods Manual (TDMM), Latest Edition
- j. National Fire Protection Agency (NFPA-70): National Electrical Code (NEC)

1.04 Submittals

- A. Comply with requirements of Division 0 and Division 1 - Submittals and as modified below.
- B. Product Data: Submit manufacturer's product literature, technical specifications and similar information for the following items demonstrating compliance with the specified requirements.
 - 1. Audio Visual cables and connectors
 - 2. Communications outlets, faceplates, and accessories.
 - 3. Wall outlets
- C. The Contractor shall submit line drawings of all systems showing major components of the systems. Submit wiring diagrams showing typical connections for all systems and equipment.
- D. Quality Control Submittal
 - 1. Test Reports: Submit complete sample test data and reports with exact labels used on cables and faceplates.
 - 2. Certificates
 - a. Manufacturer Certification: Submit certification from manufacturer of products to be installed under this contract certifying that Installer is authorized by manufacturer to install specified products.
 - b. Installer Experience Listing: Submit list of at least 5 completed projects as specified below in "Quality Assurance – Qualifications – Installer."
- E. Contract Closeout Submittal: Comply with requirements of Division 0, including submission of operating and maintenance instructions as item in "Operation and Maintenance Data" manual described in that Section.

1.05 Quality Assurance

- A. All Work shall be installed in a first class, neat and professional manner by skilled Technicians. The quality of the workmanship shall be subject to inspection and approval

by authorized school district personnel. Any work found to be of inferior quality and/or workmanship shall be replaced and/or reworked until the approval of the school district is obtained.

- B. Installer Qualifications: Qualified to cable, terminate and test cabling system specified in this Section, certified by manufacturer of products to be installed, and completed at least 5 installations of similar size, nature and complexity as specified for this project.
- C. Conditions for Consideration of "Or Equal" Products: Where products are specified by name and accompanied by the term "or equal", the proposed "or equal" product will be considered when the following conditions are satisfied. If all the following conditions are not satisfied, Design Consultant will return requests without action, except to record noncompliance with these requirements:
 - 1. Proposed product does not require extensive revisions to the Contract Documents.
 - 2. With the exception of the product name or number and manufacturer's name, proposed product conforms with requirements indicated on the Drawings and in the Specifications in every respect and will produce indicated results.
 - 3. The proposed product is fully documented and properly submitted.
 - 4. The proposed product has received necessary approvals of the authorities having jurisdiction.
 - 5. The proposed product is compatible with AND has been coordinated with other portions of the Work.
 - 6. The proposed product provides a specified warranty.
 - 7. If the proposed product involves more than one contractor, the proposed product has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
 - 8. The submission is accompanied with detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
 - 9. The submission is accompanied with a list of similar installations for completed projects with project names and addresses and names and addresses of design consultants and authorities, if requested.
 - 10. The submission is accompanied with proposed product's Manufacturer signed written statement on Manufacturer's letterhead, certifying that manufacturer complies with requirements in the Contract Documents.

1.06 Warranty

- A. Installer's Warranty: Provide manufacturer's system warranty against electrical or mechanical defects for two years from date of final acceptance.

1. System Certification: Upon successful completion of the installation and subsequent inspection, the Authority shall be provided with a numbered certificate, from the manufacturing company, registering the installation.

PART 2 - PRODUCTS

2.01 Materials – All materials shall be new and unused.

- A. Acceptable AV Products (Contractor Furnished, Contractor Installed)
 1. Audio Enhancement
 2. Front Row
 3. Extron
 - a. PUBLIC ADDRESS SYSTEM MUST BE FROM THE SAME MANUFACTURER AS THE AV SYSTEM. (SEE SECTION 275000)
 4. All Audio/Visual Cabling shall be from one manufacturer and have pre-terminated connectors.
- B. Acceptable Electronic Displays (Owner Furnished, Contractor Installed)
 1. Smart Technologies
 - a. Substitutions are not allowed.
- C. Classroom Sound equipment
 1. Audio Enhancement MS-600
 2. Audio Enhancement FS-22 Speakers
 3. Audio Enhancement Wall Plates
 4. Audio Enhancement XD Microphones
- D. General Classroom/Conference Room A/V Cabling (Contractor Furnished, Contractor Installed)
 1. AV Cabling (NO SUBSTITUTES)
 - a. Audio Enhancement AVConnect V2 Extender Kit
 - b. 6' HDMI cables
 - c. 6' USB (A-B) cables
 - d. 15' HDMI cables
 - e. 15' USB (A-B) cables
 - f. Cat 6 F/UTP cabling
 - g. 3.5 MM Audio Cabling

- h. RJ-45 shielded modular ends.
 - i. Grommeted / Brushed Opening white wall plates.
 - j. Decora wall plates white
- 2. Cables in proper length to reach outlets and devices.
- 3. Provide for each AV system with all cables on both ends of the system.
- E. Classroom/Conference Room Wall Mounted Electronic Displays (Owner Furnished, Contractor Installed)
 - 1. With embedded computing.
 - 2. 75" SMART Board Display MX75
 - 3. Smart MX075-V2 Interactive Display with iQ

PART 3 - EXECUTION

3.01 Examination

- A. Verification of Conditions: Examine conditions under which AV cabling and sound enhancement equipment and related components are to be installed in coordination with Installer of materials and components specified in this Section and notify affected Prime Contractors and Design consultant in writing of any conditions detrimental to proper and timely installation. Do not proceed with installation until unsatisfactory conditions have been corrected to ensure a safe and timely installation.
 - 1. When the installer confirms conditions as acceptable to ensure proper and timely installation and to ensure requirements for applicable warranty or guarantee can be satisfied, submit to Design consultant written confirmation from applicable Installer. Failure to submit written confirmation and subsequent installation will be assumed to indicate conditions are acceptable to the installer.
 - 2. Visit Site to identify and become familiar with existing field conditions and specific requirements of each Site.
 - 3. Verify all dimensions in field and confirm condition of existing hardware to be utilized.
 - 4. Confirm space requirements and physical confines of all work areas to ensure that all materials can be installed in indicated spaces.
 - 5. Confirm all outlet locations and cable pathways and advise Design consultant in writing of any discrepancies or issues in Design described in Contract Documents.

3.02 Preparation

- A. Protection: Provide adequate protection of equipment and hardware before and after installation.
- B. Existing Communications Services: Ensure all telecommunications systems (voice, video and data) remain operational throughout the project.

1. Identify any additional outlets, circuits, and wiring at the site not shown on T-Drawings and interfering with installation of specified equipment.
2. Remove all accessible portions of abandoned communications cabling per NEC 800.52. Tag all communications cabling not terminated at both ends but retained for future use.

3.03 Installation

- A. Provide and install all components necessary to install complete AV cabling and sound enhancement equipment systems, including (but is not limited to) connectors, electronics, terminators, pass-thrus, cables etc...
1. Cable runs shall be factory terminated. Splicing of any cable is prohibited.
 2. Secure all cables within ceiling cavities to building structure.
 3. Loosely bundle all cables and support from structure at unequal intervals from 5 to 6 feet with spring steel fasteners and cable clip rated for use with high performance cables where cable tray or other support structure has not been provided as indicated on Drawings. All mounting clips shall be seismic type as per BOCA.
 4. Do not violate manufacturer's recommended loadings. Leave 30% capacity for future use of pathway.
 5. Verify all horizontal cable run lengths prior to installation. Ensure cables do not exceed distances that would degrade the signal transmission requirements.
 6. Do not support cables from ceiling grid T-Bars, grid wire supports or bridle rings. Do not allow cables to touch the ceiling grid.
 7. Install cables in EMT in all unfinished or exposed areas.
 8. Do not secure cables with permanent cable ties. Do not tighten cable bundles in such a way as to cause jacket deformation or damage.
 9. Place cables in compliance with ANSI/TIA-568.B standards and BICSI recommended methods.
 10. Tight 90-degree bends are unacceptable, and use of plastic "cinch-type" tie-wraps are not permitted, in order to prevent damage to cable jacket and compromise the cable's electrical or optical characteristics.
 11. Communications outlets shall be located to be no more than 6 feet from an electrical outlet.
- B. Determine allowable cable proximity to other electrical power sources of 480 Volts or less using ANSI/TIA-569A "Cabling Pathway Standard" for UTP cable separations from sources of EMI:
1. Minimum separation distance from Power Source at 480 V or less:

CONDITION	<u>< 2kVA</u>	<u>2-5 Kva</u>	<u>> 5 kVA</u>
a. Unshielded power lines or electrical	6 in.	12 in.	24 in.

- | | | | | |
|----|---|--------|--------|--------|
| | equipment in proximity to open or non-metal pathways | | | |
| b. | Unshielded power lines or electrical equipment in proximity to open or non-metal pathways | 3 in. | 6 in. | 12 in. |
| c. | Power lines enclosed in a grounded metal conduit (or equivalent shielding) in proximity to grounded metal conduit pathway | 3 in. | 6 in. | 12 in. |
| d. | Transformers & Elec. Motors | 40 in. | 40 in. | 40 in. |
| e. | Fluorescent Lighting | 12 in. | 12 in. | 12 in. |
- C. Install all cables in accordance with National, state and local codes and ANSI/TIA Standards, and BICSI methods.
1. Follow manufacturer’s guidelines and requirements for all cable termination.
- D. Permanently identify all system components following ANSI/TIA-606A “Administration Standard for Commercial Telecommunications Infrastructure” with identification format:
1. Identification: Provide permanent identification labels for outlets, faceplates and cables.
2. Each individual cable shall be labeled on both ends of cable terminations regardless of cable intended use. Labels must be machine printed with permanent black ink on laminated white label material. Contractors must check with appropriate school district personnel for appropriate labeling scheme. The intended format and labeling material must be approved by the school district Technology Department before labeling begins.

3.04 Testing

- A. Audio Visual Wiring
1. The contractor shall test all cables included in the harness for proper signal transmission based on manufacturer standards.
2. The contractor shall record and remove any cable that does not meet manufacturer standards and replace it with a correctly functioning cable.
3. The contractor shall demonstrate that the installed cables meet manufacturer standards for signal transmission prior to the job being considered complete.

3.05 As-Builts

- A. Accurate as-built drawings shall be provided in electronic and hard copy format.
1. Drawings shall accurately show and describe all cable routing and equipment location in redline format.

2. 3 copies of electronic (CAD) drawings shall be distributed on appropriate media: 1 to construction management, 1 to designers and 1 to the school district.
3. 3 hard copies of CAD drawings shall be plotted on full size sheets and test results of every installed cable have been given to the construction management for appropriate distribution.
4. Diagrams: The Contractor shall furnish three complete sets of operating instructions, including cable diagrams, and other information necessary for proper installation, operation and maintenance of the system components. As-built drawings of the system shall be supplied.

3.06 Acceptance

- A. The contractors work shall be considered complete after the following conditions have been met:
 1. Cable installation is complete and all cable runs have been tested and documented to be installed according to specifications and drawings.
 2. Equipment installation is complete and all functions have been tested and documented to function as designed and per the manufacturer's recommendations.
 3. All punch list items have been reconciled.
 4. All disturbed ceiling panels, fire stopping materials, covers, etc. have been properly reinstalled.
 5. All materials and trash have been removed from the site.
 6. A 2-Year Installers warranty has been given to a school district Technology representative.
 7. Submit Manufacturers Extended Warranty Application.

END OF SECTION

SECTION 27 41 00
SPECIALIZED A/V SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes

1. This section and associated drawings define audio and video systems for the gymnasium and cafeteria. The contractor shall provide all equipment, cables and components necessary for complete systems.
2. This section and associated drawings define audio and video systems for the culinary demo camera systems. The contractor shall provide all equipment, cables and components necessary for complete systems.
- 3.

1.02 SYSTEM DESCRIPTION AND SUMMARY

A. Audio / Video Systems

1. Gymnasium audio system shall include audio input locations, signal processing and switching, mixing distribution and amplification to speakers. The system shall be capable of analog and digital signal formats as well as zoning and zone combining. Wireless microphones and assistive listening devices shall be provided as part of the systems.
2. Cafe multi-input, mixing and multi-loudspeaker system shall be provided. The equipment rack shall contain the audio and video equipment and allow for presets or live mixing of various inputs. Loudspeakers shall be provided and placed as shown on the drawings. Clearly label and color code the master volume control for all functions. Wireless microphones and assistive listening devices shall be provided as part of the system.
3. Culinary Demo Camera multi-input, mixing and multi-output system shall be provided. The equipment rack shall contain the audio and video equipment and allow for presets or live control of various inputs. Clearly label and color code the components for all functions. Wireless microphones and assistive listening devices shall be provided as part of the system.
4. All stand-alone sound systems must have a call override from the Intercom/PA system in case of an emergency.
5. Hearing Assistance System - Provide a reinforcement system for the hearing impaired in the Gymnasium and Cafeteria. The hearing assistance system shall be an FM radio system that shall not limit operation to certain seats or areas of the room(s). Provide approximately 20-40 milliseconds of high-quality digital signal delay to help in the localization of the sound source.

B. Regulatory requirements

1. All work will conform to the National Electric Code and applicable local ordinances.

1.03 Submittals

- A. Comply with requirements of Division 0 and Division 1 - Submittals and as modified below.
- B. Product Data: Submit manufacturer's product literature, technical specifications and similar information for the following items demonstrating compliance with the specified requirements.
 1. Submit the shop drawings, product data and quality control submittals specified below at the same time as the package.
 2. Shop Drawings shall include the following items but are not limited to:
 - a. Digital and Analog Input Plates
 - b. Scalers
 - c. Processors
 - d. Mixers
 - e. Touch Panels
 - f. Controllers
 - g. Signal Extenders
 - h. Switchers
 - i. Display Devices
 - j. Input Sources
 - k. Sound coverage and pressure level diagram for each auxiliary sound system
 - l. Sound Amplifier
 - m. Sound Speakers
 - n. Sound Microphones
 - o. Sound Cabling and Wiring
 - p. Audio Visual cables and connectors
 - q. Communications outlets, faceplates, and accessories.
 - r. Wall outlets
 - s. Wire types
 - t. System wiring diagrams showing all connections.
 - u. Shop Drawings including all equipment locations.

- v. Associated equipment specifications and cut sheets.
 - w. Product data including catalog cut sheets, manufacturer's default specifications, user operation guides and a bill of materials.
 - C. Quality Control Submittal
 - 1. Submit the name, address and telephone number of the nearest fully equipped service organization.
 - 2. Submit a certificate of completion of installation and service training from the system manufacturer.
 - 3. Certificates
 - a. Manufacturer Certification: Submit certification from manufacturer of products to be installed under this contract certifying that Installer is authorized by manufacturer to install specified products.
 - b. Installer Experience Listing: Submit list of at least 5 completed projects as specified below in "Quality Assurance – Qualifications – Installer."
 - D. Contract Closeout Submittal: Comply with requirements of Division 0, including submission of operating and maintenance instructions as item in "Operation and Maintenance Data" manual described in that Section.
- 1.04 As-builts
 - A. All systems must have as-built drawings provided in electronic CAD and hardcopy format that clearly show all system components, wiring schemes and system interconnections.
- 1.05 Quality Assurance
 - A. All Work shall be installed in a first class, neat and workmanlike manner by skilled Technicians. The quality of the workmanship shall be subject to inspection and approval by authorized school system personnel. Any work found to be of inferior quality and/or workmanship shall be replaced and/or reworked until the approval of school system personnel is obtained.
 - B. Qualifications
 - 1. Installer
 - a. Must be qualified to cable, terminate, install and program the equipment specified in this Section, certified by manufacturer of products to be installed, and completed at least 5 installations of similar size, nature and complexity as specified for this project.
- 1.06 Warranty
 - A. Special Warranty: Provide manufacturer's system warranty against electrical or mechanical defects for two years from date of final acceptance.

1. System Assurance: The System Assurance shall cover the failure of the wiring system to support the application which it was designed to support as well as additional application(s) introduced in the future by recognized standards or user forums.
2. System Certification: Upon successful completion of the installation and subsequent inspection, the Authority shall be provided with a numbered certificate, from the manufacturing company, registering the installation.
3. In addition, the primary manufacturer of the Networked Communications and Event Management System will offer a 5-year warranty on all items they supply.

1.07 Training

- A. The installing contractor shall provide a minimum of 8 hours of training on system operation and managements as part of their scope of work.
 1. Additional hours shall be provided on a time and materials basis at the request of the owner.
- B. Installing contractor shall provide a video recording on a standard format DVD to the owner which includes training sessions.

1.08 Operation And Maintenance Manuals

- A. The installing contractor shall provide a minimum of two hardcopy and one electronic copy of all operation and maintenance manuals to the owner at project completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable manufacturers
 1. The auxiliary sound systems are based on Biamp, Shure, Extron, Listen, Crown, Lowell and other like reputable manufacturers.
 - a. Equipment substitutions must be submitted in writing to the design team for review and approval.
 - b. Any equipment not meeting the design criteria will be rejected at the contractor's expense.

2.02 MATERIALS

- A. PRODUCT OVERVIEW.

2.03 Auxiliary Sound Systems

- A. Main Gym Sound Equipment:
 1. Controlllers
 - a. Extron IPL Pro S6
 2. AV Switch

- a. 12 Port PoE Gigabit Switch
3. Mixer / DSP
 - a. Biamp TesiraFORTE DAN AI
 - b. Include all required cards.
4. Portable Mixer
 - a. Allen and Heath Zed10
5. XLR Input Plates
 - a. BTX Custom as needed.
 - b. RDL DD-BTN44
6. Amplifier
 - a. QSC CMX 2000Va
7. Loudspeakers
 - a. Atlas IED FS12T-66
 - b. Atlas IED FS12T-sub
 - c. Mount to structure and also include safety rigging.
8. Mounting Bracket
 - a. Per Speaker
9. Shunt Relay
 - a. Bogen VAR1
10. Logic box
 - a. Biamp Tesira Ex-Logic
11. Remote Controller
 - a. Crestron MC4 with ANT-EXT-5 Antenna and MTX-3 Remote
12. WAP
 - a. Crestron CEN-GWEXER
13. Hearing Assistance
 - a. Listen LS-54-072 Kit
14. Equipment Rack
 - a. Middle Atlantic SR-40-32 with locking, vented door

15. Door
 - a. Vented Door
16. Rack Shelf
 - a. Lowell US-214
17. Blank Panel
 - a. Lowell LE-193
18. Storage Drawer
 - a. Lowell UDP-414 (1)
19. CD/Bluetooth Player
 - a. Denon DN-300Z
20. Wireless Mics
 - a. Shure ULXS24/58 (2)
21. Antenna
 - a. Shure UA844SWB (2)
22. Hand Held Mic
 - a. Shure SM58 (2)
23. 25' Mic Cable
 - a. ProCo SMM25 (2)
24. Mic Stands
 - a. Ultimate MC-05B (2)
25. MPC Input
 - a. Whirlwind Isopod
26. Direct box
 - a. Whirlwind PCDI (1)
27. Power Sequencer
 - a. SurgeX SEQ
28. Cables
 - a. 18/2 AWG Speaker Wire (minimum, increase gauge as needed)
 - b. XLR Mic Cables

- c. Cat 6 UTP
- B. Cafeteria:
 - 1. Controller
 - a. Biamp TEC-1s
 - 2. AV Switch
 - a. 12 Port PoE Gigabit Switch
 - 3. Wireless Access Point
 - a. Crestron CEN-GWEXER
 - 4. Mixer / DSP
 - a. Biamp TesiraFORTE DAN AI
 - b. Include all required cards.
 - 5. XLR Input Plates
 - a. BTX Custom as needed.
 - b. RDL DD-BTN44
 - 6. Amplifier
 - a. Crown CDi 1000
 - b. Crown XLC 12300
 - 7. Loudspeakers
 - a. JBL CBT1000 + CBT1000E
 - b. JBL V2-215S
 - c. Mount to structure and also include safety rigging.
 - 8. Mounting Bracket
 - a. JBL
 - 9. Shunt Relay
 - a. Bogen VAR1
 - b. Biamp Ex-Logic
 - c. Atlas AA-PPRC
 - 10. Controller
 - a. Crestron MC4 with ANT-EXT-5 Antenna and TSR-310 Remote
 - 11. Hearing Assistance

- a. Listen LS-54-072 Kit
- 12. Equipment Rack
 - a. Middle Atlantic SR-40-32 with locking, vented door
- 13. Door
 - a. Vented Front Door
- 14. Rack Shelf
 - a. Middle Atlantic vented
- 15. Blank Panel
 - a. Middle Atlantic 1RU and 2RU
- 16. Storage Drawer
 - a. Lowell UDP-414 (1)
- 17. Line Level
 - a. RDL STACR-2 (1)
- 18. Power Supply
 - a. RDL PS-24AS (2)
- 19. Line Level Transformer
 - a. RDL TX-70A (1)
- 20. CD/Bluetooth Player
 - a. Denon DN-300Z
- 21. Wireless Mics
 - a. Shure ULXD24/58 (2)
- 22. Antenna
 - a. Shure UA844SWB (2)
- 23. Hand Held Mic
 - a. Shure SM58 (2)
- 24. 25' Mic Cable
 - a. ProCo SMM25 (2)
- 25. Mic Stands
 - a. Ultimate MC-05B (2)

- 26. MPC Input
 - a. Whirlwind Isopod
- 27. Direct box
 - a. Whirlwind PCDI (1)
- 28. Power Sequencer
 - a. SurgeX SEQ
- 29. Cables
 - a. 18/2 AWG Speaker Wire
 - b. XLR Mic Cables
 - c. Cat 6 UTP
- C. Demo Camera System
 - 1. Camera
 - a. Legrand Roboshot 12E Camera
 - b. Legrand Roboshot 12E QDVI DVI/HDMI SR (QDVI)
 - 2. Remote control
 - a. Vaddio IR Remote
 - b. Extron TLP Pro 525M
 - 3. HDMI Distribution Amp
 - a. Extron HDMI DA6 HD 4K
 - b. Or approved equal with up to 8 HDMI outputs.
 - 4. Control Processor
 - a. Extron IPCP 505
 - 5. 55” LED
 - a. NEC 55” 4k LED with ceiling mount
 - 6. Sound System
 - a. Lightspeed 975
 - b. Lightspeed Mic
 - c. Lightspeed Ceiling Speakers
 - 7. Wiring
 - a. Extron HDMI Pro series

- b. Cat 6 or greater.

PART 3 - EXECUTION

3.01 Examination

- A. Verification of Conditions: Examine conditions under which telecommunications cabling and equipment and related components are to be installed in coordination with Installer of materials and components specified in this Section and notify affected Prime Contractors and Design consultant in writing of any conditions detrimental to proper and timely installation. Do not proceed with installation until unsatisfactory conditions have been corrected to ensure a safe and timely installation.
1. When the installer confirms conditions as acceptable to ensure proper and timely installation and to ensure requirements for applicable warranty or guarantee can be satisfied, submit to Design consultant written confirmation from applicable Installer. Failure to submit written confirmation and subsequent installation will be assumed to indicate conditions are acceptable to the installer.
 2. Visit Site to identify and become familiar with existing field conditions and specific requirements of each Site.
 3. Verify all dimensions in field and confirm condition of existing hardware to be utilized.
 4. Confirm space requirements and physical confines of all work areas to ensure that all materials can be installed in indicated spaces.
 5. Confirm all device locations and cable pathways and advise Design consultant in writing of any discrepancies or issues in Design described in Contract Documents.

3.02 Preparation

- A. Protection: Provide adequate protection of equipment and hardware before and after installation.
- B. Existing Communications Services: Ensure all telecommunications systems (voice, video and data) remain operational throughout the project.
1. Identify any additional intercom equipment, devices, and wiring at the site not shown on T-Drawings and interfering with installation of specified equipment.
 2. Remove all accessible portions of abandoned communications cabling per NEC 800.52. Tag all communications cabling not terminated at both ends but retained for future use.

3.03 Installation

- A. Provide and install all components necessary to install complete intercom/PA/master clock system, including (but is not limited to) cable, connectors, patch panels, call switches, speakers, etc...
- B. Secure all horizontal cables within ceiling cavities to the building structure.

1. Loosely bundle all cables and support from structure at unequal intervals from 5 to 6 feet with spring steel fasteners and cable clip rated for use with high performance cables (similar to Caddy Series “CableCat” or approved alternate mounting methods) including placement in cable tray as indicated on Drawings. All mounting clips shall be seismic type as per BOCA.
 2. Do not violate manufacturer’s recommended loadings. Leave 30% capacity for future use of pathway.
 3. Verify all horizontal cable run lengths prior to installation. Re-distribute horizontal cabling to maintain distance requirements and maintain pathway route accessibility.
 4. Do not support cables from ceiling grid T-Bars, grid wire supports or bridle rings.
 5. Do not allow cables to touch the ceiling grid.
 6. Install cables in EMT conduit in all unfinished, exposed areas as shown in Design consultant roof plans and/or T-Drawings, unless alternate pathways are noted.
 7. Do not secure cables with permanent cable ties. Do not tighten cable bundles in such a way as to cause jacket deformation or damage.
 8. Place cables in compliance with ANSI/TIA-568.B standards and BICSI recommended methods.
 9. Re-terminate and re-test any cables or pairs of cables failing end-to-end testing requirements. Replace any faulty cables/pairs or termination devices. Remove all defective cables completely from pathways.
- C. Install all exposed cabling in surface raceway by Wiremold, Hubbell or Panduit where in-wall conduit has not been provided. Follow all manufacturers’ guidelines requirements regarding bending radius and slack. All bends, offsets and fittings shall be appropriately sized to provide 30% capacity after installation.
- D. Install all cable in accordance with National, state and local codes and ANSI/TIA Standards, and BICSI methods.
1. Follow manufacturer’s guidelines and requirements for all cable termination.
 2. Follow detail drawings to locate equipment racks and cabinets. Where it is necessary to deviate, to obtain 30-inch clearance between equipment, obtain Design consultant’s written approval before mounting cabinet/rack.
 3. Ladder-type cable tray shall be affixed 6 inches above all data racks and equipment cabinets, and routed to all points of entry into each telecommunications room.
 - a. Include transition to proper height for penetration into hallway or other wall penetration as indicated on Drawings.
 - b. Install sufficient 4-inch conduits from telecom rooms into hallway (minimum of 2) with protective insulating bushings, cable spillway or specially designed cable tray sections, with appropriate firestop materials.
- E. Properly terminate all cables at speakers, call switches, administrative consoles and distribution racks. Permanently identify all cables in pullboxes, transition points, and

termination points by affixing pre-marked self-adhesive wraps similar to Brady “B-500+ Plastic Cloth Markers.”

- F. Permanently identify all system components following ANSI/TIA-606A “Administration Standard for Commercial Telecommunications Infrastructure” with identification format:
 - 1. Identification: Provide permanent identification labels for end devices and associated cabling at each end.

3.04 Testing

- A. Audio Visual Equipment
 - 1. The contractor shall test all equipment for proper signal transmission based on manufacturer standards.
 - 2. The contractor shall record and remove any cable that does not meet manufacturer standards and replace it with a correctly functioning cable.
 - 3. The contractor shall demonstrate that the installed cables meet manufacturer standards for signal transmission prior to the job being considered complete.
- B. Sound Equipment
 - 1. The contractor shall test all aspects of the sound system once it is installed and demonstrate these functions to the owner or owner’s representative.
 - a. Speaker levels shall be verified to function individually and as a unit.
 - b. Microphones shall be demonstrated to work as intended by the manufacturer.

3.05 Acceptance

- A. The contractors work shall be considered complete after the following conditions have been met:
 - 1. Cable installation is complete and all cable runs have been tested and documented to be installed according to specifications and drawings.
 - 2. Equipment installation is complete and all functions have been tested and documented to function as designed and per the manufacturer’s recommendations.
 - 3. All punch list items have been reconciled.
 - 4. All disturbed ceiling panels, fire stopping materials, covers, etc. have been properly reinstalled.
 - 5. All materials and trash have been removed from the site.
 - 6. A 2-Year Installers warranty has been given to a school district Technology representative.
 - 7. Submit Manufacturer’s Warranty Application.

END OF SECTION

SECTION 2 11
AUDIO VIDEO SYSTEMS

PART 1 GENERAL

1.01 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 Audio / Video System Contractor (AVC) shall be responsible for all labor, equipment, material, and procedures required for the supply, fabrication, installation, commissioning, and warranty of the Audio / Video System (AV) as specified herein and on the AV Contract Drawings, including design and engineering responsibilities, and submission for review of shop drawings, reports, samples, and mock-ups. Detailed descriptions of these requirements are included in “Part 1 - General” and “Part 3 - Execution”.
- C. Requirements Included:
 - 1. The scope of work of this Section shall include, but not necessarily be limited to, the following systems, equipment, material, arrangements, and procedures as indicated and specified herein for:
 - a. All labor, equipment and materials.
 - b. Supply nonstandard back boxes and floor-boxes for installation by Electrical Contractor except where noted.
 - c. Termination of all AV equipment racks.
 - d. Provide supplemental conduit, junction/pull boxes, fittings, and electrical hardware, as required for connection of Sound equipment to the Sound empty conduit system as supplied by Electrical division.
 - e. All wire, wire pulling, and termination.
 - f. All tools and measuring & testing equipment required for installation.
 - g. Daily and final cleanup.
 - h. Shop drawings, samples and mock ups, as built documentation, and operating manual.
 - i. Testing and adjustment, interim shop inspection, initial test report, final site inspection, final test report, and demonstration and instruction.
 - j. Guarantee and warranties, and maintenance and service contract.
- D. Audio / Video System:
 - 1. See detailed description of the following system and specific information about the equipment, components, and material in “Part 2 Products”:
 - a. Audio / Video System: Permanent Audio / Video System, including speech and music reinforcement, archival audio & video recording, music, effects, and prerecorded tracks processing and playback and stage monitor/foldback, utilizing the following subsystems:
 - b. Permanent loudspeaker positions, including rigging points, and cable management.
 - c. AV equipment racks, including appropriate cabinetry.
- E. Related Requirements:
 - 1. The following systems, equipment, material, arrangements, and procedures are not included in the scope of work of this Section. Coordinate all work of this Section with the work specified in other sections (exceptions as noted):
 - a. A complete, pull-ready conduit system for installation of Audio / Video System wiring and devices—including all conduit and raceway, junction/pull boxes, standard back boxes, terminal cabinets and “pull group” boxes, fittings, drag line (pull line), electrical hardware, etc. (Electrical Contractor).

- b. Electrical power service—including transformers, feeder cable, distribution panels, branch circuit panelboards, and individual wall receptacles (Electrical Contractor).
- c. Audio / Video System “Audio / Video System” isolated ground AC power network (Electrical Contractor). Note: inter-rack AC power wiring, shall be the responsibility of the SC. Single-point termination to the racks shall be conducted on-site by the EC.
- d. Loudspeaker suspension points
- e. Equipment rack room (including lighting, furnishings, and finishes) (various Trades).
- f. Painting and finishing (except as noted below for Audio / Video System equipment).
- g. House telephone, data, life safety, fire alarm, and security systems (Electrical Contractor).

F. Definitions

- 1. In addition to the definitions in the General Conditions, the following also apply to this Section:
 - a. The term “Consultant” refers to Stages Consultants.
 - b. The terms “Audio / Video System Contractor”, “this Contractor”, “AVC” as used in this specification refer to that contractor directly responsible for supply and installation of the Audio / Video System.
 - c. The terms “engineer” and “engineering” as used in this specification refers to the interpretation, organization, and execution of the design of the Audio / Video System as provided in the Contract Documents.
 - d. The term “supply” as used in this specification indicates that the Audio / Video System Contractor shall supply, free issue, including instruction and supervision for installation by others, such equipment, components, and material of the Audio / Video System so as to fulfill the intent of the Contract Documents.
 - e. The term “provide” as used in this specification indicates that the Audio / Video System Contractor shall supply, fabricate, install, and make operable such equipment, components, and material of the Audio / Video System so as to fulfill the intent of the Contract Documents.
 - f. The terms “preapproved equivalent” and “or as approved” as used in this specification indicate that acceptance shall be obtained from the Consultant. Refer to “Product Substitution” below.
 - g. The terms “NIC” or “not in contract” as used in this specification indicate an item or system that shall be furnished under another contract. Preparation for the future inclusion of such an item or system shall be limited to the extent outlined in the Contract Documents.
 - h. The terms “OEM” or “original equipment manufacturer” or “manufacturer” as used in this specification refer to a direct supplier to the Audio / Video System Contractor.
 - i. “UON” denotes “unless otherwise noted.”
 - j. “AFF” denotes “above finished floor.”
 - k. “U” denotes “rack unit,” as in “10U” to denote 10 standard 44mm (1.75”) rack units, for a total of 440mm (17.5”) of rack space.

PART 2 PRODUCTS

	<i>description</i>	<i>mfr</i>	<i>model</i>	<i>qty</i>
A	<i>Permanent Loudspeaker/dDSP/Amplifier</i>			
1	Loudspeaker - Center Upper	d&b audiotechnik	Yi10P Z0713.001	1
2	Loudspeaker - Center Lower	d&b audiotechnik	E12-D Z0602.001	1
3	Loudspeaker - Left & Right	d&b audiotechnik	E12-D Z0602.001	2
4	Loudspeaker - Subwoofer	d&b audiotechnik	Bi6-SUB Z0711.001	1
5	Loudspeaker - MP Rooms	d&b audiotechnik	E12 Z0601.001	4
6	Loudspeaker - Small Monitor	d&b audiotechnik	E6 Z0350.001	4
7	Horizontal Bracket for Yi10P	d&b audiotechnik	Z5398.000	1
8	Horizontal Bracket for E12-D	d&b audiotechnik	Z5353.000	5
9	Flying Bracket for E-12D	d&b audiotechnik	Z5352.000	2
10	Horizontal Bracket for Bi6-SUB	d&b audiotechnik	Z5389.000	1
11	4-Channel Power Amplifier/DSP - 10D	d&b audiotechnik	Z2760.500	3
12	4-Channel Power Amplifier/DSP - 5D	d&b audiotechnik	Z2880.000	1
13	Custom #12 NL2 Cables for Permanent Loudspeakers	Whirlwind	\$500 Allowance	1
	Custom #12 NL2 Cables for Montior Loudspeakers	Whirlwind	\$500 Allowance	1
14	Miscellaneous Rigging Materials incl Safeties for all Loudspeakers	Custom	\$250 Allowance	1
B	<i>Mixing System and Multipurpose Room Control</i>			
1	64x64 Audio Matrix Processor	Allen & Heath	AH-AHM-64	1
2	48 Channel/ 36 Bus Digital Mixer	Allen & Heath	AH-SQ-5	1
3	Dante Network Interface Card	Allen & Heath	AH-M-SQ-SDANTE64-A	2
4	16 XLR Input/ 8 XLR Output Dante Expander	Allen & Heath	DT168	1
5	8-Fader Remote Controller for AHM-64	Allen & Heath	AH-IP-8	1
6	7" Custom Control Touch Panel	Allen & Heath	AH-CC-7	2
7	Rack Mount Kit for SQ-5	Allen & Heath	AH-SQ-5-RK-19	1
8	16u Portable Rack w/ 13u Mixer Top	ProX	T-16MRSS13ULT	1
9	3u Rack Drawer	Middle Atlantic	D3	3
10	iPad Air, 64GB, Wifi, w/ Smart Folio	Apple	iPad Air 64GB wifi	1
11	EtherCon Cable- 25'	Whirlwind	ENC6ASE025	6

C Wireless Microphones				
1	UHF Digital 2 Ch Wireless Receiver w/Dante	Sennheiser	EW-DX EM 2 DANTE	1
2	UHF Digital Handheld Transmitter	Sennheiser	EW-DX SKM-S	2
3	Handheld Microphone Module	Sennheiser	MMD 835-1 BK	2
4	UHF Digital Bodypack Transmitter	Sennheiser	EW-DX SK	2
5	Clip-on Microphone w/ Cardioid Pattern	Sennheiser	MKE 40-EW	2
6	Passive, Directional Antenna	Sennheiser	ADP-UHF	2
7	EW-D Charging set, Incl 70N charger, 2 BA70 batteries	Sennheiser	EW-DX CHARGING SET	1
8	Miscellaneous Rigging Materials for Antenna Mounting	Sennheiser	\$200 Allowance	1
D Wired Microphones and Direct Boxes				
1	Handheld, dynamic Microphone	Shure	SM-58LC	4
2	Handheld, dynamic Microphone w/switch	Shure	SM-58S	1
3	Dynamic Instrument Microphone	Shure	SM-57LC	2
4	Condenser Instrument Microphone, cardioid	Shure	SM-81LC	4
5	Condenser Recording Microphone, cardioid, Matched Pair	Neumann	KM 184-MT-STEREOSET	2
6	Drum Microphone Kit	Shure	DMK57-52	1
7	Miniature Omni Instrument Kit, incl XLR adapter	DPA	4099-DC-101-U	2
8	Direct Box, Jensen, single-ch	Radial	JDI	2
9	Direct Box, Jensen, PC/iPod	Radial	JPC	1
10	Instrument Cable, 10'	Whirlwind	SN10	2
11	iPod Cable, 3.5mm Stereo>2x M-XLR, 6'	Whirlwind	MST2XM06US	2
E Microphone Stands				
1	Microphone Stand, Round Base, Black	K&M	260/1	4
2	Microphone Stand, One-hand clutch, stackable, Black	K&M	26075	6
3	Microphone Stand, Tripod w/ Boom, Black	K&M	210/8	4
4	Microphone Stand, Short, Round Base, w/ Boom, Black	K&M	25960	2
5	Microphone Boom Arm	K&M	211/1	1
6	Microphone Clamp	K&M	238	4
7	Microphone Holder	K&M	240/5	4
8	Microphone Desk Stand, Black	Atlas	DS7E	6
9	Microphone Stand Crate	Custom	\$500 Allowance	1
F Microphone Cable				
1	Microphone Cable, Canare/Neutrik, 10'	Whirlwind	MK410NP	5
2	Microphone Cable, Canare/Neutrik, 25'	Whirlwind	MK425NP	15
3	Microphone Cable, Canare/Neutrik, 50'	Whirlwind	MK450NP	10

G Wired Intercom				
1	Intercom 2 Channel Power Supply	Clear-Com	PS-702	1
2	2 Channel Beltpack	Clear-Com	RS-702	6
3	2-Channel Speake Station	Clear-Com	KB-702	2
4	Desk Mount for 2-Channel Speaker Station	Clear-Com	U-Box-X6	2
5	Lightweight Intercom Headset	Clear-Com	CC110-X4	8
H Wireless Intercom				
1	1.9GHz Wireless Intercom System, 8 Users incl. Headsets	Hollyland	SOLIDCOM M1-8B	1
I Assistive Listening System				
1	FM Assistive Listening System, w/transmitter, 4 receivers, 12-unit Charging Tray	Listen	LS-71-072	1
2	Receiver, digital	Listen	LR-5200-072	4
3	Ear Buds	Listen	LA-161	4
5	House Microphone	Shure	VP82	1
J Equipment Rack, Portable Storage Cabinet				
1	Equipment Rack - Backstage	MiddleAtlantic	BGR-4532	1
2	Rack Top, vented	MiddleAtlantic	BGR-LVT	1
3	Side Panels - Pair	MiddleAtlantic	BSPN-45-32	1
4	Rear Rails	MiddleAtlantic	FWD-BGR-RR45	1
5	24 Outlet Power Strip	MiddleAtlantic	PD-2420SC-NS	1
6	Modular Power Raceway-56"	MiddleAtlantic	MPR-6A	1
7	Junction Box for MPR Series Raceway	MiddleAtlantic	MPR-JB863a	1
8	20Amp Controlled Power Module - Isolated Ground	MiddleAtlantic	RLM-20IGA	3
9	20Amp Always On Power Moudule - Isolated Ground	MiddleAtlantic	M-2X20IGA	1
10	6 Channel Sequencer	MiddleAtlantic	MPR-SEQA	1
11	Remote Power Switch Decora Mount	MiddleAtlantic	S-DEC	1
12	1u Decora Device Panel for 1 Device	MiddleAtlantic	DECP-1X1	1
13	Cable Lacer Bars - 10pk	MiddleAtlantic	LBP-2A	1
14	1sp Rack Vent Panel	MiddleAtlantic	EVT1	4
15	1sp Brush Panel	MiddleAtlantic	BR1	5
16	Rack Panel Screws	MiddleAtlantic	HP500	1
17	Internal Rack Work Light	MiddleAtlantic	WL-60	1
18	Rack Mount Power Conditioner	Furman	PL-PRO C	1
19	XLR Patch Cables - 2'	Whirlwind	MK402NP	12
20	EtherCon Patch Cable - 18"	Whirlwind	ENC6ASE020	1
21	TechFlex, 1.25"-2.75" expandable tubing	TechFlex	PET8-50-BK	2
22	Cable Management, in rack, vertical cable tray	Hellerman, equal	2x2, 3x3	2

K Networking				
1	Network Router/Wifi Access Point	Netgear	SXR80	1
2	24 Port L3 Network Switch M4250 series(Booth)	Netgear	GSM4230P	1
4	12 Port L3 Network Switch M4250 Series (Dante)	Netgear	GSM4212P	2
L Custom Panels, Patch Cables				
1	Custom Panel, laser-etched, black aluminum	WW Custom	C11, C12	2
2	Custom Panel, laser-etched, black aluminum	WW Custom	C13, C14, C16, C17	4
3	Custom Panel, laser-etched, black aluminum	WW Custom	C15, C18, C19	6
5	Custom Panel, laser-etched, black aluminum	WW Custom	PRJ PANEL	1
8	Custom Panel, laser-etched, black aluminum	WW Custom	A2 PANEL	1
9	Custom Panel, laser-etched, black aluminum	WW Custom	ANT PANEL	3
10	Custom Panel, laser-etched, black aluminum	WW Custom	S1 PANEL	7
11	Custom Panel, laser-etched, black aluminum	WW Custom	S2 PANE,	1
12	Custom Panels, Patch Panels	WW Custom	AUDIO TIE LINES	2
13	Custom Panels, Patch Panels	WW Custom	AHM64 Input Panel	1
14	Custom Panels, Patch Panels	WW Custom	S-Link Drive Patch Panel	1
15	24 Port CAT6A Shielded Patch Panel	Leviton	4S255-H24	2
M WUXGA Projection System and Screen				
1	14,000 Lumen WUXGA LCD Projector	Panasonic	PT-MZ14KL	1
2	2.10-4.14:1 Long Throw Zoom Lens	Panasonic	ET-EMT700	1
3	Large Venue Projector Mount	Chief	VCT	1
4	Large Venue Vibration Iso Coupler	NIGEL-B	NB-UI-M-60	1
5	162"x260" Electric Roll Down Screen. With 34"Drop	Draper	Paragon E p/n:114229	1
6	Low Voltage Control Module for Screen	Draper	LVC-IV p/n:121233	1
7	3-Button Control Station for Screen	Draper	LVC-S p/n:121225	1
8	4K/UHD 6 Input Multi-Format Switcher	Atlona	AT-OME-PS62	1
9	1-Gang HDMI & USB-C Wall HDBaseT Transmitter	Atlona	AT-OME-EX-TX-WP	1
10	Portable HDBaseT Transmitter	Atlona	AT-OME-EX-TX	1

N	<i>Raw Wire - Estimated Quantities</i>			
1	A1 - Microphone cable, 1pr - 1000'	Belden	9451	0.25
2	A2 - Microphone cable, 2pr - 500'	Belden	1509C	1
3	A4 - Microphone cable, 4pr - 1000'	Belden	1510C	1
4	D2 - 50ohm RG-8/U Coaxial Cable - 1 Foot	Belden	9913	200
5	D3 - 4x23 AWG Twisted Pair, CAT6A, Foil Shield - Plenum Rated -1000'	West Penn	254346AF	6
6	D4 - 4x20 AWG Stranded Copper w/ PVC Jacket - 500'	West Penn	242	0.5
7	E1 - 20 AWG Twisted Pair, Mylar Shield - 1000'	West Penn	292	2
8	F1 - 2x 12 AWG Stranded Copper w/ PVC Jacket - 1000'	Belden	5000UP	1.5
9				
10	LOT, Pre-made Cables for all Interconnect	Custom	\$1,000 Allowance	1
11	LOT, Pre-made Cables for all Patching	Custom	\$500 Allowance	1
12	Misc Wiring and Rigging Hardware	Custom	TBD	1

PART 3 EXECUTION

3.01 QUALITY ASSURANCE AND WORKMANSHIP

- A. The Audio / Video System Contractor shall follow good working practices and fabricate and install items in accordance with the manufacturer's recommendations and the Consultant's specifications. Provide quality control procedures acceptable to the Owner and Consultant. Provide a properly qualified site supervisor who shall carry out supervision duties only. Provide straight, plumb, true and aligned components throughout, and shall consult with other trades doing related work and adjoining work in order to provide an installation of first-class quality.
- B. The Consultant reserves the right to reject any part of the installation not in compliance with the Contract Documents. The Audio / Video System Contractor shall carry out any necessary remedial work or replacement free of charge and without delay to the Owner.
- C. A standard reference guide for the design, engineering, and installation of the Audio / Video System shall be Audio System Design and Installation, by Philip Giddings (Sams Publishing).

3.02 DEFINITIONS

- A. Electrical Reference:
 1. The following electrical references are used throughout the Audio / Video System specification:
 - a. Voltage: dBv $20\log(E1/E2)$
 - b. Power: dB $10\log(P1/P2)$
 - c. 0dBu 0.775VRMS; ratio of voltages measured open circuit
 - d. 0dBv 0.775VRMS; ratio of voltages measured open circuit
 - e. 0dBV 1.0VRMS; ratio of voltages measured open circuit
 - f. 0dBm 1mW; power level (typically 0.775V into 600-ohm load)
 - g. 0VU 4dBm; power level referenced to 600 ohms
- B. Electrical Characteristics:

1. Unless otherwise specified in the Contract Documents, electrical characteristics of the Audio / Video System equipment shall be as follows:
 - a. Microphone preamplifier inputs shall be balanced, have an impedance greater than or equal to 1.2k ohms, and designed to be driven from sources of 600 ohms or less.
 - b. Line inputs shall be balanced bridging, have an impedance greater than or equal to 10k ohms, and designed to be driven from sources of 10k ohms or less.
 - c. Line outputs shall be balanced, have an impedance less than or equal to 100 ohms, and designed to drive loads of 600 ohms or greater.
- C. Connector Polarity: Proper polarity of connectors on combination panels, receptacle plates, rack panels, patch panels, and other devices fabricated and/or wired by this Contractor shall be established as follows: Polarity of connectors for OEM devices and equipment may be different, and should be wired to patch panels so as to maintain consistent system polarity.
 1. Microphone and Line Level
 - a. Balanced Connection

XLR-3 connectors: pin 1 ground/shield (do not connect to case); pin 2 high (“hot”); and pin 3 = low (“cold”).

¼” T/R/S phone connectors: sleeve = ground/shield; ring = low (“cold”); and tip = high (“hot”).
 - b. Unbalanced Connection

XLR-3 connectors: pin 1 ground/common/shield (do not connect to case); pin 2 high (“hot”); and pin 3 = tie to pin 1 only.

¼” T/S phone connectors: sleeve = ground/common/shield; and tip = high (“hot”).

Phono (RCA) connectors: sleeve or shell ground/common/ shield; and center pin high (“hot”).
 2. Multiconductor Application
 - a. Multipin connectors: Refer to the manufacturer’s specifications.
 3. Data Connection
 - a. RJ45 connectors: Refer to the manufacturer’s specifications.
 4. Video and RF Level
 - a. BNC-type connectors: sleeve or collar ground/shield; and center pin signal (“hot”).
 5. Low Impedance Loudspeaker Level
 - a. Neutrik NL4 series connectors used for bi-amplified or passive (mono-amplified) Audio / Video System loudspeakers: pin “1+” = Low frequency or full-range driver “+”; pin “1-” = Low frequency or full-range driver “-”; pin “2+” = High frequency driver “+”; pin “2-” = High frequency driver “-”.
 - b. Neutrik NL4 series connectors used for 70.7 volt lines: pin “1+” = high (“hot”); pin “1-” = N/C; pin “2+” = N/C; and pin “2-” = low (“common”).
- D. Transducer Polarity: Proper polarity of electro-acoustic transducers shall be established as follows, with exceptions as noted:
 1. Microphone
 - a. Positive acoustic pressure on the microphone diaphragm produces a positive voltage on pin 2, with respect to pin 3 of the output connector.
 2. Loudspeaker

- a. Positive voltage applied to the () terminal produces a displacement of the loudspeaker cone away from the magnet, thus producing a positive acoustic pressure.

3.03 INSTALLATION

A. General:

1. All equipment except portable equipment shall be securely held in place with a safety factor of at least three; except that all equipment rigged overhead shall be so done using safe rigging practices and with rated hardware selected to meet a safety factor of at least ten. All equipment shall be installed in such a fashion as to present no safety hazard to operating personnel.
2. All equipment shall be adequately ventilated when operating under worst-case power dissipation.
3. All metal cabinets connected to the Audio / Video System audio ground network shall be effectively isolated from any conduit or other metallic component that is connected to the building electrical safety ground.
4. All installation work shall be carried out in a neat and orderly fashion.

B. Wiring:

1. Ensure by drawing review and field survey that the conduit/raceway infrastructure is sufficient for the proper installation of the specified and required wire and cable, and/or any approved-substitute types of wire and cable.
2. Do not begin pulling Audio / Video System wiring through the Audio / Video System Empty Conduit System until all conduit, pull boxes, etc. for each given run (point-to-point) are completely installed by the Electrical Contractor and ready for such wire and cable installation. Undertake a field inspection of the conduit system and pull boxes, reporting any missing conduit, sharp edges, missing bushings or drag lines, blocked runs, etc., prior to attempting installation of wire and cable.
3. The Audio / Video System Contractor shall ensure that the wire and cable is installed in a manner that shall neither cause nor permit damage to the wire and cable throughout the installation process. Damaged wire and cable (including wire and cable spliced in violation of specified requirements) shall be rejected and replaced by this Contractor at no cost to the Owner.
4. All microphone level, line level, video/RF level, Data level, low impedance loudspeaker level, and AC power level wiring shall be restricted to individual and separate conduit systems.
5. All microphone and line level wiring shall be balanced and floating, unless otherwise indicated.
6. Take all necessary precautions to prevent electromagnetic, electrostatic, and radio frequency interference.
7. Care should be taken in wiring and installation to prevent damage to wire or equipment. All wire entering racks or other equipment shall have a service loop of at least four (4) feet unused (slack) length after termination. This service loop shall be neatly bundled and harnessed in place.
8. No splices shall be allowed in microphone, line level, video/RF or data cables unless it is physically impossible to install the wire in one length. Splices must be approved by the Consultant on a case-by-case basis. When approved, the following splicing methods may be used:
 - a. Crimp-type “butt” splice connectors with an appropriately sized shrink tube for each conductor, as well as an overall shrink tube for all audio and intercom cable types.
 - b. Female BNC “barrel” connectors for video/RF cable. Male BNC connectors shall be provided on cable ends at location of the splice.

- c. Female 8P8C (commonly known as RJ45) “barrel” connectors for Data cable. Male 8P8C connectors shall be provided on cable ends at the location of the splice.
- d. Splices in loudspeaker cable are permitted without prior approval by the Consultant. Such splices shall be kept to a minimum.
- e. Any splices made shall occur only at junction boxes, pull boxes or other permanently accessible locations. Such splices shall be listed on a schedule provided with the as-built documentation.

C. Flexible Cords and Cables:

- 1. Flexible cords used shall be selected giving consideration to ambient and conductor temperatures, wear-resistance, flexing, and mechanical stress. Vulcanized rubber, butyl rubber, EP, or silicone rubber insulated cables shall be used in preference to PVC insulated types, wherever possible. All flexible cords and cables shall comply with the current edition of the applicable local Electrical Codes and appropriate regulations as identified in “Part 1 - General: Safety and Code Requirements”.
- 2. Flexible cables used as hanging or trailing leads, for power or control circuits, shall comply with the previous clause and shall, if under tension, be fitted with a strain-relief center core that shall be clamped at both ends to relieve the strain on conductors. Trailing leads shall be of a suitable length for the actual application.
- 3. The segregation of conductors carrying different category circuits shall be as defined in the applicable regulations (local, state and national Electrical Codes and elsewhere herein) and shall be maintained in all flexible cables used. Adequate insulation shall be ensured on all multicore and control circuits.
- 4. Where the final connection to any equipment is by means of a flexible cable, such flexible cable shall have the same current rating as the rest of the circuit. The current ratings for the ambient temperature shall be as given in the applicable local Electrical Code.

D. Labeling and Marking:

- 1. All Audio / Video System wire and cable shall be logically and permanently marked by the Audio / Video System Contractor. All wire shall be identified at each termination point, and shall be marked to indicate the discrete destination (i.e., a wire shall show the reference number of the jack or connector to which its other end is terminated). All cable markers shall bear the alphanumeric characters of the circuit shown on the approved shop drawings.
- 2. Wire and cable shall be marked with an approved system of durable identification markers, such as slip-on type PVC or neoprene sleeves, or with directly heat stamped characters. The use of computer-generated labeling systems, such as the Brady DAT-34 or DAT-37, is recommended. Cloth, vinyl or P-Touch tape-type markers are not acceptable.
- 3. The individual pairs of multipair cable and individual conductors of multiconductor cable shall be readily identified by permanent color coding of the wire insulation. Multipair or multiconductor cable that is identified only by means of the form or order of lay of individual wire is not acceptable.
- 4. All spare wire shall be marked “spare” at both ends and numbered consecutively. A “spare schedule” shall be provided indicating spare wire and cable numbers, locations and types.

E. Termination:

- 1. All connections and joints shall be made with rosin-core solder or an approved mechanical connector.
- 2. All multipin connectors shall have crimp-type gold-plated contacts.
- 3. All Contactor-terminated data cables & connections must be “certified” using industry-standard testing and verification equipment.

4. Where flexible cable joins fixed wiring the terminations shall be accomplished with either a pair of appropriate mating connectors or a suitable terminal block.
 5. All terminations of shielded cables shall consist of a PVC or neoprene heat shrink sleeve covering the shield drain wire and an overall PVC or neoprene heat shrink sleeve covering the point at which the cable jacket and shield end.
- F. Audio Grounding:
1. All shielded cables shall have their shields isolated from both the conduit system and any other shielded cables. Shields shall be continuous from source to input points. Shields shall be connected at input points only, with shields lifted at the source, except as noted below.
 2. Microphone wiring shall have continuous shields from the microphone receptacle to microphone patch jack.
 3. Tie-line patch points shall have continuous shield connection from one patch jack to another with no permanent connection to the audio ground network.
 4. Unbalanced wiring, such as used in certain communication systems, shall have audio shields connected at device inputs and floated at device outputs. Strap shield to “low” side of unbalanced input.
 5. No “doubling up” of ground points on multipin connectors or terminal blocks shall be allowed.
- G. AC Power System:
1. AC power for the Audio / Video System, provided by the Electrical Contractor, is distributed at 120VAC, 60Hz. Refer to the electrical plans for further information.
- H. Grounding:
1. The Audio / Video System audio ground network (“audio ground”), including ground source, ground conductors, and ground distribution points is provided by the Electrical Contractor. The isolation and ground continuity of this network, although the responsibility of the Electrical Contractor, shall be confirmed by the Audio / Video System Contractor prior to installation of equipment. Any ground shorts or faults shall be reported for correction by the Electrical Contractor.
 2. The audio ground network shall be isolated from all other electrical grounds except at the source of the ground network, the building safety ground, specified to be of high quality. Therefore, if the connection between the audio ground network and the source of the ground is disconnected, no continuity between the audio ground and the building electrical ground shall exist.
 3. The Audio / Video System audio ground network connects all Audio / Video System equipment positions together by a single, low impedance, ground network. All AC power wall receptacles in Audio / Video System areas, provided by the Electrical Contractor unless otherwise indicated, will be the isolated ground type, connected only to the associated audio ground spur in that area.
 4. All Audio / Video System equipment racks containing active electronics shall be connected to the audio ground network, except as otherwise noted in this specification. Caution must be exercised so that these racks are not permanently, or in any way during operation, capable of being accidentally connected to the building safety ground.
 5. All conduits and back boxes containing Audio / Video System wiring shall be permanently connected to the building electrical safety ground.
 6. Video (RF) and infrared (RF) devices, being unbalanced in nature, shall not be connected to the Audio / Video System audio ground network.
- I. Electrical Safety:

1. No voltage in excess of 25V rms AC or 24V ripple free DC shall be exposed to touch in normal use or in any equipment by the withdrawal of modules or of any plug or connector or without the removal of suitably indelibly labeled covers.
 2. Unless specifically excepted, all live electrical parts above 50V rms AC or 60V ripple free DC, including terminals, shall remain completely shrouded by insulation or grounded metal when the main access panels are removed. The separate shrouds or covers shall require a tool to remove them to prevent inadvertent contact with live parts.
 3. In addition, where enclosures or items of equipment containing predominantly control, computer, or similar low voltage signals also contain voltages in excess of 50V rms AC or 60V ripple free DC, clear standard warning notices indicating the maximum voltage present shall be provided on all removable access panels. Similar warning notices shall be provided where voltages exceeding 120V are present in any enclosure or item of equipment and such a voltage would not reasonably be expected to be present.
 4. Within enclosures, racks and panels identify with prominent, standard, and indelible signage, which circuit breakers or disconnects are to be switched off in order to isolate the equipment totally. Warning notices shall also be provided on all equipment that contains live terminals after operation of its circuit breaker or disconnect. These terminals must be completely shrouded to prevent inadvertent contact.
 5. All equipment, control stations, equipment racks, enclosures, and all metal cases, raceways, and conduit shall be efficiently grounded. Special hand held or portable equipment that is not double insulated shall have duplicated grounding connections. All grounding shall be in accordance with the current edition of the applicable local, state and national Electrical Codes and as identified within this Section and Division 13.
- J. Control System Voltage:
1. Control circuits shall generally be operated at a maximum of 24V AC or DC as appropriate, and in compliance with the protection described. Hand held control panels shall not contain line (120V) voltage unless approved. Special arrangements to feed movable panels with both line voltage and control voltage must provide suitable mechanical protection and ensure separation of services using the correct category of cable as defined in the codes and regulations identified in “Part 1 - General: Safety and Code Requirements”.
- K. Equipment:
1. Operating parts of all equipment shall be suitably machined and finished. Tolerances, fits, finishes, etc., where not specified herein or indicated on the drawings, shall conform to best trade practices and the operational intent of the equipment.
 2. All components shall be of new or recent manufacture, built within two (2) years of the date of installation and never used prior to installation.
 3. All components and items used in Audio / Video System shall be by a recognized manufacturer specializing in professional Sound and electrical equipment and shall conform to applicable industry and code standards.
 4. The quality of workmanship and materials of all equipment and components requiring custom fabrication shall be comparable to that of professional audio equipment as produced by specialized original equipment manufacturers.
 5. All components used in the equipment installations shall be selected on the basis that each item, or a similarly performing substitute, will be obtainable by the Owner for a period of five (5) years should further spares be required.
 6. All electronic components shall be readily available from at least two recognized manufacturers.
 7. Custom firmware (EPROM, ROM, etc.) shall be supported by readily available spares.

8. All equipment forming part of a given system or installation, and all like components, spares and replacements shall be electrically and mechanically interchangeable.
 9. Electrical and electronic components shall be selected for long operating life and reliability. The design of components and assemblies shall ensure that all such components work at a minimum of 25% less than their maximum ratings.
 10. All integrated circuits containing program code and all circuits with twenty four or more pins shall be mounted in sockets.
 11. All indicators, controls, fuses, relays, contactors, printed circuit cards, and other major components shall each be fitted with a permanent label indicating their type, rating, and duty to expedite any necessary replacement or fault finding. Where applicable, a means of identifying normally open, normally closed, and other contact configurations shall be marked on the component.
 12. Annunciators, indicators, and fuses in individual power and electronic systems shall be standardized and approved by the Consultant before design is finalized. Indicating devices shall be of as few different types as possible and wherever practicable shall have a minimum life of 10,000 hours.
 13. All contactors and relays (although not necessarily special approved types such as reed relays) shall be of the snap-track type developed for mounting inside equipment rack. Generally the contact rating shall be twice the expected maximum operating or inrush current whichever is the greater.
 14. Fuses and circuit breakers shall be panel mounted. Fuses shall be mounted in indicating fuse holders, illuminated when the fuse has failed. Where fuses must be concealed they shall be easily accessible. All panels with concealed fuses shall be marked accordingly on the outside and shall have panel mounted indicator lights. Spare fuses shall be provided in holders mounted within the panel.
 15. All internal switches shall be clearly and permanently labeled.
 16. All connectors external to the equipment shall be of rugged metal construction with self-contained locking devices. Nonmetallic external connector shells are unacceptable.
 17. All keyswitches and keylocks for similar components shall use the same key. Unless otherwise specified, keys shall be removable in all positions. Supply four (4) key copies for each keyswitch/keylock.
 18. All edge connectors, ribbon cable connectors and headers shall have gold-plated contacts. All IC sockets shall be of a face-wipe, gas-tight design.
- L. Assemblies:
1. Manufacturing, assembly, and wiring work shall be carried out by trained and experienced technicians.
 2. Ensure that all parts and components of electrical, electronic, or computer installations are readily accessible for inspection, service, and maintenance. All components shall be replaceable without removal of operational components other than those mounted on or carrying the faulty component. All parts shall be replaceable without strain or damage to other parts.
 3. Electrical and electronic systems shall be constructed as separately removable modules. Where a system comprises a large number of similar modules, these modules shall be designed so as to be easily interchangeable. Where such equipment is of a plug-in type, withdrawing or replacing the modules with the power "on" shall not cause damage to the units or to other equipment.
 4. Electrically dissimilar modules or connectors shall not be able to be wrongly connected. Operating surfaces of control panels/consols shall be of steel, aluminum, or other rigid material, reinforced where necessary to prevent noticeable panel deflection. Generally, all sides of a control panel shall be fully supported.

5. Where possible all control and connection panels shall have hinging or drawer access to electronics for installation and maintenance. Panels shall be held closed by captive quick locking hardware. Provide terminal strips, and neatly bundled wiring to facilitate access. Captive fasteners shall be provided for all removable panels or parts. Any inaccessible nuts shall be fixed. Countersunk or instrument head screws shall be used on external surfaces.
- M. Custom Fabrication:
1. Particular attention shall be paid to the selection of operational components used on custom pendants and control panels. All such components shall be selected for long life under arduous conditions, including rough use in a dusty and dirty environment.
 2. Pushbuttons, selector switches, key switches, operating knobs, handles, and similar shall all be rugged industrial-type components, firmly mounted and capable of giving long trouble-free service. Commercial-grade units will not be accepted.
- N. Finishes:
1. Unless otherwise indicated, all steel equipment cabinets and panels shall be finished with one coat of primer and two coats of semi-gloss baked enamel after full degreasing and rust preventing processes. Colors shall be as selected by the Consultant or as specified herein.
 2. Aluminum panel surfaces shall be anodized black or other color as indicated herein or on the drawings.
 3. Finishes subjected to high temperatures shall be of heat-resistant epoxy or other durable high-temperature baked-on enamel finish.
 4. Finishes shall be durable and capable of withstanding normal usage in the areas in which they are installed.
- O. Equipment Racks:
1. All internal wiring of electrical, electronic or computer equipment shall be in accordance with the current editions of the applicable Electrical Code and governing regulations as identified in "Part 1 - General: Safety and Code Requirements".
 2. All internal wiring shall be of adequate mechanical strength as well as electrical current rating. Multistrand cables shall be used for low current wiring in preference to solid conductors. The current carrying capacity of all cables within equipment enclosures shall take account of de-rating factors and ambient temperatures in accordance with applicable local, state and national Electrical Code regulations.
 3. All terminal strips shall be logically positioned and indelibly marked in accordance with the circuit drawings. Generous space shall be left for installation of the external cables.
 4. All terminals, to which connections are to be made by Division 16, shall have clear markings that are unique for each terminal and are as identified on the shop drawings.
 5. All internal wiring shall be color coded and contained within raceways. At least 40% space shall be available as initial spare capacity. All the conductors of a given power circuit shall be contained within the same conduit or raceway. All internal wiring shall be protected from mechanical damage.
- P. Labeling:
1. All wall receptacle plates shall be engraved and filled to indicate the reference number of the circuit to which each is attached. Such numbers will, when applicable, be referenced to the patch panel jack to which the circuit connects. Refer to the contract drawings for reference numbers and designations.
 2. Panels and receptacles must be readable in dim lighting. Quality of engraving and filling, letter sizes, etc. shall comply with "Part 2 – Products: Receptacle Plates" of this specification and as approved by the Consultant through shop drawing and sample submittal.

3. All legends shall be engraved and filled in a color as indicated on the drawings, unless otherwise noted below.
 4. Where required, engraved, adhesive-backed lamacoid labels shall also be mechanically fixed in place only in those cases where there is no risk of damage to a device's internal components or wiring.
- Q. Noise from Equipment
1. The residual noise and hum output of the systems shall be such that PNC-15 or below can be measured at the center of main floor, and the character of the remaining noise must be random, with no audible discrete frequency components.
 2. Where a control panel or rack is to be used or located in an operational area, such as on stage, a gallery, or control room, there shall be no acoustic noise associated with the panel. No internal cooling fans or similar moving or magnetic equipment shall be permitted unless approved by the Consultant in writing.
 3. Operation of switches, pushbuttons, relays, solenoids, and similar shall not be audible to members of the audience (even in the control rooms with the window open).
- R. Spare Parts
1. Supply spare parts to be stored on-site for all user serviceable equipment and systems. A sufficient quantity of bulbs, fuses, knobs, switches, and other miscellaneous parts shall be supplied. Refer to "Part 2 - Products" for spares of electronic and transducer parts to be supplied.
 2. Label all spare parts with manufacturer's part number, designation, description, and location(s) where part is used. Provide neatly labeled storage containers for all spare parts, including special static free wrapping for electronically sensitive parts.
 3. The spare parts shall be released to the Owner after completion of the commissioning procedure.
- S. Site Work
1. The Audio / Video System Contractor shall be responsible for delivery, storage and handling of equipment and tools during the period of the installation.
- T. Painting
1. Except for special requirements as approved by the Consultant, each painting system shall use paint products of one manufacturer to ensure compatibility of primer and undercoat with top coats.
 2. All paint products shall be factory prepared of the best grade and quality (front line) produced by the manufacturers, subject to approval by the Consultant.
 3. Finish coats on components exposed to view at all locations shall be two (2) coats of approved finish.
 4. The Audio / Video System Contractor shall be held wholly responsible for the finished appearance of the painting work. Painting will be in accordance with the highest standards of the trade.
 5. All components exposed to view shall be shop painted to match approved samples.
 6. Re-touch all shop painted or finished work wherever necessary or as directed, including unpainted screws and other fasteners. Prime paint all patched portions in addition to all other specified coats.
- U. Protection Of Work
1. Shipping and Storage
 - a. The Audio / Video System Contractor shall be responsible for the satisfactory packing and protection of all components and materials for shipment from the factory to the site. Any items suffering damage during transit due to unsatisfactory packing shall be replaced without charge to the Owner.

- b. All equipment shall be packed to withstand the intended method of transport and environmental conditions expected. This Contractor shall take full account of the effects of rough handling, temperature extremes, dust, heavy rain, direct sunlight, and high relative humidity (up to 99%) during transit and installation. The packing shall, where necessary, reduce the effects of condensation.
- c. All equipment shall be packed in sturdy containers to provide mechanical protection during shipping and storage. Provide padding, etc., as necessary to protect the equipment from vibration and shock.
- d. Inner plastic sheeting shall be provided to protect the equipment from moisture and dust. Such covers shall be kept on equipment until environmental conditions have stabilized and the installation areas have been completed.
- e. No equipment shall be shipped to the job site by this Contractor until notification by the Contractor that storage facilities are available to protect the equipment prior to installation.
- f. The Audio / Video System Contractor shall be responsible for storage and protection of portable equipment and components until turning these items over to the Owner during commissioning. Instruct the Owner as to the proper method of storage and protection of the equipment during installation.
- g. Refer also to the General Conditions, as amended by the Supplementary Conditions.
- 2. Installation
 - a. Installation shall be authorized only when site conditions provide mechanical, electrical, and environmental protection suitable for the electronic equipment.
- 3. Special Protection of Electronic Equipment and Cable
 - a. This Contractor shall conform with the following minimum standards and procedures for the storage and protection of the equipment during installation:
 - b. Class 1 - Cable and distribution apparatus, back boxes, face plates, terminal boxes, and rack frames may be stored and installed in weather-protected spaces under “normal” construction site conditions provided that no electronic components are contained within devices and provided that storage boxes are sturdy, well sealed, and devices are protected with imperforate inner plastic sheeting. When installed, devices must be protected from dirt, dust and moisture by sturdy impermeable plastic sheeting, and completely covered with heavy corrugated cardboard, held in place securely by duct tape. Covers shall not be removed until the area is broom cleaned. Care shall be taken to prevent damage and prolonged exposure to improper site conditions during installation. In no case shall devices remain uncovered overnight during installation or while work is taking place causing high dirt dust or moisture levels in the area of placement.
 - c. Class 2 - Control panels, spare parts, and test equipment (except as listed under Class 3) shall be protected and treated as per the Class 1 devices with the following additional provisions: Equipment shall be stored in an air-conditioned secure space. Equipment shall not be shipped until such space exists on site and is approved by the Consultant and Contractor. Control panels with electronic components may be installed providing they are protected as described under Class 1 description above, but electronic components must be removed and shall not be installed until the area of installation is broom cleaned and all dirt, dust and moisture producing work is completed in the area. All other equipment in this class shall not be installed until the area of installation is broom cleaned, “blown” clean with pressurized air, mopped, secure, and air conditioned.
 - d. Class 3 - Mixing consoles, filled equipment racks, and other electronic equipment shall not be shipped to site until the control rooms are finished, air conditioned, dust free, broom and mop cleaned, secure, and in all respects complete and ready for

occupation. This class of equipment shall not be unpacked until the system is complete in all other respects. Under no circumstances may any equipment in this class be removed from the control rooms into or through spaces that are not cleaned, air conditioned, and complete.

3.04 TESTING AND ADJUSTMENT

A. General

1. Perform tests and adjustments to the Audio / Video System as outlined in this specification. These tests and adjustments shall be completed at the time(s) specifically indicated in “Part 1 - General: Commissioning.”
2. Provide a minimum of two qualified technicians to assist in tests, adjustments, and final modifications during the testing and adjustment period.

B. Preparation

1. Ensure that all equipment racks, panels, and back boxes have been adequately cleaned of dirt, dust, and debris. Reassemble all equipment and replace all panels and covers with the necessary screws and/or other appropriate hardware prior to the final site inspection.
2. Before applying AC power to Audio / Video System equipment, perform a complete system inspection on the site to verify that all items are correctly installed and will operate safely as specified in the Contract Documents.
3. Verify also that each individual section of the Audio / Video System has been correctly installed and is fully operational.

C. Conditions

1. Do not use any major control equipment intended for installation in the Audio / Video System for the purpose of checking or testing wiring or circuitry until such time as requirements for “Class 3” equipment meet the environmental conditions described in “Special Protection of Electronic Equipment and Cable” above. Provide testing apparatus, substitute control equipment, or other devices for testing wiring and circuitry prior to the existence of these conditions at all locations of Audio / Video System equipment.
2. Electroacoustic measurements shall only be made once all interior room finishes are completed and all performance equipment is in place and operational. Such equipment includes, but is not necessarily limited to, audience chamber seating, acoustic isolation doors, acoustic canopies, and acoustic control curtains and banners.

D. Test Equipment

1. The following test equipment, provided at the expense of the Audio / Video System Contractor, shall be available on site during all testing and adjustment sessions, initial and final site inspections, and demonstration and instruction sessions. Provide all appropriate monitors, adapters, cables, and connectors necessary to interconnect the test equipment devices to each other and to the Audio / Video System equipment.
 - a. Multi-Function Audio Signal Generator/Analyzer
 - 1) Neutrik Minirator MR2 / Minilyzer ML1, or approved equal
 - b. Digital Multimeter
 - 1) Fluke 77 IV Series, or approved equal.
 - c. Polarity Testing System
 - 1) LA Audio PC90 or approved equal
 - d. Impedance Meter
 - 1) Goldline M-1, or approved equal.
 - e. Sound Level Meter
 - 1) MiniAnylyzer, approved equal
 - f. Two-channel FFT-Based Electroacoustic Analysis System
 - 1) SIA SMAART

- 2) General: Computer-based electroacoustic measurement system requiring proprietary equipment and a certified operator. Provides dual-channel FFT transfer- function measurements, phase response, delay locator and real-time analysis and ability to perform these measurements with test signals and with program (music) occurring during performances.
 - g. Two-Way Radios
 - 1) Motorola UHF, or approved equal.
 - 2) Quantity: Six (6) , with spare battery & charger.
 2. Requests for alternate test equipment shall be submitted to the Consultant for approval shall meet or exceed the manufacturers' published specifications for the above components. No exceptions. Nonprofessional test equipment, including "custom-built" components, shall not be acceptable.
- E. Procedure:
1. Perform the following tests and adjustments to the Audio / Video System. All test results and system adjustments shall be fully documented for inclusion in the Initial and Final Test Reports. Refer to "Part 1 - General: Commissioning".
 2. Continuity
 - a. All permanent Audio / Video System wire and cable shall be tested for continuity after installation in conduit and before termination in panels or racks. Also test for shorting contact between any and all conductors in a multipair or multiconductor cable and between each conductor and the conduit (building safety ground). Use a continuity meter for all tests.
 - b. All Audio / Video System wirepaths shall be tested to ensure that device inputs and outputs, assigned to particular circuits or channels, terminate to the correct location, and that all corresponding labeling is accurate.
 - c. Measure and verify electrical and electroacoustic polarity of all Audio / Video System components to ensure that the entire system is properly connected (i.e., the system shall be "in phase"). Ensure that absolute polarity is maintained throughout all signal paths, regardless of patching or other routing changes.
 - d. Document all wiring or termination changes made in order to maintain system polarity.
 3. Impedance
 - a. Measure and document the impedance of each microphone and line level line terminated with a 600-ohm 1% precision resistor, at 250Hz, 1kHz, and 4kHz, while disconnected from any device input. The load impedance value shall be greater than the resistive load.
 - b. Measure and document the impedance of each low-impedance loudspeaker line to an unconnected receptacle, at the patch panel, terminated at the opposite end with an 8-ohm 1% precision resistor, at 250Hz, 1kHz, and 4kHz, while disconnected from any device input. The load impedance value shall be greater than the resistive load.
 - c. Measure and document the impedance of each low-impedance (nominal 2 to 8-ohm) loudspeaker line while disconnected from the power amplifier. The load impedance value shall be greater than the total rated impedance of all connected loudspeaker drivers.
 - d. Test each full-range loudspeaker line at 63Hz, 250Hz, 1kHz, 4kHz, 8kHz, and 16kHz.
 - e. Test each band-limited loudspeaker line (i.e., bi-, tri-, or quad-amp systems) at the maximum number of test frequencies that fall within the frequency range of the driver under test.
 - f. Measure and document the impedance of each 70.7V loudspeaker line at 250Hz, 1kHz, 4kHz, and 8kHz, while disconnected from the power amplifier. The load

impedance value shall be greater than the total rated impedance of all connected voice-coil transformers.

4. Radio Frequency Interference
 - a. Use a minimum 60 MHz bandwidth analyzer in conjunction with loudspeaker or infrared receiver/headset monitoring to ensure that the Audio / Video System under test is free of spurious oscillation and radio frequency interference (RFI). Measure and document all results.
5. Gain Structure
 - a. Set and document input and output gain controls on all Audio / Video System components to provide appropriate signal balance (i.e. unity gain) and optimum signal-to-noise ratio for each signal path. Unity gain shall be set by adjusting the gain of each active device (excluding power amplifiers and mixer/amplifiers) for input level equals output level by using a reference signal of 0dBv pink noise at the mixing console output.
 - b. Ensure that a minimum of 18dB of headroom exists for each gain stage. The overall system gain (excluding mixer/preamplifiers, mixer/amplifiers, and power amplifiers) through any signal path from any input to any output shall be unity 1.5dBv.
 - c. Conduct listening tests from center of coverage of each high-frequency horn device to determine that there is no audible hiss or distortion.
6. Electronic Signal Path
 - a. Measure and document frequency response, signal to noise ratio (S/N), maximum output before clipping, total harmonic distortion (THD), and any spurious noise and/or hum signals of all electronic components in the Audio / Video System. Measured values must be as published by the manufacturer, or better.
 - b. With unity gain levels set, measure and document electrical frequency response for all discrete signal paths from the mixer through each active device, including mixer/amplifier outputs with the loudspeaker lines disconnected. Also test typical signal paths through each combination of mixer input to output. Use a -60dBv (0.8mV RMS) sine wave signal at microphone inputs from 20Hz to 20kHz and a 0dBv (0.775 VRMS) sine wave signal from 20Hz to 20kHz at line level inputs. Deviation shall be within +/-1.0dBv from the range of 30Hz to 20kHz, or the specified bandpass for a particular circuit. (Refer to manufacturers' published data).
 - c. With unity gain levels set, measure and document signal to noise ratio for all discrete signal paths from the mixer through each active device with mixer input shorted.
 - d. Measure and document maximum output before clipping (headroom) and total harmonic distortion of each active device with methods recommended by the equipment manufacturer.
 - e. With unity gain levels set, measure and document any spurious noise and hum signals such as 60Hz, 120Hz with harmonics, high frequency oscillation, clicks, pops, or noise spikes for all discrete signal paths from the mixer through each active device, including the mixer/amplifier outputs with loudspeaker lines disconnected. If any unwanted signals are detected, troubleshoot and correct or modify as necessary.
7. Power Output
 - a. Measure and document the output power of each power amplifier and mixer/amplifier, using a sine wave oscillator with less than 0.5% THD as an input source. Terminate each power amplifier channel output with a load resistor to match the nominal loudspeaker impedance. Apply a 1KHz signal at a level to achieve 10 dB below full rated power output of the mixer/amplifier. Observe the sine wave with an oscilloscope to insure that full voltage for rated power can be reached without noticeable deformation of the waveform.
8. Buzzes, Rattles, Distortion

- a. Apply a sine wave sweep at a slow rate from 30Hz to 10kHz at 6dB below full rated power output of each amplifier in the Audio / Video System with output connections made to all loudspeaker drivers or voice-coil transformers. Adjust test frequency range to compensate for band-limited low-voltage loudspeaker lines (i.e., bi-, tri-, or quad-amp circuits) or 70.7 volt loudspeaker lines. Listen carefully to each loudspeaker for electromechanical buzzes, rattles, distortion, or other objectionable noises and correct all causes of such defects. If cause is outside Audio / Video System equipment and/or the scope of this section of the contract, promptly notify the Owner and Consultant of the cause and suggested corrective procedure.
- F. Audio / Video System Testing
1. The following Audio / Video System Tests shall be conducted as part of the SMAART measurement and optimization process. Audio / Video System Testing will require two 8-hour sessions scheduled to ensure quiet ambient noise levels in the test area. The Audio / Video System Contractor shall provide a certified SMAART technician to operate the SMAART System.
 - a. Sound Pressure Level: Measure and document sound pressure level of loudspeaker arrays throughout the seating areas and adjust suspended loudspeaker aiming, as necessary, to achieve a coverage of ± 3 dB, or better, with a peak continuous level of 105dB SPL. Take all readings at seated ear level height.
 - b. Loudspeaker Array Driver Alignment: Measure and document the loudspeaker driver alignment of the components of each loudspeaker array. Adjust precision signal delay units as necessary to achieve the best average signal alignment between adjacent components.
 - c. Frequency Response: Measure and document the frequency response of each loudspeaker array, as measured in both the reverberant field and near field (with windowed FFT methods), to ensure that the frequency response is within ± 3 dB from 100Hz to 3kHz, and rolls off at a rate of 3dB/octave ± 3 dB from 3kHz to 12kHz (and beyond, if possible). Apply the pink noise source at a line input of the mixing console. Adjust fixed Audio / Video System equalization as necessary. If discrepancies arise, the final curve shall be based on the average of the values measured. Hard copy documentation shall be recorded for both time-energy-frequency analysis and ISO one- third octave band frequency response measurement.
 - d. Speech Intelligibility: Perform subjective and/or objective speech intelligibility measurements or surveys throughout the facility and make adjustments as necessary to the Audio / Video System for maximum speech intelligibility. Submit proposed methods of testing to the Consultant for approval.

3.05 PROGRAMMING

- A. At the completion of the Testing process, and in conjunction with the Consultant, Project Architect and Design Team, and other trades, the Audio / Video System Contractor shall provide full time technical support for ten (10) 12-hour days of Ride Programming. Two (2) technicians shall be provided for the entire duration of the Programming period.
- B. Technical personnel should be prepared to adjust loudspeaker positions, facilitate required changes to Audio / Video System equipment programming, and troubleshoot any technical problems that may arise during Ride Programming Sessions.

END OF SECTION

SECTION 27 50 00
PUBLIC ADDRESS AND CLOCK

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes

1. This section and associated drawings define a communications system for a public address and master clock system. The contractor shall provide all infrastructure, cable, hardware and equipment as defined to provide a complete and operational system.
2. System manufacturer must match the classroom / conference room AV equipment from Section 274000.

1.02 SYSTEM DESCRIPTION AND SUMMARY

- A. Furnish and install all equipment, accessories, and materials in accordance with the specifications herein and drawings to provide a complete and operating Networked Communications and Event Management System.**
- B. Regulatory requirements**
1. All work will conform to the National Electric Code and applicable local ordinances.

1.03 Submittals

- A. Comply with requirements of Division 0 and Division 1 - Submittals and as modified below.**
- B. Product Data: Submit manufacturer's product literature, technical specifications and similar information for the following items demonstrating compliance with the specified requirements.**
1. Submit the shop drawings, product data and quality control submittals specified below at the same time as the package.
 2. Shop Drawings shall include the following items but are not limited to:
 - a. Wire types
 - b. System wiring diagrams showing all equipment and connections.
 - c. Drawings including all equipment locations.
 - d. Associated equipment specifications and cut sheets.
 - e. Product data including catalog cut sheets, manufacturer's default specifications, user operation guides and a bill of materials.
- C. Quality Control Submittal**

1. Submit the name, address and telephone number of the nearest fully equipped service organization.
2. Submit a certificate of completion of installation and service training from the system manufacturer.
3. Certificates
 - a. Manufacturer Certification: Submit certification from manufacturer of products to be installed under this contract certifying that Installer is authorized by manufacturer to install specified products.
 - b. Installer Experience Listing: Submit list of at least 5 completed projects as specified below in “Quality Assurance – Qualifications – Installer.”
- D. Contract Closeout Submittal: Comply with requirements of Division 0, including submission of operating and maintenance instructions as item in “Operation and Maintenance Data” manual described in that Section.

1.04 As-builts

- A. All systems must have as-built drawings provided in electronic AutoCAD 2015 and hardcopy format that clearly show all system components, wiring schemes and system interconnections.
 1. PDFs inserted into CAD files are not acceptable and will be rejected.

1.05 Quality Assurance

- A. All Work shall be installed in a first class, neat and workmanlike manner by skilled Technicians. The quality of the workmanship shall be subject to inspection and approval by authorized owner personnel. Any work found to be of inferior quality and/or workmanship shall be replaced and/or reworked until the approval of the owner is obtained.
- B. Qualifications
 1. Installer
 - a. Must be qualified to cable, terminate, install and program the equipment specified in this Section, certified by manufacturer of products to be installed, and completed at least 5 installations of similar size, nature and complexity as specified for this project.

1.06 Warranty

- A. Special Warranty: Provide manufacturer’s system warranty against electrical or mechanical defects for 2 years from date of final acceptance.
 1. System Assurance: The System Assurance shall cover the failure of the wiring system to support the application which it was designed to support as well as additional application(s) introduced in the future by recognized standards or user forums.

2. System Certification: Upon successful completion of the installation and subsequent inspection, the Authority shall be provided with a numbered certificate, from the manufacturing company, registering the installation.
3. In addition, the primary manufacturer of the Networked Communications and Event Management System will offer a 5-year warranty on all items they supply.

1.07 Training

- A. The installing contractor shall provide a minimum of 8 hours of training on system operation and managements as part of their scope of work.
 1. Additional hours shall be provided on a time and materials basis at the request of the owner.
- B. The installing contractor shall provide a video recording on a standard format DVD to the owner which includes training sessions.

1.08 Operation and Maintenance Manuals

- A. The installing contractor shall provide a minimum of two hardcopy and one electronic copy of all operation and maintenance manuals to the owner at project completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable manufacturers
 1. The preferred Alternate shall be Audio Enhancement.
 - a. Substitutions must provide equal or greater performance. Any other manufacturers will be rejected at the contractor's expense.
 - b. The functions and features specified are vital to the operation of this facility and therefore all requirements of the system must be met by the specified equipment.

2.02 MATERIALS

- A. PRODUCT OVERVIEW.
 1. PA and Master Clock System and Equipment
 - a. Audio Enhancement
 - b. Front Row
 - c. Extron
- B. CENTRAL Equipment
 1. Headend
 - a. Audio Enhancement Epic Headend Server
 2. Kiosk

- a. Audio Enhancement Kiosk
- 3. Common Area Components
 - a. Audio Enhancement MS-600 Network Device
 - b. Audio Enhancement MS-300 Network Device
- 4. Amplifiers
 - a. 25/70v Amplifier
- 5. 70v Speakers
 - a. 25/70v Speakers and horns
- 6. Horn Speakers
 - a. Atlas VTF Recessed Horn
- 7. UPS
 - a. APC 3000 VAC UPS with L5-30p input plug
- 8. Network Equipment
 - a. See 272000 (By Owner)
- 9. Volume Controller
 - a. Audio Enhancement Rotary Volume Knob
- 10. Call Switch
 - a. Audio Enhancement WPA-504
- 11. Call Station with integrated speaker
 - a. Algo 8028V
 - b. Connected to the IP network.
- C. System Speakers
 - 1. All speakers must have integral volume control as well as taps.
 - 2. Classroom Speakers shall be Audio Enhancement:
 - a. Drop-in Ceiling Speakers:
 - b. Cut-in Ceiling Speakers:
 - c. Wall Speakers:
 - 3. Hallway Speakers shall be Audio Enhancement:
 - a. Ceiling Speakers:

- b. Cut-in Ceiling Speakers:
 - c. Wall Speakers:
 - 4. Outdoor / Gym / Locker Room Speakers shall be Atlas Sound:
 - a. Atlas Sound VTF-157UCN or similar
 - 5. Pendant Speaker:
 - a. Tannoy OCV 6
 - b. TOA PE-304
 - c. TOA PJ-304
 - 6. Phone System Integration
 - a. The system allows access to live paging and emergency event initiation through SIP telephone access, as well as through the web-browser User Interface. This feature will allow user specific, pin code protected access to the system live paging, and emergency event initiation for each user's unique programmed locations. This requires a separate server to interface to the Networked Communications and Event System server and the district phone system.
- D. CLOCK SYSTEM
 - 1. Sapling SMA-2000 with NTP Server Upgrade
 - 2. Or Approved Equal
- E. CLOCKS
 - 1. Sapling SBP 4" High Digit, 6 Digit Display Digital Clocks
 - a. Correction directly from NTP/SNTP
 - b. Double face options as noted.
 - c. SLD option larger clocks for gymnasiums and cafeteria
 - 2. Software
 - a. Sapling Network Clock Monitoring Software
 - 3. Wiring
 - a. Cat 6 UTP Data Cable
- F. SPARE CAPACITY/SYSTEM EXPANSION
 - 1. The contractor shall include extra circuits for staff telephones and loudspeakers built into the system for future expansion. The contractor shall provide and install fifteen percent (25%) extra circuitry (line cards, expanders, etc.) for these devices. The Owner shall add only field instruments (telephones and loudspeakers), cabling, and programming to make these extra capacity circuits fully operational.

G. REMOTE SOUND SYSTEMS INTERLOCK

1. Provide circuits, as required, to include loudspeakers connected to remote (local) sound systems into the telecommunication system. Remote loudspeakers shall be temporarily “seized” during paging, two-way intercom, any transmitted tone-sets and program distribution, which include the remote system(s) area(s). After completion of the transmission the remote sound system shall be returned to normal local operation.

H. Cable and Jacks

1. Cat 6 UTP
2. 18/2 AWG plenum rated cable.
 - a. Increase cable gauge as needed.
3. 18/4 AWG plenum rated cable.
 - a. Increase cable gauge as needed.
4. PA Cable must be presented to the architect/engineer and owner for approval prior to installation.

PART 3 - EXECUTION

3.01 Examination

- A. Verification of Conditions: Examine conditions under which telecommunications cabling and equipment and related components are to be installed in coordination with Installer of materials and components specified in this Section and notify affected Prime Contractors and Design consultant in writing of any conditions detrimental to proper and timely installation. Do not proceed with installation until unsatisfactory conditions have been corrected to ensure a safe and timely installation.
1. When the installer confirms conditions as acceptable to ensure proper and timely installation and to ensure requirements for applicable warranty or guarantee can be satisfied, submit to Design consultant written confirmation from applicable Installer. Failure to submit written confirmation and subsequent installation will be assumed to indicate conditions are acceptable to the installer.
 2. Visit Site to identify and become familiar with existing field conditions and specific requirements of each Site.
 3. Verify all dimensions in field and confirm condition of existing hardware to be utilized.
 4. Confirm space requirements and physical confines of all work areas to ensure that all materials can be installed in indicated spaces.
 5. Confirm all device locations and cable pathways and advise Design consultant in writing of any discrepancies or issues in Design described in Contract Documents.

3.02 Preparation

- A. Protection: Provide adequate protection of equipment and hardware before and after installation.
- B. Existing Communications Services: Ensure all telecommunications systems (voice, video and data) remain operational throughout the project.
 - 1. Identify any additional equipment, devices, and wiring at the site not shown on T-Drawings and interfering with installation of specified equipment.
 - 2. Remove all accessible portions of abandoned communications cabling per NEC 800.52. Tag all communications cabling not terminated at both ends but retained for future use.

3.03 Installation

- A. Provide and install all components necessary to install complete PA/master clock system, including (but is not limited to) cable, connectors, patch panels, call switches, speakers, etc...
- B. Secure all horizontal cables within ceiling cavities to the building structure.
 - 1. Loosely bundle all cables and support from structure at unequal intervals from 5 to 6 feet with spring steel fasteners and cable clip rated for use with high performance cables (similar to Caddy Series “CableCat” or approved alternate mounting methods) including placement in cable tray as indicated on Drawings. All mounting clips shall be seismic type as per BOCA.
 - 2. Do not violate manufacturer’s recommended loadings. Leave 30% capacity for future use of pathway.
 - 3. Verify all horizontal cable run lengths prior to installation. Re-distribute horizontal cabling to maintain distance requirements and maintain pathway route accessibility.
 - 4. Do not support cables from ceiling grid T-Bars, grid wire supports or bridle rings.
 - 5. Do not allow cables to touch the ceiling grid.
 - 6. Install cables in EMT conduit in all unfinished, exposed areas as shown in Design consultant roof plans and/or T-Drawings, unless alternate pathways are noted.
 - 7. Do not secure cables with permanent cable ties. Do not tighten cable bundles in such a way as to cause jacket deformation or damage.
 - 8. Re-terminate and re-test any cables or pairs of cables failing end-to-end testing requirements. Replace any faulty cables/pairs or termination devices. Remove all defective cables completely from pathways.
- C. Install all exposed cabling in surface raceway by Wiremold, Hubbell or Panduit where in-wall conduit has not been provided. Follow all manufacturers’ guidelines requirements regarding bending radius and slack. All bends, offsets and fittings shall be appropriately sized to provide 30% capacity after installation.
- D. Install all cable in accordance with National, state and local codes and ANSI/TIA Standards, and BICSI methods.

1. Follow manufacturer's guidelines and requirements for all cable termination.
 2. Follow detail drawings to locate equipment racks and cabinets. Where it is necessary to deviate, to obtain 30-inch clearance between equipment, obtain Design consultant's written approval before mounting cabinet/rack.
 3. Ladder-type cable tray shall be affixed 6 inches above all data racks and equipment cabinets, and routed to all points of entry into each telecommunications room.
 - a. Include transition to proper height for penetration into hallway or other wall penetration as indicated on Drawings.
 - b. Install sufficient 4-inch conduits from telecom rooms into hallway (minimum of 2) with protective insulating bushings, cable spillway or specially designed cable tray sections, with appropriate firestop materials.
- E. Properly terminate all cables at speakers, call switches, administrative consoles and distribution racks. Permanently identify all cables in pullboxes, transition points, and termination points by affixing pre-marked self-adhesive wraps similar to Brady "B-500+ Plastic Cloth Markers."
- F. Permanently identify all system components following ANSI/TIA-606A "Administration Standard for Commercial Telecommunications Infrastructure" with identification format:
1. Identification: Provide permanent identification labels for end devices and associated cabling at each end.

3.04 Testing

- A. PA and Clock Equipment
1. The contractor shall test all equipment for proper signal transmission based on manufacturer standards.
 2. The contractor shall record and remove any cable that does not meet manufacturer standards and replace it with a correctly functioning cable.
 3. The contractor shall demonstrate that the installed cables meet manufacturer standards for signal transmission prior to the job being considered complete.
- B. Sound Equipment
1. The contractor shall test all aspects of the sound system once it is installed and demonstrate these functions to the owner of the owner's representative.
 - a. Speaker levels shall be verified to function individually and as a unit.
 - b. Microphones shall be demonstrated to work as intended by the manufacturer.

3.05 Programming

- A. All aspects of the system shall be fully programmed and active for the owner.
- B. Integration with local sound systems shall be programmed.
- C. Integration with owner telephone equipment shall be programmed.

1. The system shall work seamlessly with owner supplied telephone equipment allowing calls to be answered and initiated with telephone equipment through the system.
2. Coordinate all programming with the owner and owner's equipment at the time of construction and installation.

3.06 As-builts

- A. As-builts shall be provided by the contractor in hardcopy and electronic CAD format prior to project completion and inspection. PDFs inserted into CAD documents are not acceptable.
- B. As-builts by contractor must include parts lists and wiring diagrams that clearly indicate all equipment, locations, wiring and connections.
- C. The owner's manuals shall be supplied as part of the as-built documentation.

3.07 Demonstration and Training

- A. All aspects of the systems must be demonstrated for the owner at the time of training. A minimum of 16 hours of training shall be provided.
- B. Training shall be video and audio recorder for the owner and turned over to the owner at acceptance.

3.08 Acceptance

- A. The contractors work shall be considered complete after the following conditions have been met:
 1. Cable installation is complete and all cable runs have been tested and documented to be installed according to specifications and drawings.
 2. Equipment installation is complete and all functions have been tested and documented to function as designed and per the manufacturer's recommendations.
 3. All punch list items have been reconciled.
 4. All disturbed ceiling panels, fire stopping materials, covers, etc. have been properly reinstalled.
 5. All materials and trash have been removed from the site.
 6. A 2-Year Installers warranty has been given to a school district Technology representative.
 7. Submit Manufacturer's Warranty Application.

END OF SECTION

SECTION 28 05 01
SECURITY PATHWAYS AND SPACES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Telecommunications Room Build Out
- B. Pathways for Security Systems
- C. Grounding and Bonding for Security

1.02 References

- A. Industry Codes, Standards and Methods shall be observed, including the following:
 - 1. ANSI/TIA-568-C.0: Generic Telecommunications Cabling for Customer Premises.
 - 2. ANSI/TIA-568-C.1: Commercial Building Telecommunications Cabling Standard
 - 3. ANSI/TIA-568-C.2: Balanced Twisted Pair Cabling and Components Standard
 - 4. ANSI/TIA-568-C.3: Optical Fiber Cabling Components Standard
 - 5. ANSI/TIA-569-B: Commercial Building Standard for Telecommunications Pathways and Spaces
 - 6. ANSI/TIA-570-B: Residential Telecommunications Cabling Standard
 - 7. ANSI/TIA-606-A: Administration Standard for Telecommunications Infrastructure of Commercial Buildings
 - 8. ANSI-J-STD-607-A: Commercial Building Grounding and Bonding Requirements for Telecommunications
 - 9. ANSI/TIA-758-D: Customer-Owned Outside Plant Telecommunications Cabling Standard
 - 10. BICSI Telecommunications Distribution Methods Manual (TDMM), Latest Edition
 - 11. National Fire Protection Agency (NFPA-70): National Electrical Code (NEC)
- B. Comply with all local, state and federal codes for telecommunications installations.

1.03 System Description

- A. Design Requirements
 - 1. The contractor shall outfit all telecom rooms according to TY Drawings. Pathways, wall boards and grounding equipment shall be installed according to manufacturer's guidelines and industry standards.
 - 2. TR and TER layouts shall be approved by Technology personnel prior to installation.
- B. Performance Requirements

1. Materials and equipment will be installed in an orderly and precise manner. Clearances between equipment will prevent incidental damage or unsafe conditions.
2. Equipment shall provide proper support and housing of all intended active and non-active components.
3. Refer to Telecom Room Details for precise location of equipment and termination fields.

1.04 Submittals

A. Product Data

1. Provide product data for all equipment listed in Part 2
2. Equipment data must be submitted in a single package and clearly indicated for efficient review. (by specifications section) Equipment submittals not clearly called out will be rejected without question at the contractor's expense for resubmittal.
3. Product data must be approved by designer and owner prior to purchase and installation of equipment.
4. LEED Submittals
 - a. Product data for Credit IEQ 4.1: For adhesives and sealants applied within the building waterproofing envelope, documentation including printed statement of VOC content in g/L.
 - b. Product data for Credit IEQ 4.2: For paints and coatings applied within the building water proofing envelope, documentation including printed statement of VOC content in g/L.
 - c. Product data for Credit IEQ 4.4: For composite wood installed in the building interior as equipment backer boards, documentation indicating no added urea formaldehyde resins.

B. Shop Drawings

1. Provide scaled drawings to show proposed equipment locations and clearances of Telecom Rooms and equipment.
2. Shop drawings must be approved by the designer and owner prior to purchase and installation of any equipment.

C. As-Built Drawings

1. Contractor shall upon completion of the project, provide a complete set of As-Built drawings. These drawings shall identify room numbers and outlet identification numbers for all low voltage cabling systems. Drawings should also include all IDF and MDF locations with a detailed layout of all racks, patch panels, trays, and wall fields.
2. Additional project information shall include Reline Details of all horizontal and backbone cable routes and pathways.

3. As-builts shall be submitted in electronic CAD format and in hardcopy at the end of the project.

1.05 Quality Assurance

A. Regulatory Requirements

1. All equipment shall be installed in a neat and professional manner. All methods of construction that are not specifically described or indicated in the contract documents shall be subject to the control and approval of the school district. Equipment and materials shall be of the quality and manufacturer indicated. The equipment specified is based upon the acceptable manufacturers listed. Where “approved equal” is stated, equipment shall be equivalent in every way to that of the equipment specified and subject to approval.

B. Substitutions

1. Conditions for consideration of “Or Equal” Products: Where products are specified by name and accompanied by the term “or equal”, the proposed “or equal” product will be considered when the following conditions are satisfied.
 - a. If all the following conditions are not satisfied, Design Consultant will return requests without action, except to record noncompliance with these requirements.
 - b. Proposed product does not require extensive revisions to the Contract Documents.
 - c. With the exception of the product name or number and manufacturer’s name, proposed product conforms with requirements indicated on the Drawings and in the Specifications in every respect and will produce indicated results.
 - d. The proposed product is fully documented and properly submitted.
 - e. Proposed product is compatible with and has been coordinated with other portions of the Work.
 - f. Proposed product provides specified warranty.
2. If proposed product involves more than one contractor, proposed product has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
3. The submission is accompanied with detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
4. The submission is accompanied with a list of similar installations for completed projects with project names and addresses and names and addresses of design consultants and authorities, if requested.

1.06 Warranty

- ##### A. Warranty: Installer must provide manufacturer’s warranty without cost to the owner during that time period, including materials, hourly costs, etc.,

- B. The installer's warranty shall guarantee workmanship for a period of two years, during which time any deficiency in installation shall be repaired or replaced at no additional cost to the school district. Contractor must respond within 2 business days of written notification.

PART 2 - PRODUCTS

2.01 Materials

- A. Adhesives, sealants, paints and coatings applied within the building waterproofing envelope: Comply with low-emitting requirements in Division 01 Section "Indoor Air Quality Requirements."
- B. Composite wood installed in the building interior as equipment backer boards: Contain no added urea formaldehyde resins.
- C. J-Hooks
1. J-Hooks shall be rated for low voltage cables.
 2. J-hooks shall be provided where cable tray and conduit are not present.
 3. J-hooks shall be installed on 5'-6' centers, not further apart.
- D. Conduit
1. In-wall conduit shall be provided for work in new areas. Refer to TY Drawings for conduit details.
 2. Conduit bend radii shall follow current ANSI/TIA standards for telecommunications.
 3. Refer to TY drawings for locations and sizes of all sleeves for telecommunications.
- E. Gang Boxes
1. In-wall Gang Boxes for low voltage
 - a. In-wall Double Gang Box for low voltage: 4 Inch Back Knockout, 4 Inch Side Knockout, 4 Inch End Knockout, Length 3 3/4 Inches, Width 3 25/32 Inches, Depth 3 1/2 Inches or comparable.
 2. Extra Deep in-wall gang boxes
 - a. 3 3/4" Deep, 2 3/16" Wide, 3 7/8" High
 - b. 4 Knockouts, 2 Per End
- F. Distribution Backboard
1. Plywood
 - a. 3/4" AC-grade plywood shall be provided as shown on T drawing details to line the walls within the TR. The plywood should be provided in 4' x 8' sheets.
 - b. Plywood shall be void free and painted on all sides with two coats of fire-resistant paint.

- G. Electrical Protection for Security Systems
 - 1. Telecommunications Primary Bonding Busbar (PBB) and Telecommunications Secondary Bonding Busbar (SBB)
 - a. The telecom grounding and bonding system shall be bonded to the main electrical ground for the facility and include the security systems.

PART 3 - EXECUTION

3.01 Examination

- A. Site Verification of Conditions
 - 1. Contractor shall ensure that sufficient space has been allocated for the installation of all equipment per TY Drawings prior to Installation. Clearances and existing equipment should be taken into consideration. If insufficient space exists, the Design consultant should be notified in writing, before proceeding with Installation.

3.02 Installation

- A. Distribution Backboard
 - 1. Securely fasten backboard to wall-framing members to ensure it can support attached equipment.
 - 2. Mount plywood on all available areas where telecommunications equipment may be located.
 - 3. Refer to TY Drawings for minimum coverage.
- B. Firestop
 - 1. Provide re-enterable, non-hardening, intumescent putty, rated for floors or wall, UL approved assembly, with approved packing material for fire stopping inside building cable penetrations through conduits sleeves.
 - 2. The material used for sealing all openings shall have a fire rating equal to or greater than the floor ceiling, wall or partition material.
- C. Sleeves and openings
 - 1. The security contractor shall provide sleeves through all walls and floors to protect cabling and or raceways installed as part of the telecommunications system. All sleeves shall extend through the respective wall or partition and finish with a connector protective bushing.
 - 2. Sleeves through all fire rated structures shall have the appropriate fire stop system.

END OF SECTION

SECTION 28 10 00
INTRUSION DETECTION SYSTEM

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Intrusion Detection cabling
- B. Intrusion Detection sensors
- C. Intrusion Detection end devices
- D. Intrusion Detection headend equipment
- E. Associated power supplies, terminations, equipment, labeling and associated cable performance testing.

1.02 Definitions

- A. Intrusion Detection system refers to burglar alarm equipment including motion detectors, door contacts, control panels, communication panels, power supplies, expansion modules and associated wiring.

1.03 System Description

- A. Design Requirements
 - 1. Remote Access: The system shall provide a method for users to remotely access the system and perform all of the functions possible on an operator terminal by LAN (IP). Provide network interface module and Cat 6 cable and associated connections to school's data network.
 - 2. Primary Control Unit: Control unit shall consist of a power supply, signal processing circuitry, tamper circuits, alarm relay and driver circuits. Solid state, modular construction of the control unit must be incorporated for quick and easy servicing.
 - 3. The system shall be installed so that 10 percent future area protection of each zone may be added without compromising system performance in any way and no additional control equipment is necessary.
 - 4. The system shall be continuously supervised by a tamper circuit to prevent defeat by cutting, jumping or shorting to ground one or more transducer lines. When the system is in the armed mode of operation or in the stand-by mode of operation, attempts at tampering will activate a remote trouble unit.
 - 5. All zone controls shall be tamperproof installations so that tampering with a zone control will activate the remote trouble module.
 - 6. The system shall operate from 120 volts, 60 Hz power under normal conditions. In the event of a power interruption, the system will automatically operate from a self-contained emergency D.C. power source located within the control cabinet. When normal A.C. power is restored, the system shall resume normal operation. Under no circumstance will interruption of A.C. power cause the system to generate false alarms or fail to operate.

7. Arming and disarming shall be controlled by keypads.
8. The system shall include the LCD readout style annunciator sensor zone and every hardwired door zone as indicated on the drawings.
9. A system operating keypad shall be a part of the annunciator. The keypad shall override the main arm/disarm clock.
10. System shall have ENTRY AND EXIT time of 60 seconds, and keypads shall sound audible tone during ENTRY AND EXIT.
11. Standby batteries. Quantity as required to support system for specified hours upon loss of power. Note: Security system shall be fed from school's emergency generator power source. It is the responsibility of the contractor to coordinate with other trades to fulfill this requirement regardless if shown on the contract drawings.
12. The control panel shall have provision to send a signal to the building's PA system when armed. The control panel shall have provision to send a different signal to the PA system when in alarm.
13. When the security alarm system is first armed, a voice warning shall announce, via interior public address speakers, that the alarm system has been armed and continually announce the time the occupants have to leave the building or disarm the system (a maximum of five [5] minutes). If alarm system is disarmed, voice warning shall shut down immediately.
14. All security alarm outputs shall generate a two-minute voice alarm, warning intruder(s) that the police have been notified, using interior public address speakers.
15. All devices shall be individually addressable.
16. DS2e Stoppers (wire guards): Safety Technology International, STI series. Provide for all devices in gym, locker rooms, and other high abuse areas noted on drawings.
17. Interface security system to external digital communicator/dialer, refer to drawing(s) for additional requirements.
18. Panel shall be capable of arming and disarming by a maintained relay contact.
19. Provide labor, materials, equipment, services and operations required for a complete installation of an Intrusion Detection System.
 - a. Base panel
 - b. Expansion modules
 - c. Keypads
 - d. Annunciators
 - e. Motion Detectors
 - f. Door Contacts
 - g. Communication Modules

- h. Power Supplies
- i. Controllers
- j. Servers
- k. Application Software

20. All wiring shall be wired according to manufactures specifications.

- a. Refer to notes on each drawing to determine exact installation methods.
- b. Strictly adhere to most current version of ANSI/TIA Telecommunications cabling standards.
- c. Permanently identify and label all cables and termination devices, at distribution rack and workstation in accordance with ANSI TIA-606 Standard or as agreed by Design consultant and Authority.
- d. Remove and replace any cables failing to meet end-to-end testing requirements; do not abandon cable in place. All cable shall be terminated at both ends, unless noted in TY-Drawings.

B. Performance Requirements

- 1. The system shall be capable of interface with the Building Control System at the facility.
- 2. The system shall be capable of interface to the lighting control system at the facility
- 3. The system shall produce a signal if the system is breached by an unauthorized user.
- 4. Each sensor shall be individually alarmed.
- 5. The system shall be capable of a minimum of 8 partitions.
- 6. The system shall be capable of being scheduled.
- 7. The system shall be capable of being controlled from the main panel, keypad locations, central station and PC connected to the LAN.
- 8. The intrusion detection system will alert and record movement throughout the facility that is both authorized and unauthorized.
- 9. The systems will be capable of communicating onsite as well as to remote locations.
- 10. The systems shall be controllable in case of emergency situation.
- 11. All systems shall operate on dedicated circuits with associated cabling in EMT.
- 12. Comply with applicable requirements in Local, State and Federal Codes, ANSI/TIA Standards, and BICSI methodology.
- 13. Specified cabling system derived from recommendations in approved telecommunications industry codes, standards and methods, including the following documents:

- a. Articles 250, 725, 760, 770, 800,810 and 820 of the current National Electrical Code.
- b. ANSI/TIA-568-B.1: Commercial Building Telecommunications Cabling Standard Part 1 – General Requirements
- c. ANSI/TIA-568-B.2: Commercial Building Telecommunications Cabling Standard Part 2 – Balanced Twisted Pair Cabling Components and subsections.
- d. ANSI/TIA-568-B.3: Commercial Building Telecommunications Cabling Standard Part 3 – Optical Fiber Cabling Components
- e. ANSI/TIA-569-A: Commercial Building Standard for Telecommunications Pathways and Spaces
- f. ANSI/TIA-606: Administration Standard for Telecommunications Infrastructure of Commercial Buildings
- g. ANSI/TIA-607-D: Commercial Building Grounding and Bonding Requirements for Telecommunications
- h. BICSI Telecommunications Distribution Methods Manual (TDMM), Latest Edition
- i. National Fire Protection Agency (NFPA-70): National Electrical Code (NEC)

1.04 Submittals

- A. Comply with requirements of Division 0 and Division 1 - Submittals and as modified below.
- B. Product Data: Submit manufacturer's product literature, technical specifications and similar information for the following items demonstrating compliance with the specified requirements.
 - 1. Motion Detectors, Door Contacts, Keypads
 - 2. Headend Control Panels and Communications Modules
 - 3. Power supplies
 - 4. Copper cable and termination devices.
 - 5. Inner duct and accessories.
 - 6. Wiring diagrams.
 - 7. Controllers
 - 8. Servers
- C. Shop Drawings: Provide complete shop drawings showing all devices, device connections, wiring pathways, wire types, headend equipment elevations and associated components prior to installation, for approval by designer.

- D. Samples: Provide samples of assemblies and connections as described below, prior to installation, for approval by designer.
 - 1. Intrusion Detection cables and connections – Submit samples of cables and terminations to be provided including following components and characteristics:
 - a. Provide all components in colors selected by Design consultant.
- E. Quality Control Submittal
 - 1. Test Reports: Submit complete sample test data and reports with exact labels used on cables termination fields.
 - 2. Certificates
 - a. Manufacturer Certification: Submit certification from manufacturer of products to be installed under this contract certifying that Installer is authorized by manufacturer to install specified products.
 - b. Installer Experience Listing: Submit list of at least 5 completed projects as specified below in “Quality Assurance – Qualifications – Installer.”
- F. Contract Closeout Submittal: Comply with requirements of Division 0, including submission of operating and maintenance instructions as item in “Operation and Maintenance Data” manual described in that Section.

1.05 Quality Assurance

- A. All Work shall be installed in a first class, neat and workmanlike manner by skilled Technicians. The quality of the workmanship shall be subject to inspection and approval by authorized school district personnel. Any work found to be of inferior quality and/or workmanship shall be replaced and/or reworked until the approval of school district personnel is obtained.
- B. Qualifications
 - 1. Installer
 - a. Qualified to cable, terminate, program and test Intrusion Detection systems, and associated power wiring specified in this Section and other Division 17000 series specifications, certified by manufacturer of products to be installed, and completed at least 5 installations of similar size, nature and complexity as specified for this project.
- C. Conditions for Consideration of "Or Equal" Products: Where products are specified by name and accompanied by the term "or equal", the proposed "or equal" product will be considered when the following conditions are satisfied. If all the following conditions are not satisfied, Design Consultant will return requests without action, except to record noncompliance with these requirements:
 - 1. Proposed product does not require extensive revisions to the Contract Documents.
 - 2. With the exception of the product name or number and manufacturer's name, proposed product conforms with requirements indicated on the Drawings and in the Specifications in every respect and will produce indicated results.

3. Proposed product is fully documented and properly submitted.
4. Proposed product has received necessary approvals of authorities having jurisdiction.
5. Proposed product is compatible with AND has been coordinated with other portions of the Work.
6. Proposed product provides specified warranty.
7. If proposed product involves more than one contractor, proposed product has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
8. Submission is accompanied with detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
9. Submission is accompanied with a list of similar installations for completed projects with project names and addresses and names and addresses of design consultants and authorities, if requested.
10. Submission is accompanied with proposed product's Manufacturer signed written statement on Manufacturer's letterhead, certifying that manufacturer complies with requirements in the Contract Documents.

1.06 Warranty

- A. Installer's Warranty: Provide manufacturer's system warranty against electrical or mechanical defects for 2 years from date of final acceptance.
- B. Manufacturer warranty coverage for cable systems associated with the Intrusion Detection System

1.07 Training

- A. Installing contractor shall provide a minimum of 8 hours of training on system operation and managements as part of their scope of work.
 1. Additional hours shall be provided on a time and materials basis at the request of the owner.
- B. Installing contractor shall provide a video recording on a standard format DVD to the owner which includes training sessions.

1.08 Operation And Maintenance Manuals

- A. Installing contractor shall provide a minimum of two hardcopy and one electronic copy of all operation and maintenance manuals to the owner at project completion.

PART 2 - PRODUCTS

2.01 Manufacturers

- A. Basis of Design

1. Honeywell
- 2.02 Intrusion Detection
- A. Control Panel
 1. Honeywell
 - a. Up to 599 points
 - b. Support for 32 Keypads
 - c. Up to 8 partitions
 2. Plug-in Phone Line
 - a. Honeywell
 3. Cellular Communicator
 - a. Honeywell
 4. Ethernet Module
 - a. Honeywell
 5. Keypads
 - a. Honeywell with LCD Display
 6. Motion Detectors
 - a. Wide Angle
 - b. Medium Range
 - c. Long Range
 7. Door Contacts (DPDT Type)
 - a. ¾” Recessed
 - b. Surface Mount
 - c. Overhead Door
 8. Expansion Modules
 - a. Honeywell Expander
 9. Wired Panic Button
 - a. ISC-PB1-100
 - i. Provide and install 2 units in the main office
 - ii. Provide and install 1 unit in the principal office

10. Wireless Panic Button
 - a. Bosch Radion RFPB-TB-A
 - i. Provide 2 units
 11. Wireless Receiver and Repeater
 - a. Honeywell
 - i. Install no more than 800 ft. from the control panel.
 - ii. Exact location TBD in the field
 - b. Radion RFRP-A
 - i. Install 8 units around the building for coverage, locations to be determined in the field
 12. Power Supplies
 - a. Located in MDF and IDF Rooms as required.
 13. Cable
 - a. Two Conductor 18 AWG min
 - b. Four Conductor 18 AWG min
 14. Battery Backup
 - a. Provide properly sized backup battery power supply for full system operation.
- B. Cable/Wiring
1. ALL CABLE/WIRING SHALL BE RUN IN WHITE, EMT CONDUIT. Provide Allied True Color products, or equal. All junction boxes are to be painted white to match conduit. All wiring shall be concealed. No surface metal raceway shall be used unless approved by owner, and if approved, shall be painted to match adjacent wall color.
 - a. General: 18-AWG, 4-wire, unshielded.
 2. Surge Protection: Provide transient surge protection devices on the power feeds for all major components of equipment. This shall include equipment with electronic components such as the control panel. Surge protection devices shall be UL listed, equal to Transtector or Isobar. The devices shall have a 5 nanosecond or less response time for clipping excessive voltage. The surge protection devices shall consist of solid state circuitry, will automatically reset after an operation with no degradation in protective capability and have an indicated light to indicate when the unit is non-operational. Devices shall be direct plug-in type, plug strip type, or hard-wired connection type as applicable.

PART 3 - EXECUTION

3.01 Examination

- A. Verification of Conditions: Examine conditions under which Intrusion Detection cabling and equipment and related components are to be installed in coordination with Installer of materials and components specified in this Section and notify affected Prime Contractors and Design consultant in writing of any conditions detrimental to proper and timely installation. Do not proceed with installation until unsatisfactory conditions have been corrected to ensure a safe and timely installation.
 - 1. When Installer confirms conditions as acceptable to ensure proper and timely installation and to ensure requirements for applicable warranty or guarantee can be satisfied, submit to Design consultant written confirmation from applicable Installer. Failure to submit written confirmation and subsequent installation will be assumed to indicate conditions are acceptable to Installer.
 - 2. Visit Site to identify and become familiar with existing field conditions and specific requirements of each Site.
 - 3. Verify all dimensions in field and confirm condition of existing hardware to be utilized.
 - 4. Confirm space requirements and physical confines of all work areas to ensure that all materials can be installed in indicated spaces.
 - 5. Confirm all outlet locations and cable pathways and advise Design consultant in writing of any discrepancies or issues in Design described in Contract Documents.

3.02 Preparation

- A. Protection: Provide adequate protection of equipment and hardware before and after installation.
- B. Existing Intrusion Detection Equipment: Ensure all systems remain operational throughout the project.
 - 1. Identify any circuits and/or wiring at the site not shown on TY-Drawings and interfering with installation of specified Equipment.
 - 2. Remove all accessible portions of abandoned communications cabling per NEC 800.52. Tag all communications cabling not terminated at both ends but retained for future use.

3.03 Installation

- A. Provide and install all components necessary to install a complete Intrusion Detection System, including (but is not limited to) connectors, sensors, panels, power supplies, terminators, etc...
 - 1. Cable runs shall be per manufacturer's recommendations in all cases. Any deviation will result in system rejection.
 - 2. Secure all horizontal cables within ceiling cavities to building structure.
 - 3. Loosely bundle all cables and support from structure at unequal intervals from 5 to 6 feet with spring steel fasteners and cable clip rated for use with high performance

cables where cable tray or other support structure has not been provided as indicated on Drawings. All mounting clips shall be seismic type as per BOCA.

4. Do not violate manufacturer's recommended loadings. Leave 30% capacity for future use of pathway.
 5. Do not support cables from ceiling grid T-Bars, grid wire supports or bridle rings. Do not allow cables to touch ceiling grid.
 6. Install cables in EMT conduit in all unfinished, exposed areas as shown in Design consultant and Architectural roof plans and/or TY-Drawings, unless alternate pathways are noted.
 7. Do not secure cables with permanent cable ties. Do not tighten cable bundles in such a way as to cause jacket deformation
 8. Place cables in compliance with ANSI/TIA-568.B standards and BICSI recommended methods.
 9. Tight 90-degree bends are unacceptable, and use of plastic "cinch-type" tie-wraps are not permitted, in order to prevent damage to cable jacket and compromise the cable's electrical or optical characteristics.
 10. Cable bundles shall be neatly routed with a service loop to provide 10 feet of slack at the cross-connect end and as noted in the T-drawings. Cable bundles shall be secured using only black Velcro cable wraps.
- B. Install all exposed cabling in surface raceway by Wiremold, Hubbell or Panduit where in-wall conduit has not been provided. Follow all manufacturers' guidelines requirements regarding bending radius and slack. All bends, offsets and fittings shall be appropriately sized to provide 30% capacity after installation.
- C. Install all cables in accordance with National, state and local codes and ANSI/TIA Standards, and BICSI methods.
1. Follow manufacturer's guidelines and requirements for all cable termination.
 2. Identification: Provide permanent identification labels for patch panels, access panels and entrance facilities.

3.04 Testing

A. Intrusion Detection System

1. Upon completion of work, all parts of the systems installation shall be tested by the installing Contractor and demonstrated free of any defects. Preliminary testing will be permitted but shall not be accepted in lieu of obtaining final test results. Final test results shall be accomplished by the use of proper test equipment for the system being tested.
2. Each device shall be demonstrated to individually alarm and pinpoint the exact triggered sensor. Any system failing this requirement will be wholly rejected at the contractor's expense.

3. Re-terminate and re-test any cables or pairs of cables failing end-to-end testing requirements. Replace any faulty cables/pairs or termination devices. Remove all defective cables completely from pathways.

3.05 As-Built

- A. All devices shall be shown in their accurate location
- B. All equipment and cables shall be properly identified and labeled.
- C. Accurate as-built drawings shall be provided in electronic and hard copy format.
 1. 3 copies of electronic (CAD) drawings shall be distributed on appropriate media: 1 to construction management, 1 to designers and 1 to school district personnel.
 2. 3 hard copies of CAD drawings shall be plotted on full size sheets and test results of every installed cable have been given to the construction management for appropriate distribution.

3.06 Demonstration

- A. Intrusion Systems Demonstration
 1. 16 Hours of demonstration and training on all aspects of the completely installed systems must be provided for the owner.
 - a. Training shall be video recorded for the owner and given to them after acceptance.
 - b. Training and system demonstration must include all aspects of the system and its operation.
 - c. Additional training, beyond the initial 16 hours, shall be provided for the owner at their request on an hourly rate basis.

3.07 Acceptance

- A. The contractors work shall be considered complete after the following conditions have been met:
 1. Cable and equipment installation is complete and all cables and equipment have been tested and documented to be installed according to specifications and drawings. Use form at the bottom of this specification for zone descriptions and delineation.
 2. A school district Security representative has successfully tested the “LIVE” system.
 3. All punch list items have been reconciled.
 4. All disturbed ceiling panels, covers, etc. have been properly reinstalled.
 5. All materials and trash have been removed from the site.
 6. A 2-Year Installers warranty has been given to a school district Security representative.
 7. Submit Manufacturers Extended Warranty Application.

PAUL M. HODGSON VOCATIONAL
TECHNICAL HIGH SCHOOL

Subscriber Name _____

☐ ADDENDUM TO A NEW SUBSCRIBER MONITORING AGREEMENT.
☐ CHANGE TO DATA ON AN EXISTING SUBSCRIBER ACCOUNT.

FOR YOUR CONVENIENCE, PANEL PRINT OLITS ARE ACCEPTED. HOWEVER, PLEASE INDICATE CALLBACK OPTION. EXCLUSION OF THIS INFORMATION MAY DELAY THE PROCESSING OF A SUBSCRIBER MONITORING AGREEMENT. IF YOU HAVE ANY QUESTIONS, PLEASE CONTACT YOUR SALES REPRESENTATIVE.

PANEL: ☐ Honeywell OTHER (SPECIFY) _____
 PARTITIONED: ☐ NO ☐ YES (DEFINE BELOW)

1	5
2	6
3	7
4	8

[illegible]

Bid Pack D – Building Envelope & Fit Out

**SECTION 28 11 00
ACCESS CONTROL SYSTEM**

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Access Control cabling
- B. Access Control sensors
- C. Access Control devices
- D. Access Control headend equipment
- E. Access Control Hardware, Panels, Nodes, Card Readers, Servers, Software and associated cabling.
- F. Associated power supplies, terminations, equipment, labeling and associated cable performance testing.

1.02 Definitions

- A. Access Control system refers to system database to allow or prevent access to the facility.
- B. Access Control system refers equipment including card readers, door controllers, access control panels, access control cards, access control database, door contacts, control panels, communication panels, power supplies, expansion modules and associated wiring.

1.03 System Description

- A. Design Requirements
 - 1. Provide labor, materials, equipment, services and operations required for complete installation of an integrated Access Control System with the electric door hardware, intrusion detection system and CCTV system.
 - 2. Remote Access
 - a. The system shall provide a method for users to remotely access the system and perform all of the functions possible on an operator terminal by LAN (IP). Provide Cat 6 cable and associated connections to school's data network. Install associated system software on all administrative and custodial office computers (pc's) for controlling and monitoring system. Turn over software disc to owner after installations.
 - 3. Provide labor, materials, equipment, services and operations required for a complete installation of an Access Control System.
 - a. Base panel
 - b. Expansion modules
 - c. Card Readers
 - d. Door Controllers

- e. Communication Modules
 - f. Power Supplies
 - g. Controllers
 - h. Servers
 - i. Cabling and connectors
 - j. Application Software
4. All wiring shall be wired according to the manufacturer's specifications.
- a. Refer to notes on each drawing to determine exact installation methods.
 - b. Strictly adhere to most current version of ANSI/TIA Telecommunications cabling standards.
 - c. Permanently identify and label all cables and termination devices, at distribution rack and workstation in accordance with ANSI/TIA-606 Standard or as agreed by Design consultant and Authority.
 - d. Remove and replace any cables failing to meet end-to-end testing requirements; do not abandon cable in place. All cable shall be terminated at both ends, unless noted in TY-Drawings.
- B. Performance Requirements
- C. Access Control System Requirements
- 1. The system shall interface with the Building Controls System at the facility.
 - 2. The system shall allow or prevent access to the facility and certain areas of the facility.
 - 3. The system shall provide notification of events occurring on the system.
 - 4. The system shall be on emergency power systems.
 - 5. The system shall be on the local area network.
 - 6. The system shall be connected to the Intrusion Detection System.
 - 7. The system shall integrate with other currently installed systems within the district.
 - 8. The system shall allow for a key to override any lock.
 - 9. The system shall be field controllable and programmable.
 - 10. The system shall allow for instantaneous deletion of a card holder from the system.
 - 11. The system shall allow for access restriction.
 - 12. The system shall have a backup database.

13. The contractor shall be responsible for form, fit, function, and coordination of all part numbers listed above, and bring to owner's attention any changes or substitutions for approval.
14. Indoor/outdoor card readers shall be recessed. No exposed conduit shall be used.
15. No surface metal raceway shall be used unless approved by the owner, and if approved, shall be painted to match adjacent wall color.
16. The system shall be capable of being scheduled.
17. The systems will be capable of communicating onsite as well as to remote locations.
18. The systems shall be controllable in case of an emergency situation.
19. All systems shall operate on dedicated circuits with associated cabling in EMT.

D. Codes

1. Comply with applicable requirements in Local, State and Federal Codes, ANSI/TIA Standards, and BICSI methodology.
2. Specified cabling system derived from recommendations in approved telecommunications industry codes, standards and methods, including the following documents:
3. ANSI/TIA-568-C.0: Generic Telecommunications Cabling for Customer Premises.
4. ANSI/TIA-568-C.1: Commercial Building Telecommunications Cabling Standard
5. ANSI/TIA-568-C.2: Balanced Twisted Pair Cabling and Components Standard
6. ANSI/TIA-568-C.3: Optical Fiber Cabling Components Standard
7. ANSI/TIA-569-B: Commercial Building Standard for Telecommunications Pathways and Spaces
8. ANSI/TIA-570-B: Residential Telecommunications Cabling Standard
9. ANSI/TIA-606-A: Administration Standard for Telecommunications Infrastructure of Commercial Buildings
10. ANSI-J-STD-607-D: Commercial Building Grounding and Bonding Requirements for Telecommunications
11. ANSI/TIA-758-A: Customer-Owned Outside Plant Telecommunications Cabling Standard
12. BICSI Telecommunications Distribution Methods Manual (TDMM), Latest Edition

1.04 National Fire Protection Agency (NFPA-70): National Electrical Code (NEC) Submittals

- A. Comply with requirements of Division 0 and Division 1 - Submittals and as modified below.

- B. Product Data: Submit manufacturer's product literature, technical specifications and similar information for the following items demonstrating compliance with the specified requirements.
 - 1. Card Readers
 - 2. Network nodes
 - 3. Network Node cards
 - 4. Access Controllers
 - 5. Headend Control Panels and Communications Modules
 - 6. Power supplies
 - 7. Copper cable and termination devices.
 - 8. Inner duct and accessories.
 - 9. Wiring diagrams.
 - 10. Servers
- C. Shop Drawings: Provide complete shop drawings of the system including floor plan locations, door elevation details and wiring details.
 - 1. Access Control cables and devices – Submit samples of cables and terminations to be provided including following components and characteristics:
 - a. Provide all components in colors selected by Design consultant.
- D. Quality Control Submittal
 - 1. Test Reports: Submit complete sample test data and reports with exact labels used on cables termination fields.
 - 2. Certificates
 - a. Manufacturer Certification: Submit certification from manufacturer of products to be installed under this contract certifying that Installer is authorized by manufacturer to install specified products.
 - b. Installer Experience Listing: Submit list of at least 5 completed projects as specified below in "Quality Assurance – Qualifications – Installer."
- E. Contract Closeout Submittal: Comply with requirements of Division 0, including submission of operating and maintenance instructions as item in "Operation and Maintenance Data" manual described in that Section.

1.05 Quality Assurance

- A. All Work shall be installed in a first class, neat and workmanlike manner by skilled Technicians. The quality of the workmanship shall be subject to inspection and approval by authorized school district personnel. Any work found to be of inferior quality and/or

workmanship shall be replaced and/or reworked until the approval of school district personnel is obtained.

B. Qualifications

1. Installer

- a. Qualified to cable, terminate, program and test Intrusion Detection systems, and associated power wiring specified in this Section and other Division 17000 series specifications, certified by manufacturer of products to be installed, and completed at least 5 installations of similar size, nature and complexity as specified for this project.

C. Conditions for Consideration of "Or Equal" Products: Where products are specified by name and accompanied by the term "or equal", the proposed "or equal" product will be considered when the following conditions are satisfied. If all the following conditions are not satisfied, Design Consultant will return requests without action, except to record noncompliance with these requirements:

1. The proposed product does not require extensive revisions to the Contract Documents.
2. With the exception of the product name or number and manufacturer's name, proposed product conforms with requirements indicated on the Drawings and in the Specifications in every respect and will produce indicated results.
3. The proposed product is fully documented and properly submitted.
4. The proposed product has received necessary approvals of authorities having jurisdiction.
5. The proposed product is compatible with AND has been coordinated with other portions of the Work.
6. The proposed product provides the specified warranty.
7. If proposed product involves more than one contractor, proposed product has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
8. The submission is accompanied with detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
9. The submission is accompanied with a list of similar installations for completed projects with project names and addresses and names and addresses of design consultants and authorities, if requested.
10. The submission is accompanied with the proposed product's Manufacturer signed written statement on Manufacturer's letterhead, certifying that manufacturer complies with requirements in the Contract Documents.

1.06 Warranty

- A. Installer's Warranty: Provide manufacturer's system warranty against electrical or mechanical defects for 2 years from date of final acceptance.
- B. A fifteen (15) year Extended Product Warranty and Systems Assurance Warranty for UTP camera wiring system shall be provided by the Manufacturer as follows:
 - 1. System Certification: Upon successful completion of the installation and subsequent inspection, the Authority shall be provided with a numbered certificate, from the manufacturing company, registering the installation.

1.07 Training

- A. The installing contractor shall provide a minimum of 8 hours of training on system operation and managements as part of their scope of work.
 - 1. Additional hours shall be provided on a time and materials basis at the request of the owner.
- B. The installing contractor shall provide a video recording on a standard format DVD to the owner which includes training sessions.

1.08 Operation And Maintenance Manuals

- A. The installing contractor shall provide a minimum of two hardcopy and one electronic copy of all operation and maintenance manuals to the owner at project completion.

PART 2 - PRODUCTS

2.01 Manufacturers

- A. Basis of Design
 - 1. Honeywell PW-Series Access Control System
- B. Acceptable Substitutes
 - 1. Avigilon
 - 2. Salto

2.02 Access Control Components (Must fully integrate with the electric hardware included in Division 08)

- A. Honeywell Pro-Watch 5.0
 - 1. Client Software
 - a. Enterprise Edition
 - b. Wireless Reader License
 - c. Aperio Integration (AH30RN38192) or latest related to the hardware.
 - 2. Controllers
 - a. PW6K11C 32 I/O board

- i. Quantity as required to support card reader locations.
- b. PW7K1IC 32 I/O board
 - i. Quantity as required to support card reader locations.
- 3. Dual Reader modules
 - a. PW6K1R2
 - b. PW7K1R2
 - c. Quantity as required to support card reader locations.
- 4. Enclosures
 - a. PW5K1ENC3
 - b. PW5K2ENC1
 - c. Quantity as required to support card reader locations.
- 5. Power Supplies
 - a. PW7KPSU120
- 6. Advanced Logic Relay
 - a. Camden CX-33 (include as needed for complex door integrations)
- 7. Additional Nodes
 - a. Supervised Input Blades
 - b. Relay Controlled Output Blades
 - c. I/O Module, for interface with school's security panel.
 - d. Access Power Controller, for interface with school's fire alarm panel.
 - e. Network Interface Module, for IP network link communications.
- 8. Card Readers
 - a. HID Signo Multi-Class reader 20/40
 - b. Salto
- 9. Access Card/FOB
 - a. Salto Mifare Classic 4K Cards
 - b. Quantity of five-hundred (500).
- 10. Power supply
 - a. Altronix eFlowSeries

- b. Quantity as required to support system.

11. Standby batteries

- a. Quantity as required to support system for specified hours upon loss of power.
Note: Card access system shall be fed from school's emergency generator power source. It is the responsibility of contractor to coordinate with other trades to fulfill this requirement regardless if shown on contract drawings (electrical drawings).

12. Door Contacts

- a. Sentrol DPDT Recessed
- b. MC180 Door Channel Magnet

13. Request-to-exit Sensor

- a. Honeywell IS310
- b. with activation LED on doors where hardware does not provide egress.

14. Access Control Server

- a. Intel Core Xeon, 24 cores, 3.6 GHz Turbo
- b. Workstation Hardware
- c. Windows 2019 Server Enterprise Addition, 64 bit.
- d. Nvidia Quadro P2000, 5 GB
- e. 32 GB DDR4 2666 MHz RDIMM ECC Memory
- f. Raid Array 2
- g. Raid Array 1
- h. 1 TB Sata Hard drive
- i. DVD Drive

15. Card Reader Pedestals

- a. Pedestal Pro 42-3-12 with hood
- b. Pedestal Pro 72-DSP-3-12-12 Dual with Hoods and Extensions

B. Cabling

- 1. Cat 6 UTP Data Cabling
- 2. PW-Series daisy chain cable
- 3. 18/2 AWG Plenum Cable
- 4. 18/4 AWG Plenum Cable

- 5. 18/6 AWG Plenum Cable
- C. Kitchen Doorbell
 - 1. Buzzer
 - 2. Edwards Company No. 340 A-N5, 120 V, 0.05 A
- D. Panic Button
 - 1. Honeywell 5869 (In main office, installed under desk)
- E. Lock Release
 - 1. RCI 909S / 909F
 - 2. Schlage 8200 Series
- F. Pushbutton Plate
 - 1. Edwards Company No. 852 flush-mounted on a nominal 4.5- by 3-inch plate finished in satin chrome, 125-volt at 6 amps, complete with rubber gasket between wall and plate. Normally open contacts.
- G. Pushbutton for buzzer
 - 1. Edwards Company No. 821 locknut weatherproof-type mounted in plate No. 149-1 to fit standard switchbox.
 - 2. Power supply. Quantity as required to support system.
 - 3. Standby batteries. Quantity as required to support system for specified hours upon loss of power. Note: Card access system shall be fed from school's emergency generator power source. It is the responsibility of the contractor to coordinate with other trades to fulfill this requirement regardless if shown on the contract drawings (electrical drawings).
- H. Main Entry Door Video intercoms
 - 1. Axis I8016-LVE Exterior Station
 - 2. Axis TI8602 Wall Mount for Exterior Station
 - 3. 2N Indoor View Interior Station with Desk Stand
 - 4. Axis A9188 Network I/O Relay Module
 - 5. Chime Extension Speaker from Axis
 - 6. Cat 6 UTP
 - 7. 2 Conductor Cable, AWG based on distance and load.

PART 3 - EXECUTION

3.01 Examination

- A. Verification of Conditions: Examine conditions under which Intrusion Detection cabling and equipment and related components are to be installed in coordination with Installer of materials and components specified in this Section and notify affected Prime Contractors and Design consultant in writing of any conditions detrimental to proper and timely installation. Do not proceed with installation until unsatisfactory conditions have been corrected to ensure a safe and timely installation.
 - 1. When the installer confirms conditions as acceptable to ensure proper and timely installation and to ensure requirements for applicable warranty or guarantee can be satisfied, submit to Design consultant written confirmation from applicable Installer. Failure to submit written confirmation and subsequent installation will be assumed to indicate conditions are acceptable to the installer.
 - 2. Visit Site to identify and become familiar with existing field conditions and specific requirements of each Site.
 - 3. Verify all dimensions in field and confirm condition of existing hardware to be utilized.
 - 4. Confirm space requirements and physical confines of all work areas to ensure that all materials can be installed in indicated spaces.
 - 5. Confirm all outlet locations and cable pathways and advise Design consultant in writing of any discrepancies or issues in Design described in Contract Documents.

3.02 Preparation

- A. Protection: Provide adequate protection of equipment and hardware before and after installation.
- B. Existing Intrusion Detection Equipment: Ensure all systems remain operational throughout the project.
 - 1. Identify any circuits and/or wiring at the site not shown on TY-Drawings and interfering with installation of specified Equipment.
 - 2. Remove all accessible portions of abandoned communications cabling per NEC 800.52. Tag all communications cabling not terminated at both ends but retained for future use.

3.03 Installation

- A. Provide and install all components necessary to install a complete Intrusion Detection System, including (but is not limited to) connectors, sensors, panels, power supplies, terminators, etc...
 - 1. Cable runs shall be per manufacturer's recommendations in all cases. Any deviation will result in system rejection.
 - 2. Secure all horizontal cables within ceiling cavities to the building structure.
 - 3. Loosely bundle all cables and support from structure at unequal intervals from 5 to 6 feet with spring steel fasteners and cable clip rated for use with high performance

cables where cable tray or other support structure has not been provided as indicated on Drawings. All mounting clips shall be seismic type as per BOCA.

4. Do not violate manufacturer's recommended loadings. Leave 30% capacity for future use of pathway.
 5. Do not support cables from ceiling grid T-Bars, grid wire supports or bridle rings. Do not allow cables to touch the ceiling grid.
 6. Install cables in EMT conduit in all unfinished, exposed areas as shown in Design consultant and Architectural roof plans and/or T-Drawings, unless alternate pathways are noted.
 7. Do not secure cables with permanent cable ties. Do not tighten cable bundles in such a way as to cause jacket deformation.
 8. Place cables in compliance with ANSI/TIA-568.B standards and BICSI recommended methods.
 9. Tight 90-degree bends are unacceptable and use of plastic "cinch-type" tie-wraps are not permitted, in order to prevent damage to cable jacket and compromise the cable's electrical or optical characteristics.
 10. Cable bundles shall be neatly routed with a service loop to provide 10 feet of slack at the cross-connect end and as noted in the T-drawings. Cable bundles shall be secured using only black Velcro cable wraps.
- B. Install all exposed cabling in surface raceway by Wiremold, Hubbell or Panduit where in-wall conduit has not been provided. Follow all manufacturers' guidelines requirements regarding bending radius and slack. All bends, offsets and fittings shall be appropriately sized to provide 30% capacity after installation.
- C. Install all cables in accordance with National, state and local codes and ANSI/TIA Standards, and BICSI methods.
1. Follow manufacturer's guidelines and requirements for all cable termination.
 2. Identification: Provide permanent identification labels for patch panels, access panels and entrance facilities.

3.04 Testing

A. Access Control System

1. Upon completion of work, all parts of the systems installation shall be tested by the installing Contractor and demonstrated free of any defects. Preliminary testing will be permitted but shall not be accepted in lieu of obtaining final test results. Final test results shall be accomplished by the use of proper test equipment for the system being tested.
2. Each device shall be demonstrated individually and provide all functions as specified by the manufacturer's literature. Any system failing this requirement will be wholly rejected at the contractor's expense.

3. Re-terminate and re-test any cables or pairs of cables failing end-to-end testing requirements. Replace any faulty cables/pairs or termination devices. Remove all defective cables completely from pathways.

3.05 As-Built

- A. All devices shall be shown in their accurate location with associated wiring.
- B. All equipment and cables shall be properly identified and labeled.
- C. Accurate as-built drawings shall be provided in electronic and hard copy format.
 1. 3 copies of electronic (CAD) drawings shall be distributed on appropriate media: 1 to construction management, 1 to designers and 1 to school district personnel.
 2. 3 hard copies of CAD drawings shall be plotted on full size sheets and test results of every installed cable have been given to the construction management for appropriate distribution.

3.06 Demonstration

- A. Access Control Systems Demonstration
 1. 8 Hours of demonstration and training on all aspects of the completely installed systems must be provided for the owner.
 - a. Training shall be video recorded for the owner and given to them after acceptance.
 - b. Training and system demonstration must include all aspects of the system and its operation.
 - c. Additional training, beyond the initial 16 hours, shall be provided for the owner at their request on an hourly rate basis.

3.07 Acceptance

- A. The contractors work shall be considered complete after the following conditions have been met:
 1. Cable and equipment installation is completed, and all cables and equipment have been tested and documented to be installed according to specifications and drawings.
 2. A school district Security and Technology representative has successfully tested the “LIVE” system.
 3. All programming has been provided and entered into the system.
 4. All punch list items have been reconciled.
 5. All disturbed ceiling panels, covers, etc. have been properly reinstalled.
 6. A 2-Year Installers warranty has been given to a school district Security representative.
 7. Submit Manufacturers Extended Warranty Application.

END OF SECTION

SECTION 28 20 00
VIDEO SURVEILLANCE SYSTEM

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Video Surveillance Cabling, Cameras, NVRs, VMS, Control Equipment, cabling and interface units.
- B. Halo Sensors, associated cabling and programming.
- C. Associated power supplies, terminations, labeling and associated cable performance testing.
- D. All materials, terminations, equipment, labeling and associated cable performance testing.

1.02 Definitions

- A. Refer to sections 27 and 28 for applicable definitions and terms.
- B. CCTV and video surveillance refer to the same system and are used interchangeably. Terms refer to the cabling system included in this specification section.

1.03 System Description

- A. Design Requirements
 - 1. Provide labor, materials, equipment, services and operations required for complete installation of a CCTV System.
 - a. Fiber/PoE extenders and associated power wiring shall be homerun from end device location to head equipment location without breaks or splices.
 - b. Cat 6 UTP network cables with all terminations from cameras to switches and control equipment shall be installed without splicing.
 - c. Cables shall be routed from distribution racks throughout the building as shown on T-Drawings.
 - i. Refer to notes on each drawing to determine exact installation methods.
 - ii. Note and record all cable lengths to the nearest foot.
 - iii. Strictly adhere to most current version of ANSI/TIA Telecommunications cabling standards.
 - d. Permanently identify and label all cables and termination devices, at distribution rack and workstation in accordance with ANSI/TIA-606 Standard or as agreed by Design consultant and Authority.
 - e. Remove and replace any cables failing to meet end-to-end testing requirements; do not abandon cable in place. All cable shall be terminated at both ends, unless noted in T-Drawings.

B. CCTV System Requirements

1. The system shall provide notification of events occurring on the system.
2. The system shall be on emergency power systems.
3. The system shall be on the local area network.
4. The system shall integrate with other currently installed systems within the district.
5. The system shall be field controllable and programmable.
6. The system shall allow for access restriction.
7. The contractor shall be responsible for form, fit, function, and coordination of all part numbers listed above, and bring to owner's attention any changes or substitutions for approval.
8. No surface metal raceway shall be used unless approved by the owner, and if approved, shall be painted to match adjacent wall color.

C. Performance Requirements

1. Comply with applicable requirements in Local, State and Federal Codes, ANSI/TIA Standards, and BICSI methodology.
2. Specified cabling system derived from recommendations in approved telecommunications industry codes, standards and methods, including the following documents:
 - a. ANSI/TIA-568-C.0: Generic Telecommunications Cabling for Customer Premises.
 - b. ANSI/TIA-568-C.1: Commercial Building Telecommunications Cabling Standard
 - c. ANSI/TIA-568-C.2: Balanced Twisted Pair Cabling and Components Standard
 - d. ANSI/TIA-568-C.3: Optical Fiber Cabling Components Standard
 - e. ANSI/TIA-569-B: Commercial Building Standard for Telecommunications Pathways and Spaces
 - f. ANSI/TIA-570-B: Residential Telecommunications Cabling Standard
 - g. ANSI/TIA-606-A: Administration Standard for Telecommunications Infrastructure of Commercial Buildings
 - h. ANSI-J-STD-607-D: Commercial Building Grounding and Bonding Requirements for Telecommunications
 - i. ANSI/TIA-758-A: Customer-Owned Outside Plant Telecommunications Cabling Standard
 - j. BICSI Telecommunications Distribution Methods Manual (TDMM), Latest Edition

k. National Fire Protection Agency (NFPA-70): National Electrical Code (NEC)

1.04 Submittals

- A. Comply with requirements of Division 0 and Division 1 - Submittals and as modified below.
- B. Product Data: Submit manufacturer's product literature, technical specifications and similar information for the following items demonstrating compliance with the specified requirements.
 - 1. Video Management System (VMS)
 - 2. Video Recorder Units (NVRs)
 - 3. Cameras.
 - 4. Fiber and PoE extenders.
 - 5. Copper cable, patch cables and termination devices.
 - 6. Video Surveillance Control Software.
 - 7. Video Surveillance Control Servers.
 - 8. Inner duct and accessories.
 - 9. Complete Wiring diagrams including floor plans and elevation diagrams.
 - 10. Sample of each cable test report.
- C. Shop Drawings: Provide complete shop drawings showing all devices, device connections, wiring pathways, wire types, headend equipment elevations and associated components prior to installation, for approval by designer.
 - 1. Shop drawings shall be submitted in AutoCad and PDF format.
- D. Quality Control Submittal
 - 1. Test Reports: Submit complete sample test data and reports with exact labels used on cables and patch panels.
 - 2. Certificates
 - a. Manufacturer Certification: Submit certification from manufacturer of products to be installed under this contract certifying that Installer is authorized by manufacturer to install specified products.
 - b. Installer Experience Listing: Submit list of at least 5 completed projects as specified below in "Quality Assurance – Qualifications – Installer."
- E. Contract Closeout Submittal: Comply with requirements of Division 0, including submission of operating and maintenance instructions as item in "Operation and Maintenance Data" manual described in that Section.

1.05 Quality Assurance

- A. All Work shall be installed in a first class, neat and workmanlike manner by skilled Technicians. The quality of the workmanship shall be subject to inspection and approval by authorized owner personnel. Any work found to be of inferior quality and/or workmanship shall be replaced and/or reworked until the approval of the owner is obtained.
- B. Qualifications
 - 1. Installer
 - a. Qualified to cable, terminate and test data network cabling system, coaxial cable system and associated power wiring specified in this Section and section 271000, certified by manufacturer of products to be installed, and completed at least 5 installations of similar size, nature and complexity as specified for this project.
- C. Conditions for Consideration of "Or Equal" Products: Where products are specified by name and accompanied by the term "or equal", the proposed "or equal" product will be considered when the following conditions are satisfied. If all the following conditions are not satisfied, Design Consultant will return requests without action, except to record noncompliance with these requirements:
 - 1. Proposed product does not require extensive revisions to the Contract Documents.
 - 2. With the exception of the product name or number and manufacturer's name, proposed product conforms with requirements indicated on the Drawings and in the Specifications in every respect and will produce indicated results.
 - 3. The proposed product is fully documented and properly submitted.
 - 4. The proposed product has received necessary approvals of authorities having jurisdiction.
 - 5. The proposed product is compatible with AND has been coordinated with other portions of the Work.
 - 6. Proposed product provides specified warranty.
 - 7. If proposed product involves more than one contractor, proposed product has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
 - 8. The submission is accompanied with detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
 - 9. The submission is accompanied with a list of similar installations for completed projects with project names and addresses and names and addresses of design consultants and authorities, if requested.
 - 10. The submission is accompanied with the proposed product's Manufacturer signed written statement on Manufacturer's letterhead, certifying that manufacturer complies with requirements in the Contract Documents.

1.06 Warranty

- A. Installer's Warranty: Provide manufacturer's system warranty against electrical or mechanical defects for 2 years from date of final acceptance.
- B. A fifteen (15) year Extended Product Warranty and Systems Assurance Warranty for UTP camera wiring system shall be provided by the Manufacturer as follows:
 - 1. System Certification: Upon successful completion of the installation and subsequent inspection, the Authority shall be provided with a numbered certificate, from the manufacturing company, registering the installation.
- C. Manufacturer warranty coverage for fiber systems associated with the CCTV System.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Video Surveillance Equipment (No substitutions)
 - 1. Milestone VMS
 - 2. Milestone NVRs
 - 3. Cisco Meraki Switching Equipment (Owner Furnished, Contractor Installed)
 - 4. Axis Cameras (Basis of Design)
 - a. Acceptable Substitutes
 - i. Avigilon
 - ii. Vicon
 - b. Cameras must be listed as compatible partner products on the Milestone website.
- B. Licensing
 - 1. Provide all necessary VMS, NVR and Camera licenses for the complete system.
- C. 4-Post Equipment Rack
 - 1. Floor mounted 4-Post Equipment Rack.
 - 2. See Section 270500 / 271000 / 28 05 01 for details.
- D. Cabling Components for video surveillance systems.
 - 1. UTP Camera Cabling (Plenum Rated)
 - a. CCTV System cabling shall be a distinct color.
 - b. Camera cabling shall provide identical performance to Cat 6 UTP data and voice cabling included in Section 27 10 00 and meet all district performance criteria.

- c. Third-party verified to meet ANSI/TIA Category 6 requirements. All completed cabling channels fully backwards compatible with requirements of Category 5 and 5e cabling systems.
 - d. See section 27 10 00 for cabling requirements.
 - 2. Patch Panels for CCTV Cabling
 - a. All patch panels must provide identical performance to Cat 6 patch panels included in Section 27 10 00 and meet all district performance criteria.
 - b. Shall meet requirements for category 6 (per SCHOOL DISTRICT standards) performance requirements.
 - c. Panels shall contain the number of termination ports required to terminate all LAN and telephone jacks in the service area, plus 20% spare capacity.
 - d. Acceptable units:
 - i. See section 27 10 00.
 - e. Panels shall contain the number of termination ports required to terminate all LAN and telephone jacks in the service area, plus 20% spare capacity.
 - 3. Patch Cables for CCTV Cabling
 - a. Factory terminated and tested UTP patch cables at workstation and equipment cross-connect meeting requirements of ANSI/TIA-568-B for patch cable testing.
- E. Video Management System
 - 1. Milestone XProtect Expert
- F. Video Surveillance NVRs / Servers
 - 1. Dell
 - 2. Husky IVO
- G. CCTV Cameras (Provide latest model)
 - 1. Exterior cameras shall be an Axis P3268-LVE 8 MP dome pendant/wall mount color units.
 - 2. Interior units shall be an Axis P3268-LV 8 MP dome ceiling/wall mount with associated mounts.
 - 3. Interior cameras shall be Axis P3818-PVE 13MP 180 Degree Network Camera dome ceiling/wall mount with associated mounts.
 - 4. 360° Cameras shall be Axis M3719-PLE MP 15 MP Network Camera dome pendant/wall mount with associated mounts.
- H. Pole Enclosure
 - 1. Altronix WP3 with pole mount kit.

- I. The owner shall provide the system with static IP addresses as needed for multiplexers, and remote master viewing station (PCs) access. Contractor shall supply the Owner with a minimum of (4) copies/licenses of software.
- J. The Owner shall supply remote viewing station PCs.
- K. Provide ceiling or wall mount bracket to support flat screen LCD TVs/all-in-one PCs as indicated on drawings. These TVs shall be fed network cabling and allow for CCTV viewing.
- L. CCTV Wiring
 - 1. Leviton One Reach system (for site cameras) over 90 meters.
 - 2. Singlemode Fiber.
 - 3. Cat 6 UTP.
 - 4. 18/2 AWG.
- M. Halo Sensors
 - 1. Halo Sensor 2C
 - 2. Cat 6 UTP with surface box and patch cord
 - a. Install in a similar manner to CCTV cameras. See CCTV camera details for information.
 - 3. Programming
 - a. Integrate / Program with VMS so cameras are activated / alerted when the sensor is alarmed.
 - b. Audible Alarm is triggered when the sensor is alarmed.

PART 3 - EXECUTION

3.01 Examination

- A. Verification of Conditions: Examine conditions under which CCTV cabling and equipment and related components are to be installed in coordination with Installer of materials and components specified in this Section and notify affected Prime Contractors and Design consultant in writing of any conditions detrimental to proper and timely installation. Do not proceed with installation until unsatisfactory conditions have been corrected to ensure a safe and timely installation.
 - 1. When the installer confirms conditions as acceptable to ensure proper and timely installation and to ensure requirements for applicable warranty or guarantee can be satisfied, submit to Design consultant written confirmation from applicable Installer. Failure to submit written confirmation and subsequent installation will be assumed to indicate conditions are acceptable to the installer.
 - 2. Visit Site to identify and become familiar with existing field conditions and specific requirements of each Site.

3. Verify all dimensions in field and confirm condition of existing hardware to be utilized.
4. Confirm space requirements and physical confines of all work areas to ensure that all materials can be installed in indicated spaces.
5. Confirm all outlet locations and cable pathways and advise Design consultant in writing of any discrepancies or issues in Design described in Contract Documents.

3.02 Preparation

- A. Protection: Provide adequate protection of equipment and hardware before and after installation.
- B. Existing Communications Services: Ensure all telecommunications systems (voice, video and data) remain operational throughout the project.
 1. Identify any circuits and/or wiring at the site not shown on T-Drawings and interfering with installation of specified Equipment.
 2. Remove all accessible portions of abandoned communications cabling per NEC 800.52. Tag all communications cabling not terminated at both ends but retained for future use.

3.03 Installation

- A. Provide and install all components necessary to install complete telecommunications cabling and equipment systems, including (but is not limited to) connectors, patch cables, terminators, etc...
 1. Cable runs shall be continuous and unbroken from end to end. Splicing of any LAN, Horizontal, Homerun multi conductor cable or coaxial video distribution cable is prohibited.
 2. Secure all horizontal cables within ceiling cavities to the building structure.
 3. Loosely bundle all cables and support from structure at unequal intervals from 5 to 6 feet with spring steel fasteners and cable clip rated for use with high performance cables where cable tray or other support structure has not been provided as indicated on Drawings. All mounting clips shall be seismic type as per BOCA.
 4. Do not violate manufacturer's recommended loadings. Leave 30% capacity for future use of pathway.
 5. Verify all horizontal cable run lengths prior to installation. Re-distribute horizontal cabling to maintain distance requirements and maintain pathway route accessibility.
 6. Do not support cables from ceiling grid T-Bars, grid wire supports or bridle rings. Do not allow cables to touch the ceiling grid.
 7. Install cables in EMT in all unfinished, exposed areas as shown in Design consultant and Architectural roof plans and/or T/TY-Drawings, unless alternate pathways are noted.

8. Do not secure cables with permanent cable ties. Do not tighten cable bundles in such a way as to cause jacket deformation or damage.
 9. Provide a minimum of 15' of cable slack at camera location and 10 feet at patch panels, unless noted otherwise. Do not coil cable slack.
 10. Place cables in compliance with ANSI/TIA-568.C standards and BICSI recommended methods.
 11. Tight 90-degree bends are unacceptable and use of plastic "cinch-type" tie-wraps are not permitted, in order to prevent damage to cable jacket and compromise the cable's electrical or optical characteristics.
 12. Cable bundles shall be neatly routed with a service loop to provide 10 feet of slack at the cross-connect end and as noted in the T/TY-drawings. Cable bundles shall be secured using only black Velcro cable wraps.
 13. Contractor shall not secure service loop in coils, but route in such a manner as to minimize EMI.
- B. Install all exposed cabling in surface raceway by Wiremold, Hubbell or Panduit where in-wall conduit has not been provided. Follow all manufacturers' guidelines requirements regarding bending radius and slack. All bends, offsets and fittings shall be appropriately sized to provide 30% capacity after installation.
- C. Install all cables in accordance with National, state and local codes and ANSI/TIA Standards, and BICSI methods.
1. Follow manufacturer's guidelines and requirements for all cable termination.
- D. Properly terminate all cables at camera locations and distribution racks. Permanently identify all cables in pullboxes, transition points, and termination points by affixing pre-marked self-adhesive wraps similar to Brady "B-500+ Plastic Cloth Markers."
- E. Permanently identify all system components following ANSI/TIA 606 "Administration Standard for Commercial Telecommunications Infrastructure" with identification format:
1. Identification: Provide permanent identification labels for patch panels, access panels and entrance facilities.

3.04 Testing

- A. Video Surveillance System
1. Upon completion of work, all parts of the telecommunications installation shall be tested by the low voltage Contractor and demonstrated free of any defects. Preliminary testing will be permitted but shall not be accepted in lieu of obtaining final test results. Final test results shall be accomplished by the use of proper test equipment for the system being tested.
 2. Re-terminate and re-test any cables or pairs of cables failing end-to-end testing requirements. Replace any faulty cables/pairs or termination devices. Remove all defective cables completely from pathways.

3. All aspects of the management and control system shall be tested and shown to operate as specified by the manufacturer.

3.05 As-Built

- A. Accurate as-built drawings shall be provided in electronic and hard copy format.
 1. 3 copies of electronic (CAD) drawings shall be distributed on appropriate media: 1 to construction management, 1 to designers and 1 to the school district.
 2. 3 hard copies of CAD drawings shall be plotted on full size sheets and test results of every installed cable have been given to the construction management for appropriate distribution.
- B. As-builts shall accurately show all devices, wiring, control equipment, rack elevations, equipment elevations and system interconnections.

3.06 Demonstration

- A. Video Systems Demonstration
 1. 8 Hours of demonstration and training on all aspects of the completely installed systems must be provided for the owner.
 - a. Training shall be video recorded for the owner and given to them after acceptance.
 - b. Training and system demonstration must include all aspects of the system and its operation.
 - c. Additional training, beyond the initial 8 hours, shall be provided for the owner at their request on an hourly rate basis.

3.07 Acceptance

- A. The contractors work shall be considered complete after the following conditions have been met:
 1. Cable installation is complete and all cable runs have been tested and documented to be installed according to specifications and drawings.
 2. Equipment installation is complete and all aspects of the system have been shown to operate as per manufacturer's specifications.
 3. A school district security representative has successfully tested the "LIVE" system.
 4. All punch list items have been reconciled.
 5. All disturbed ceiling panels, covers, etc. have been properly reinstalled.
 6. All materials and trash have been removed from the site.
 7. A 2-Year Installers warranty has been given to a district Security representative.
 8. Submit Manufacturers Extended Warranty Application.

END OF SECTION

DIVISION 28 SECTION 28 31 12
PUBLIC SAFETY – FIRST RESPONDER RADIO AMPLIFICATION SYSTEM
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SECTION 2 31 12
PUBLIC SAFETY – FIRST RESPONDER RADIO AMPLIFICATION SYSTEM

PART 1 GENERAL

1.1 SCOPE

- A. This specification includes performance requirements for Public Safety and Fire Responder radio amplification systems in structures in accordance with the provisions of NFPA 1 – Uniform Fire Code.
- B. System shall be as approved by the State Fire Marshal and the local Jurisdiction.
- C. System shall be provided in a full turn-key fashion. Locations of quantities and devices on drawings shall be verified and supplemented as required.
- D. To amplify the signals inside a building or structure not meeting the referenced standards, an FCC type-accepted Bi- Directional Amplifier (BDA) with any of the following shall be installed in order to achieve the required radio coverage: a radiating cable system, a distributed antenna system, or a combination thereof, shall be used as needed.

1.2 RELATED SECTIONS

- A. Division 26 -- Electrical

1.3 REFERENCES

- A. The system, equipment, installation, and operation shall comply with the current provisions of the following standards and publications:
 - 1. National Electric Code, Article 70.
 - 2. National Fire Protection Association Standards:
 - a. NFPA72 National Fire Alarm Code
 - b. NFPA 1 Uniform Fire Code
 - c. NFPA101 Life Safety Code
 - 3. Local and State Building Codes.
 - 4. Local Authorities Having Jurisdiction.
 - 5. Underwriters Laboratories Inc.: The system and all components shall be listed by Underwriters Laboratories, Inc
 - 6. State of Delaware Fire Prevention Code.
 - 7. FCC.

1.4 DEFINITIONS

- A. Authorized Company: A company that employs individuals that are qualified by the equipment manufacturer in writing to work on the repeater system.
- B. DAQ: Delivered Audio Quality Definitions: This is a universal standard often cited in system designs and specifications.
- C. FCC: Federal Communications Commission.
- D. OET 65 Standards: FCC's Bulletin 65 provides Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields.
- E. Public Safety/First Responder: Public Safety or First Responder agencies which are charged with the responsibility of responding to emergency situations. These include, but are not limited to: Law enforcement department, fire departments, and emergency medical companies.
- F. Radio Component of a radio amplification system that receives a signal and retransmits that signal, helping the signal to travel over a greater range.

1.5 SUBMITTALS

- A. Product Data: The Contractor shall submit six (6) complete sets of documentation within 30 calendar days after award of purchase order. Indicated in the documentation will be the type, size, rating, style, catalog number, manufacturers' names, photos, device address list, and/or catalog data sheets for all items proposed to meet these specifications. The proposed equipment shall be subject to the approval of the Engineer and no equipment shall be ordered or installed on the premises without that approval. The Contractor shall provide hourly Service Rates and Annual inspection prices, performed by factory trained and authorized personnel, with the submittal. Proof of that training and authorization of the servicing representative shall be included in the submittal. These hourly service rates shall be guaranteed for a one-year period unless otherwise specified.
- B. Shop Drawings: A complete set of Shop Drawings, one for each unit sub-assembly which requires that a field wire be connected to it, shall be supplied. The Shop Drawings shall be reproduced electronically from a Master Copy supplied by the manufacturer in digital format. Provide shop drawings as follows:
 - 1. Large scale drawing of the control panel and wiring diagram.
 - 2. Large scale drawing of the layout, configurations, and terminations.
 - 3. Single line riser diagram showing all equipment and type, number and size of all conductors.
 - 4. Large scale floor plan drawing showing device locations and types.
- C. All and any information and data (such as drawings showing device locations and types, riser diagrams, diagrams, approvals, battery calculations, sequence of operation, test data, etc.) required by local authorities. In addition to routine submission of the above material, make an identical submission to the authorities having jurisdiction. Include copies of annotated

Contract Drawings as needed to depict component locations to facilitate review. Upon receipt of comments from the authorities having jurisdiction, submit them for review. Resubmit if required to make clarifications or revisions to obtain approval.

- D. Close-out Submittals: Two (2) copies of the following Manual shall be delivered to the Owner's representative at the time of system acceptance. The close out submittals shall include:
1. Operating manuals covering the installed Life Safety System.
 2. Point-to-Point diagrams of the entire System as installed. This shall include all connected and addressable field modules. All drawings shall be provided in CAD and supplied in standard DXF format. Vellum plots of each sheet shall also be provided. A system generated point-to-point diagram is required to ensure accuracy.
 3. The application program listing for the system as installed at the time of acceptance by the building owner and/or Local AHJ (Disk and Hard copy printout).
 4. Name, address and telephone of the authorized factory representative.
 5. All drawings must reflect device address and programmed characteristics as verified in the presence of the engineer and/or the end user unless device addressing is electronically generated, and graphically printed.
 6. Submit simultaneously with the close-out submittals, complete operating and maintenance manual listing the manufacturer's name(s) including technical data sheets.
 7. Wiring diagrams shall indicate internal wiring for each item of equipment and the interconnections between the items of equipment. Drawings shall identify all terminals and illustrate all device wiring connections.
 8. Provide a clear and concise description of operation that gives, in detail, the information required to properly operate the equipment and system.
- E. Certifications: Together with the shop drawing submittal, submit a certification from the major equipment manufacturer indicating that the proposed supervisor of installation and the proposed performer of contract maintenance is an authorized representative of the major equipment manufacturer. Include names and addresses in the certification.
- F. System operation description covering this specific project, including method of operation and supervision of each type of circuit and sequence of operations for all manually and automatically initiated system inputs and outputs. Manufacturer's standard descriptions for generic systems are unacceptable.

1.6 WARRANTY

- A. Manufacturer shall guarantee the system equipment for a period of two (2) years from date of final acceptance of the system. The full cost of maintenance, labor and materials required to correct any defect during this two-year period shall be included in the submittal bid. Warranty service shall be provided by a trained specialist of the equipment manufacturer who shall be based in a fully staffed, fully stocked (replacement parts and test equipment) branch office, located within 50 miles of the site.

- B. The Contractor shall guarantee all wiring and raceways to be free from inherent mechanical or electrical defects for one (1) year from date of final acceptance of the system.
- C. Upon completion of the installation of Radio Amplification System equipment, the electrical equipment, the electrical contractor shall provide to the architect a signed written statement, substantially in form as follows: The undersigned, having engaged as the Contractor on the Project confirms that the system equipment was installed in accordance with the wiring diagrams, instructions and directions provided to us by the manufacturer.

1.7 QUALITY ASSURANCE

- A. Qualifications: The Installer shall provide proof of their qualifications as Factory Authorization and Factory Training for the product(s) specified herein. These qualification credentials shall not be more than two years old, to ensure up-to-date product and application knowledge on the part of the Installer.
- B. Warranty: Warranty all materials, installation and workmanship for three (3) years from date of acceptance, unless otherwise specified. A copy of the manufacturers' warranty shall be provided with close-out documentation and included with the operation and installation manuals.
- C. Compliance with Local Requirements: Comply with the applicable building code, local ordinances, and regulations, and the requirements of the authorities having jurisdiction.
- D. The installation of the Radio Amplification System shall be supervised by the systems equipment manufacturer.

PART 2 PRODUCTS

2.1 GENERAL

- A. The system design, and installation, shall in no case exceed the FCC's OET 65 Standards.
- B. Test the required level of signal coverage in the building and to design and install (if required) the in-building signal amplification system. The in-building coverage design shall consider, but is not limited to, the following criteria: FCC limits on BDA output power, power per carrier, signal-to- noise ratio, RF filtering, adjacent band interference, inter-modulation interference and distortion, uplink noise output, antenna locations, and proper cable size.
- C. Minimum Signal Strength and Coverage: For purposes of this section, adequate radio coverage shall be designed in accordance with the following:
 - 1. System shall be designed to provide a minimum signal level of -95 dBm for two-way coverage (both talk-out and talk-in) on each floor, and shall be available in 95% of each floor's area. Coverage shall also be provided for any mechanical penthouses, elevator machine rooms, etc., located at the top of the structure.

2. Critical rooms, including but not limited to such areas as, Fire Command Center, Fire Pump Room, Emergency Generator Room, Stairwells with a standpipe, and other staging areas as identified by the Fire Department, shall have a minimum signal level -95dBm for 98% of the room.
- D. Reliability Factor: The system shall be designed and capable of providing a 95% reliability factor.
- E. Supported Frequencies: The radio system shall support frequencies in the 700 and 800 Megahertz public safety bands as utilized by Public Safety and First Responder agencies.
- F. Reject Filters: Notch filter sections shall be incorporated to minimize adjacent channel cellular and SMR (Nextel) degradation of the signal booster performance. The minimum downlink band adjacent band ejection shall be 35 dB or greater at 85645 MHz and 870 MHz.
- G. Band Migration Capability: The signal booster shall include re-tunable or replaceable filters to accommodate rapid and economic passband changes in the event of mandatory FCC changes within the 806-824 and 851-859 MHz band. The use of non-adjustable and non-replaceable RF input and output filters is prohibited.
- H. Output Level Control: An automatic output leveling circuit shall be included for both passbands with a minimum dynamic range of 60 dB, less any gain reduction setting, to maintain FCC out of band and spurious emission compliance.
- I. Degraded performance in emergencies: The system shall be designed to allow degraded performance in adverse conditions, such as abnormally high temperatures resulting from nearby fires, extreme voltage fluctuations or other abnormal conditions that may occur during an emergency. Circuits that intentionally disable the signal booster in such situations (i.e., under/over voltage, over/under current, over/under temperature, etc.) will not be implemented as the standard mode for public safety applications. It is the purpose of this specification to assure the maximum possible level of communications to public safety personnel depending upon the signal booster even to the extent of damaging the signal booster as long as some communications benefit can be provided during the emergency.
- J. Mode of Operation: The system shall be normally powered on and shall continuously provide passing of frequencies within the Public Safety and First Responder bands.

2.2 SYSTEM COMPONENTS

- A. Compatibility: The equipment, including but not limited to repeaters, transmitters, receivers, signal boosters, cabling, fiber distributed antenna system, etc., shall be compatible with the existing communication systems utilized by the Public Safety and First Responder agencies.
- B. Power Supplies: Any part of the installed systems which contain electrically powered components, the systems shall be capable of operating on the emergency generator system, if provided, and an independent battery system. The power sources shall meet the requirements of Level 1, Type 10, Class X system of NFPA 110. The battery system shall be provided such that the system is capable of continuous duty for four (4) hours in the event of primary and generator power failure. Systems provided where an emergency onsite generator is not present shall provide battery capacity of twelve (12) hours of continuous duty.

C. Survivability:

1. Physical Protection: All wiring and fiber optics shall be installed in conduit.
2. Fire Performance: All main risers or trunks of the antenna system shall be installed with resistance to attack from a fire using one of the following methods:
 - a. A 2-hour fire-rated cable or cable system.
 - b. Routing the cable through a 2-hour fire-rated enclosure or shaft.
 - c. A system configured in a looped design, routed through 1-hour fire-rated enclosure or shaft. The circuit shall be capable of transmitting and receiving a signal during a single open or non-simultaneous single ground fault on a circuit conductor.
 - d. Performance alternative approved by the Authority Having Jurisdiction.

Laterals to individual antennas do not have to be protected by a fire-rated enclosure.

- D. Cabinet: The signal booster and all associated RF filters shall be housed in a single, NEMA 4 certified, painted steel weather-tight box. The cabinet shall be large enough to dissipate internal heat without venting the inside of the cabinet to the outside atmosphere. External or exposed RF filters are unacceptable.
- E. Operating Temperatures: Minus 22 deg F to plus 120 deg F (minus 30 deg C to plus 50 deg C) minimum temperature range, including microprocessors. Equipment installed on the roof of structures shall be rated for the expected extreme temperatures associated with rooftop installations.
- F. FCC Requirements: Active Equipment (Signal Boosters and Bi-directional Amplifiers) shall meet FCC requirements.
- G. Passive Equipment: Passband shall be 700-900 Mhz, IP rating of 2 Ghz.
- H. Cable: Passband shall be 700-900 MHz. Cable shall be rated for fire plenum and riser rating.
- I. Install in compliance with all state and local building codes including the standards of the FCC, NFPA, NEC, and TIA TSB -88-1-B. At a minimum, provide 2 conduit/conduit sleeves vertically from the roof level to the lowest level of the structure. This conduit will provide a vertical path for cable to all levels and should pass through the BDA equipment room. Provide a 20 amp AC circuit and building ground (at the BDA and outside antenna locations) to power and ground the BDA. Two copies of complete formal BDA system reference drawings, including schematics, floor layouts with cable routing, and commissioning data, are required to document the installed BDA system. The documents will be maintained by the building management, and made available to the Fire Marshal or other competent building inspectors on request.
- J. For purposes of mounting antennas provide a W 12 x 16 steel I-beam mounted horizontally that is rigidly secured to the building's roof system, with the bottom of the I-beam at least 6 inches from the roof surface. The I-beam shall be bonded to the building's grounding

electrode system and the lightning protection system.

Grounding shall comply with the following:

- ☐ Motorola R56 Site Installation Standards Manual
- ☐ NFPA 70, Article 250-50; Article 250-92; Article 250-104; Article 810-21
- ☐ NFPA 780, Section 3-9; Section 3-14; Section 3-16; Section 3-17
- ☐ ANSI T1.313-1997

The length of the I-beam shall be a minimum of 5 feet but shall be longer if 3 or more antennas are to be mounted. The length of the I-beam shall be sufficient to provide at least 3 feet of separation between each two adjacent antennas.

The I-beam must support approximately 100 lbs including antenna, antenna masts, and related hardware. The antenna mast should not exceed 6 feet so the I-beam shall be located such that the antenna is clear of obstructions or rooftop equipment which might block or reflect the signals emanating from or to be received by antennas mounted to the I-beam. 4" Conduit with minimal bends, due to the rigidity of the antenna cable, shall be provided from the roof location of the antenna mounting system to the room in which the radio system will be installed. A service cap shall be provided on the roof end of the conduit to ensure moisture does not enter the conduit.

2.3 LICENSING

- A. All Fire Department radio frequencies will be FCC licensed under the City of Salisbury system. All fees associated with the licensing shall be paid by the property owner.
- B. All testing must be done on frequencies authorized by the FCC. A valid FCC license will be required if testing is done on frequencies different from the police, fire, or emergency medical frequencies.

PART 3 EXECUTION

3.1 APPROVAL AND TESTING PROCEDURES

- A. Design Approval: Plans shall be submitted and approved prior to installation. The following information shall be provided:
 - 1. Detailed drawings showing the location of the amplification equipment and associated antenna systems which include a view showing building access to the equipment; and
 - 2. Schematic drawings of the electrical system, backup power, antenna system and any other associated equipment relative to the amplification equipment, including panel locations and labeling.
 - 3. Manufacturer's data sheets on all equipment to be installed.
- B. Commissioning Test: It is the building owner's responsibility to ensure that a commissioning test of the radio repeater system occurs prior to C of O for the building. The test shall ensure that two-way coverage on each floor of the building meets the minimum coverage requirements described above.

- C. Tests shall be made using frequencies close to the frequencies used by the Fire Department and appropriate emergency services. If testing is done on the actual frequencies, then this testing must be coordinated with the State Fire Marshal. All testing must be done on frequencies authorized by the FCC. A valid FCC license will be required if testing is done on frequencies different from the police, fire, or emergency medical frequencies.
- D. Testing Procedures:
 - 1. Minimum Signal Strength: For testing system signal strength and quality, the testing shall be based on the DAQ System. A DAQ level below 3.0 shall be considered a failed test for a given grid cell.
 - 2. DAQ shall be subdivided into a grid system consisting of 40 equally spaced grids for testing. The number of grids shall be adjusted such that the grid spacing is not less than twenty-five (25) feet, nor shall it exceed more than fifty (50) feet. Signal Strength measurements shall be taken at the center of each grid.
 - 3. A maximum of two (2) nonadjacent grid cells will be allowed to fail the test. In the event that three of the areas fail the test, in order to be more statistically accurate, the testing grid resolution may be doubled. A maximum of four (4) nonadjacent grid cells will be allowed to fail the test. If the number of grid cells is adjusted to meet the spacing requirements of Item 2 above, the number of failed cells permitted shall be adjusted accordingly to meet the 95% coverage requirement.
 - 4. Failures shall not be allowed in critical areas, including but not limited to the Fire Command Center, Fire Pump Room, Emergency Generator Room, Stairwells Center, with a standpipe, Elevator Lobbies serving the Emergency Elevator, and other areas as identified by the Fire Department.
 - 5. Both inbound and outbound signals shall be measured on each and every floor above and below-ground including stairwells, basements, penthouse facilities and parking areas of the structure.
 - 6. Measurements shall be made with the antenna held in a vertical position at three (3) to four (4) feet above the floor (portable radio worn on the belt or turnout coat pocket).
- E. Pre-Testing: It is the building owner's responsibility to have the radio system pre-tested to ensure that two-way coverage on each floor of the building meets the minimum coverage described above.
- F. Acceptance Testing:
 - 1. All acceptance testing shall be done in the presence of the State Fire Marshal.
 - 2. Small scale drawings (11 x 17 maximum) of the structure shall be provided by the Owner/Contractor. The plans shall show each floor divided into the grids as described above, and the results of the pretesting. The plans shall show each floor divided into the grids as described above. Each grid shall be labeled to indicate the DAQ result from the commissioning test.
 - 3. The Owner/Contractor shall provide the latest approved plans for the system, including any manufacturer's data sheets for any equipment changes not submitted in the original submittal.

4. All testing results of the repeater (output wattage, gain level, etc.).
5. The Owner shall provide written documentation certifying that an acceptable sweep test to measure the level of RF radiation has been conducted and that the antennae system complies with FCC OET 65 Standards.

G. Acceptance Testing:

Using the City of Salisbury control channel, each floor shall be RF signal level mapped utilizing a portable Spectrum Analyzer. Each floor shall be divided into equal grids of no more than 50 feet by 50 feet. Each grid shall meet the downlink signal level requirement as stated above. A maximum of two nonadjacent areas will be allowed to fail on the same floor. Failure of any two adjacent grids is considered a failure for the entire floor. All talk testing must pass the DAQ criterion stated above. Critical rooms, including, but not limited to, such areas as the Fire Command/Control Center, Fire Pump Room, Emergency Generator Room, stairwells with a standpipe, and other staging areas as identified by the Fire Department cannot fail coverage at all.

3.2 MAINTENANCE AND ANNUAL TESTING

- A. Maintenance & Servicing: Provide maintenance contract in place with name of authorized company, who will provide a 24-hour by 7-day emergency response within two (2) hours after notification. The system shall be maintained in accordance with FCC requirements. Maintenance Contract shall include annual testing to include all active components of the system, including but not limited to amplifier, power supplies, and back-up batteries. Amplifiers shall be tested to ensure that the gain is the same as it was upon initial installation and acceptance. The original gain shall be noted and any changes in gain shall be documented. Active components shall be checked to determine that they are operating within the manufacturer's specifications for their intended purpose. Documentation of the test shall be maintained on site and a copy forwarded to the City of Salisbury Fire Department upon completion.
- B. Maintain a list of contact personnel with phone numbers at the radio repeater system cabinet. The contact personnel shall have knowledge of the building and the repeater system and be available to respond to the building in the case of an emergency.

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DIVISION 28 SECTION 28 46 21
ADDRESSABLE FIRE-ALARM SYSTEMS
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SECTION 2 21
ADDRESSABLE FIRE ALARM SYSTEMS

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.

1.2 SUMMARY

- A. This specification provides the requirements for the installation, programming and configuration of a complete and operational Addressable Intelligent Fire Alarm System Network. The system shall include, but not be limited to: Fire Alarm Control Panel(s), Automatic and Manually Activated Voice Evacuation Alarm Subsystem, Automatic and Manually activated alarm Initiating and Indicating Peripheral Devices and Appliances, conduit, wire and accessories required to furnish a complete and operational Fire Alarm System. System shall include, but not be limited to, the following.
 - 1. Addressable fire-alarm system.
 - 2. Fire-alarm control unit.
 - 3. Manual fire-alarm boxes.
 - 4. System smoke detectors.
 - 5. Duct smoke detectors.
 - 6. Heat detectors.
 - 7. Carbon monoxide detectors.
 - 8. Notification appliances.
 - 9. Device guards.
 - 10. Magnetic door holders.
 - 11. Remote annunciator.
 - 12. Graphic annunciator.
 - 13. Addressable interface device.
 - 14. Digital alarm communicator transmitters (DACTs).
 - 15. Fire-alarm radio transmitters.

- B. The system shall include all wiring, raceways, pull boxes, terminal cabinets, outlet and mounting boxes, alarm initiating devices, alarm indicating devices, and control equipment, and all other accessories and miscellaneous items required for an operating system.
- C. The Fire Alarm System supplied under this specification shall be a microprocessor-based network system. All Control Panel Assemblies and connected Field Appliances shall be both designed and manufactured by the same company, and shall be tested and cross-listed as compatible to ensure that a fully functioning Life Safety System is designed and installed.
- D. All related work specified in other sections shall be properly coordinated with the fire alarm equipment.
- E. Related Sections
 - 1. Division 26 – Electrical

1.3 ALTERNATES

- A. Refer to Division 01 Section, Alternates for description of work under this section affected by alternates.

1.4 DEFINITIONS

- A. DACT: Digital alarm communicator transmitter.
- B. EMT: Electrical Metallic Tubing.
- C. FACP: Fire Alarm Control Panel.
- D. HLI: High Level Interface.
- E. NICET: National Institute for Certification in Engineering Technologies.
- F. Voltage Class: For specified circuits and equipment, voltage classes are defined as follows:
 - 1. Control Voltage: Listed and labeled for use in remote-control, signaling, and power-limited circuits supplied by a Class 2 or Class 3 power supply having rated output not greater than 150 V and 5 A, allowing use of alternate wiring methods complying with NFPA 70, Article 725.
 - 2. Low Voltage: Listed and labeled for use in circuits supplied by a Class 1 or other power supply having rated output not greater than 1000 V, requiring use of wiring methods complying with NFPA 70, Article 300, Part I.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product, including furnished options and accessories.

1. Include construction details, material descriptions, dimensions, profiles, and finishes.
 2. Include rated capacities, operating characteristics, and electrical characteristics.
- B. Shop Drawings: For fire-alarm system.
1. Comply with recommendations and requirements in the Documentation section of the Fundamentals chapter in NFPA 72.
 2. Include plans, elevations, sections, details, and attachments to other work.
 3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
 4. Detail assembly and support requirements.
 5. Include voltage drop calculations for notification-appliance circuits.
 6. Include battery-size calculations.
 7. Include input/output matrix.
 8. Include statement from manufacturer that all equipment and components have been tested as a system and meet all requirements in this Specification and in NFPA 72.
 9. Include performance parameters and installation details for each detector.
 10. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
 11. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale; coordinate location of duct smoke detectors and access to them.
 - a. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators.
 - b. Show field wiring required for HVAC unit shutdown on alarm.
 - c. Show field wiring and equipment required for HVAC unit shutdown on alarm and override by firefighters' control system.
 - d. Show field wiring and equipment required for HVAC unit shutdown on alarm and override by firefighters' smoke-evacuation system.
 - e. Locate detectors according to manufacturer's written recommendations.
 12. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.

13. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.

C. General Submittal Requirements:

1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect.
 - a. Secure permits and approvals prior to installation.
 - b. Prior to commencement and after completion of work, notify Authorities Having Jurisdiction.
 - c. Submit letter of approval for installation before requesting acceptance of system.
2. 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 III minimum.
 - c. Licensed or certified by authorities having jurisdiction.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For 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.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.
 1. In addition to items specified in Division 01 Section, 017800, *Operation and Maintenance Data*, include the following and deliver copies to authorities having jurisdiction:
 - a. Comply with the Records section of the Inspection, Testing and Maintenance chapter in NFPA 72.

- b. Provide Fire Alarm and Emergency Communications System Record of Completion Documents according to the Completion Documents Article in the Documentation section of the Fundamentals chapter in NFPA 72.
- c. Complete wiring diagrams showing connections between all devices and equipment. Each conductor shall be numbered at every junction point with indication of origination and termination points.
- d. Riser diagram.
- e. Device addresses.
- f. Record copy of site-specific software.
- g. Provide Inspection and Testing Form according to the Inspection, Testing and Maintenance chapter in NFPA 72, and include the following:
 - 1) Equipment tested.
 - 2) Frequency of testing of installed components.
 - 3) Frequency of inspection of installed components.
 - 4) Requirements and recommendations related to results of maintenance.
 - 5) Manufacturer's user training manuals.
- h. Manufacturer's required maintenance related to system warranty requirements.
- i. Abbreviated operating instructions for mounting at fire-alarm control unit and each annunciator unit.

1.8 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 one unit.
 - 2. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but no fewer than one unit.
 - 3. Smoke Detectors, Fire Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than one unit of each type.
 - 4. Detector Bases: Quantity equal to two percent of amount of each type installed, but no fewer than one unit of each type.
 - 5. Keys and Tools: One extra set for access to locked or tamperproofed components.
 - 6. Audible and Visual Notification Appliances: One of each type installed.
 - 7. Fuses: Two of each type installed in the system. Provide in a box or cabinet with compartments marked with fuse types and sizes.

1.9 QUALITY ASSURANCE

- A. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level III technician.
- B. NFPA Certification: Obtain certification according to NFPA 72 by a UL-listed alarm company.

1.10 PROJECT CONDITIONS

- A. Perform a full test of the existing system prior to starting work. Document any equipment or components not functioning as designed.
- B. Use of Devices during Construction: Protect devices during construction unless devices are placed in service to protect the facility during construction.

1.11 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Extent: All equipment and components not covered in the Maintenance Service Agreement.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Noncoded, UL-certified addressable system, with multiplexed signal transmission and voice/strobe evacuation.
- B. Automatic sensitivity control of certain smoke detectors.
- C. All components provided shall be listed for use with the selected system.
- D. 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.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

- A. Fire-alarm signal initiation shall be by one or more of the following devices and systems.
 - 1. Manual stations.
 - 2. Heat detectors.
 - 3. Smoke detectors.

4. Carbon monoxide detectors.
 5. Automatic sprinkler system water flow.
 6. Fire-extinguishing system operation.
 7. Fire standpipe system.
- B. Fire-alarm signal shall initiate the following actions:
1. Continuously operate alarm notification appliances, including voice evacuation notices.
 2. Identify alarm and specific initiating device at fire-alarm control unit, connected network control panels, and remote annunciators.
 3. Transmit an alarm signal to the remote alarm receiving station.
 4. Unlock electric door locks in designated egress paths.
 5. Release fire and smoke doors held open by magnetic door holders.
 6. Activate voice/alarm communication system.
 7. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
 8. Close smoke dampers in air ducts of designated air-conditioning duct systems.
 9. Activate lighting control.
 10. Activate emergency shutoffs for gas and fuel supplies.
 11. Record events in the system memory.
 12. Indicate device in alarm on the graphic annunciator.
- C. Supervisory signal initiation shall be by one or more of the following devices and actions:
1. Valve supervisory switch.
 2. Duct smoke detector.
 3. Independent fire-detection and -suppression systems.
 4. User disabling of zones or individual devices.
 5. Loss of communication with any panel on the network.

- D. 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 communication with any addressable sensor, input module, relay, control module, remote annunciator, printer interface, or Ethernet module.
 4. Loss of primary power at fire-alarm control unit.
 5. Ground or a single break in internal circuits of fire-alarm control unit.
 6. Abnormal ac voltage at fire-alarm control unit.
 7. Break in standby battery circuitry.
 8. Failure of battery charging.
 9. Abnormal position of any switch at fire-alarm control unit or annunciator.
 10. Voice signal amplifier failure.
- E. System Supervisory Signal Actions:
1. Initiate notification appliances.
 2. Identify specific device initiating the event at fire-alarm control unit, connected network control panels, and remote annunciators.
 3. After a time delay of 200 seconds, transmit a trouble or supervisory signal to the remote alarm receiving station.
 4. Transmit system status to building management system.
 5. Display system status on graphic annunciator.

2.3 FIRE-ALARM CONTROL UNIT

- A. Basis-of-Design Product: Under Alternate No. 14, subject to compliance with requirements, provide system and integration with ATC by Simplex. Under Base Bid, subject to compliance with requirements provide system and integration with ATC by Simplex or comparable product by one of the following or approved equal:
1. Edwards (United Technologies)
 2. Notifier by Honeywell

B. General Requirements for Fire-Alarm Control Unit:

1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864.
 - a. System software and programs shall be held in nonvolatile flash, electrically erasable, programmable, read-only memory, retaining the information through failure of primary and secondary power supplies.
 - b. Include a real-time clock for time annotation of events on the event recorder and printer.
 - c. Provide communication between the FACP and remote circuit interface panels, annunciators, and displays.
 - d. The FACP shall be listed for connection to a central-station signaling system service.
 - e. Provide nonvolatile memory for system database, logic, and operating system and event history. The system shall require no manual input to initialize in the event of a complete power down condition. The FACP shall provide a minimum 500-event history log.
2. Addressable Initiation Device Circuits: The FACP shall indicate which communication zones have been silenced and shall provide selective silencing of alarm notification appliance by building communication zone.
3. Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: The FACP shall be listed for releasing service.

C. Alphanumeric Display and System Controls: 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. Annunciator and Display: Liquid-crystal type, two line(s) of 40 characters, minimum.
2. Keypad: Arranged to permit entry and execution of programming, display, and control commands and to indicate control commands to be entered into the system for control of smoke-detector sensitivity and other parameters.

D. Initiating-Device, Notification-Appliance, and Signaling-Line Circuits:

1. Pathway Class Designations: NFPA 72, Class B.
2. Pathway Survivability: Level 0.
3. Install no more than 50 addressable devices on each signaling-line circuit.
4. Install fault circuit isolators to comply with circuit performance requirements of NFPA 72 or with manufacturer's written instructions, whichever is more conservative.

5. Serial Interfaces:
 - a. One dedicated RS 485 port for central-station operation using point ID DACT.
 - b. One RS 485 port for remote annunciators, Ethernet module, or multi-interface module (printer port).
 - c. One RS 232 port for PC configuration.
 - d. One RS 232 port for voice evacuation interface.
- E. Smoke-Alarm Verification:
 1. Initiate audible and visible indication of an alarm-verification signal at fire-alarm control unit.
 2. Activate an approved alarm-verification sequence at fire-alarm control unit and detector.
 3. Record events by the system printer.
 4. Sound general alarm if the alarm is verified.
 5. Cancel fire-alarm control unit indication and system reset if the alarm is not verified.
- F. Notification-Appliance Circuit:
 1. Audible appliances shall sound in a three-pulse temporal pattern, as defined in NFPA 72.
 2. Visual alarm appliances shall flash in synchronization where multiple appliances are in the same field of view, as defined in NFPA 72.
- G. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke-barrier walls shall be connected to fire-alarm system.
- H. 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.
- I. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.
- J. Voice/Alarm Signaling Service: Central emergency communication system with redundant microphones, preamplifiers, amplifiers, and tone generators provided in a separate cabinet.
 1. Indicate number of alarm channels for automatic, simultaneous transmission of different announcements to different zones or for manual transmission of

announcements by use of the central-control microphone. Amplifiers shall comply with UL 1711.

- a. Allow the application of, and evacuation signal to, indicated number of zones and, at the same time, allow voice paging to the other zones selectively or in any combination.
 - b. Programmable tone and message sequence selection.
 - c. Standard digitally recorded messages for Evacuation and All Clear.
 - d. Generate tones to be sequenced with audio messages of type recommended by NFPA 72 and that are compatible with tone patterns of notification-appliance circuits of fire-alarm control unit.
2. Status Annunciator: Indicate the status of various voice/alarm speaker zones and the status of firefighters' two-way telephone communication zones.
 3. Preamplifiers, amplifiers, and tone generators shall automatically transfer to backup units, on primary equipment failure.
- K. 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 signals, and supervisory and digital alarm communicator transmitters shall be powered by 24-V dc source.
1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.
 2. Batteries: Sealed lead calcium.
- L. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.4 MANUAL FIRE-ALARM BOXES

- A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.
1. Single-action mechanism, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
 2. Station Reset: Key- or wrench-operated switch.
 3. Weatherproof Protective Shield: Factory-fabricated, clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm. Provide for all manual fire alarm boxes.

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 four-wire type.
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. Detector must have functional humidity range within 10 to 90 percent relative humidity.
7. Color: White.

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. 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.).

3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector for smoke detection in HVAC system ducts.
4. Each sensor shall have multiple levels of detection sensitivity.
5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
6. Relay Fan Shutdown: Fully programmable relay rated to interrupt fan motor-control circuit.

2.6 CARBON MONOXIDE DETECTORS

- A. General: Carbon monoxide detector listed for connection to fire-alarm system.
 1. Mounting: Adapter plate for outlet box mounting.
 2. Testable by introducing test carbon monoxide into the sensing cell.
 3. Detector shall provide alarm contacts and trouble contacts.
 4. Detector shall send trouble alarm when nearing end-of-life, power supply problems, or internal faults.
 5. Comply with UL 2075.
 6. Locate, mount, and wire according to manufacturer's written instructions.
 7. Provide means for addressable connection to fire-alarm system.
 8. Test button simulates an alarm condition.

2.7 HEAT DETECTORS

- A. General Requirements for Heat Detectors: Comply with UL 521.
 1. Temperature sensors shall test for and communicate the sensitivity range of the device.
- B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F (57 deg C) or a rate of rise that exceeds 15 deg F (8 deg C) per minute unless otherwise indicated.
 1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
 3. Detector must have functional humidity range of 10 to 90 Insert numbers percent relative humidity.

4. Color: White.

2.8 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 complying with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word FIRE or “ALERT” as required 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 or ceiling mounted as indicated on the drawings.
 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 for wall mounted devices, white for ceiling mounted devices.
 7. Combination Devices: Factory-integrated audible and visible devices in single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.
- D. Voice/Tone Notification Appliances:
 1. Comply with UL 1480.
 2. Speakers for Voice Notification: Locate speakers for voice notification to provide the intelligibility requirements of the Notification Appliances and Emergency Communications Systems chapters in NFPA 72.

3. High-Range Units: Rated 2 to 15 W.
 4. Cone Speakers
 - a. Wall Mount: Provide speakers with a 4" mylar cone. Paper type cones are not acceptable. The rear of the speaker shall be completely sealed protecting the cone during and after installation. In - Out screw terminals shall be provided for wiring. Speaker housings shall be white. Speakers shall provide power taps at 1/4w, 1/2w, 1w, and 2w. Speakers shall provide UL confirmed 90 dBA sound output at 2w. Speakers shall mount in a North American 4" electrical box with extension ring using the 2 screws provided with ring. It must not be necessary to completely remove the screws to facilitate mounting.
 - b. Ceiling Mount (4"): Provide speakers with a 4" mylar cone. Paper type cones are not acceptable. The rear of the speaker shall be completely sealed, protecting the cone during and after installation. In-Out screw terminals shall be provided for wiring. Speaker baffles shall be round, steel with white finish. Speakers shall provide power taps at 1/4w, 1/2w, 1w, and 2w. Speakers shall provide UL confirmed 90 dBA sound output at 2w. Speakers shall mount in a North American 4" electrical box with extension ring.
 - c. Ceiling Mount (8"): Provide speakers with an 8" cone. In-Out screw terminals shall be provided for wiring. Speaker baffles shall be round, steel with white finish. Speakers shall provide power taps at 1/2w, 1w, 2w, and 4w. Provide square surface mount boxes with matching white finish.
 - d. High Output: Provide speakers with a 4" mylar cone. Paper type cones are not acceptable. The rear of the speaker shall be completely sealed, protecting the cone during and after installation. In-Out screw terminals shall be provided for wiring. Speaker baffles shall be round, steel with white finish. Speakers shall provide power taps at 1w, 2w, 4w, and 8w. Speakers shall provide UL confirmed 90 dBA sound output at 2w. Speakers shall mount in a North American 4" electrical box with extension
 5. Re-entrant Speakers: Re-entrant speakers shall have a white housing. Power taps shall be provided at 2w, 4w, 8w, and 15w. Re-entrant speakers shall provide 102 dBA peak sound output at 15w. A metal compression driver shall be inherent to the re-entrant speaker. Cone type drivers are not acceptable. Provide weatherproof wall boxes for outdoor mounting.
 6. Matching Transformers: Tap range matched to acoustical environment of speaker location.
- E. Color: ceiling mounted devices shall be white, wall mounted devices shall be red.

2.9 MAGNETIC DOOR HOLDERS

- A. Description: Units are equipped for wall or floor mounting as indicated and are complete with matching doorplate.
 - 1. Electromagnets: Require no more than 3 W to develop 25-lbf (111-N) holding force.
 - 2. Wall-Mounted Units: Flush mounted unless otherwise indicated.
 - 3. Rating: 24-V ac or dc.
- B. Material and Finish: Match door hardware.

2.10 REMOTE ANNUNCIATOR AND GRAPHIC DISPLAY

- 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: Surface cabinet, NEMA 250, Type 1.
- B. Graphic: Provide a graphic drawing of the entire facility showing all barriers, rooms and room numbers so that it is easy to correlate the LCD text with the graphic display ensuring timely response to an alarm. The graphic display shall be mounted in a picture frame and placed above the LCD annunciator. Submit the drawing for engineer approval.
- C. Display Type and Functional Performance: 80 character alphanumeric display with 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.
- D. Key-Operated Switches shall include:
 - 1. Alarm Silence.
 - 2. Trouble Silence.
 - 3. Test.

2.11 ADDRESSABLE INTERFACE DEVICE

- A. General:
 - 1. Include address-setting means on the module.
 - 2. Store an internal identifying code for control panel use to identify the module type.
 - 3. Listed for controlling HVAC fan motor controllers.

- B. Monitor Module: Microelectronic module providing a system address for alarm-initiating devices for wired applications with normally open contacts.
- C. Integral Relay: Capable of providing a direct signal to elevator controller to initiate elevator recall, to circuit-breaker shunt trip for power shutdown.
 - 1. Allow the control panel to switch the relay contacts on command.
 - 2. Have a minimum of two normally open and two normally closed contacts available for field wiring.
- D. Control Module:
 - 1. Operate notification devices.
 - 2. Operate solenoids for use in sprinkler service.
 - 3. Operate door release, sound system mute, and other functions as indicated on the drawings.

2.12 DIGITAL ALARM COMMUNICATOR TRANSMITTER (DACT)

- A. DACT must be acceptable to remote central station and must be listed for fire-alarm use.
- B. IP/Cellular based communicator transmitter shall be acceptable to the remote central station and shall comply with UL 864/NFPA. Contractor shall program and test with communicator contact ID reporting. Provide external antenna and cable. Power connections shall be made to communicator via Fire Alarm Control Panel.
- C. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of IP/Cellular line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report service restoration to the central station. If service is lost on both IP/Cellular lines, transmitter shall initiate the local trouble signal.
- D. Local functions and display at DACT must include the following:
 - 1. Verification that both IP/Cellular lines are available.
 - 2. Programming device.
 - 3. LED display.
 - 4. Manual test report function and manual transmission clear indication.
 - 5. Communications failure with central station or FACU.

- E. Digital data transmission must include the following:
 - 1. Address of alarm-initiating device.
 - 2. Address of supervisory signal.
 - 3. Address of trouble-initiating device.
 - 4. Loss of ac supply.
 - 5. Loss of power.
 - 6. Low battery.
 - 7. Abnormal test signal.
 - 8. Communication bus failure.
- F. Secondary Power: Integral rechargeable battery and automatic charger.
- G. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

2.13 NETWORK COMMUNICATIONS

- A. Provide network communications for fire-alarm system according to fire-alarm manufacturer's written requirements.
- B. Provide network communications pathway per manufacturer's written requirements and requirements in NFPA 72 and NFPA 70.
- C. Provide integration gateway using BACnet for connection to building automation system.

2.14 DEVICE GUARDS

- A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.
 - 1. Factory fabricated and furnished by device manufacturer.
 - 2. Finish: Paint of color to match the protected device.
- B. Provide for devices in Gymnasium and where indicated on the drawings.

2.15 REMOTE TEST/INDICATING STATION

- A. Provide keyed test switch with LED indicating light for each duct detector. Located below flush in accessible ceiling.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.
 - 1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.
- B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Protection of In-Place Conditions: Protect devices during construction unless devices are placed in service to protect facility during construction.

3.3 INSTALLATION

- A. Comply with NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, Fire Alarm Systems.
 - 1. Devices placed in service before all other trades have completed cleanup shall be replaced.
 - 2. Devices installed but not yet placed in service shall be protected from construction dust, debris, dirt, moisture, and damage according to manufacturer's written storage instructions.
- B. Install wall-mounted equipment, with tops of cabinets not more than 78 inches (1980 mm) above the finished floor.
- C. Manual Fire-Alarm Boxes:
 - 1. Install manual fire-alarm box in the normal path of egress within 60 inches (1520 mm) of the exit doorway.
 - 2. Mount manual fire-alarm box on a background of a contrasting color.
 - 3. The operable part of manual fire-alarm box shall be between 42 inches (1060 mm) and 48 inches (1220 mm) above floor level. All devices shall be mounted at the same height unless otherwise indicated.

D. Smoke- or Heat-Detector Spacing:

1. Comply with the Smoke-Sensing Fire Detectors section in the Initiating Devices chapter in NFPA 72, for smoke-detector spacing.
2. Comply with the Heat-Sensing Fire Detectors section in the Initiating Devices chapter in NFPA 72, for heat-detector spacing.
3. Smooth ceiling spacing shall not exceed 30 feet (9 m).
4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Annex A in NFPA 72.
5. HVAC: Locate detectors not closer than 36 inches (910 mm) from air-supply diffuser or return-air opening.
6. Lighting Fixtures: Locate detectors not closer than 12 inches (300 mm) from any part of a lighting fixture and not directly above pendant mounted or indirect lighting.

E. Install a cover on each smoke detector that is not placed in service during construction. Cover shall remain in place except during system testing. Remove cover prior to system turnover.

F. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Turn over to mechanical contractor for installation in ductwork. Sampling tubes shall be installed so they extend the full width of duct. Tubes more than 36 inches (9100 mm) long shall be supported at both ends.

1. Do not install smoke detector in duct smoke-detector housing during construction. Install detector only during system testing and prior to system turnover.

G. Remote Status and Alarm Indicators: Install in a visible location near each smoke detector, 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. Install all devices at the same height unless otherwise indicated.

I. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches (150 mm) below the ceiling. Install all devices at the same height unless otherwise indicated.

J. Device Location-Indicating Lights: Locate in public space near the device they monitor.

3.4 PATHWAYS

- A. The Fire Alarm System shall be installed in dedicated raceway, except fire rated type MC cable may be used where concealed above accessible ceilings. The entire system shall be installed in a skillful manner in accordance with approved manufacturers' manuals and wiring diagrams. The Contractor shall furnish all conduit, wiring, outlet boxes, junction boxes, cabinets and similar devices necessary for the complete installation. All wiring shall be of the type recommended by the NEC, approved by local authorities having jurisdiction for the purpose.
 - 1. Exposed pathways located less than 96 inches (2440 mm) above the floor shall be installed in raceway. Raceway shall be conduit in unfinished spaces and surface metal raceway in finished spaces, painted to match existing wall(s).
- B. All junction boxes shall be sprayed red and labeled "Fire Alarm". Wiring color code shall be maintained throughout the installation.

3.5 CONNECTIONS

- A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Division 08 Section 087100, *Door Hardware*. Connect hardware and devices to fire-alarm system.
 - 1. Verify that hardware and devices are listed for use with installed fire-alarm system before making connections.
- B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 36 inches (910 mm) 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 HVAC duct systems.
 - 2. Magnetically held-open doors.
 - 3. Electronically locked doors and access gates.
 - 4. Alarm-initiating connection to activate emergency lighting control.
 - 5. Supervisory connections at valve supervisory switches.
 - 6. Data communication circuits for connection to building management system.
- C. Each addressable analog loop shall be circuited as shown on the drawings but device loading is not to exceed 80% of loop capacity in order to leave space for future devices.
- D. Where it is necessary to interface conventional initiating devices, provide intelligent input modules to supervise Class B zone wiring.

3.6 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section 260553, *Electrical Identification*.
- B. Install framed instructions in a location visible from fire-alarm control unit.

3.7 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.
- B. Ground shielded cables at the control panel location only. Insulate shield at device location.

3.8 FIELD QUALITY CONTROL

- A. Field tests shall be witnessed by Architect, Owner and authorities having jurisdiction (if required).
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.
- D. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 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 the Completion Documents, Preparation table in the Documentation section of the Fundamentals chapter in NFPA 72.
 - b. Comply with the 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 the 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 chapter in NFPA 72 and the Inspection and Testing Form in the Records section of the Inspection, Testing and Maintenance chapter in NFPA 72.
- E. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

- F. Fire-alarm system will be considered defective if it does not pass tests and inspections.
- G. Prepare test and inspection reports.
- H. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.
- I. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.9 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
 - 1. Include visual inspections according to the Visual Inspection Frequencies table in the Testing paragraph of the Inspection, Testing and Maintenance chapter in NFPA 72.
 - 2. Perform tests in the Test Methods table in the Testing paragraph of the Inspection, Testing and Maintenance chapter in NFPA 72.
 - 3. Perform tests per the Testing Frequencies table in the Testing paragraph of the Inspection, Testing and Maintenance chapter in NFPA 72.

3.10 SOFTWARE SERVICE AGREEMENT

- A. Comply with UL 864.
- B. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.
- C. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.
 - 1. Upgrade Notice: At least 30 days to allow Owner to schedule access to system and to upgrade computer equipment if necessary.

3.11 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system. Provide video recording of training to Owner.

END OF SECTION

SECTION 31 23 00 - EXCAVATION AND BACKFILL FOR PIPELINES AND STRUCTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Work included in this section shall include furnishing all labor, materials, and equipment necessary for the Contractor to perform all excavation, backfilling, filling, grubbing and grading required for construction and installation of pipelines, pavements, structures and appurtenances and to perform general site grading. Excavation shall include removal of pavement, concrete, rock, earth and debris, regardless of character. Trenches and excavations shall be sheeted, shored and braced by the Contractor, as necessary to allow construction and provide safe working conditions. Additionally, the Contractor shall be responsible for maintaining a dry excavation by dewatering. He shall also locate, support and protect existing utilities and structures encountered in the work, provide traffic control where required, dispose of surplus and unsuitable excavated materials and restore backfilled areas to original condition or as required by the drawings and specifications. All backfilled and restored areas shall be maintained by the Contractor, in a proper condition, for the duration of the project.
- B. The Contractor is responsible for direct or indirect damage to existing structures, pipelines, conduits, utility poles, wires and utilities of every description in the vicinity of his work whether above or below ground, or that may be encountered in trench or structure excavation, whether or not such utilities are shown on the Drawings. This responsibility shall include the cost of protection by sheeting, bracing, hand excavation, when warranted, and the expense to repair or replace any existing facility damaged directly or indirectly by construction activities under this contract.
- C. The Contractor shall verify the location, size and elevation of all existing utilities at the various points of connection and/or crossings prior to starting any work. Any discrepancies in locations or elevations shall be brought immediately to the attention of the Engineer in order that the designs may be adjusted accordingly. Damages suffered or additional costs incurred by the Contractor as a result of his failure to conform to the requirements of this paragraph shall be the sole responsibility of the Contractor. Connections to existing utilities shall be made by the Contractor at such a time and in such a manner as the Engineer may direct, and the cost shall be included in the price bid for pipeline and structures, unless otherwise defined elsewhere in the proposal.
- D. RELATED SECTIONS
 - 1. Section 31 25 00: "Erosion and Sediment Control".

1.3 DEFINITIONS

- A. Excavation consists of the removal of material encountered to sub-grade elevations and the reuse or disposal of materials removed as required.
- B. Sub-grade: The uppermost surface of an excavation or the top surface of a fill or backfill immediately below sub-base, drainage fill, or topsoil materials.
- C. Borrow: Soil material obtained off-site when sufficient approved soil material is not available from excavations.
- D. Sub-base Course: The layer placed between the sub-grade and base course in a paving system, or the layer placed between the sub-grade and surface of a pavement or walk.
- E. Base Course: The layer placed between the sub-base and surface pavement in a paving system.
- F. Unauthorized excavation consists of removing materials beyond indicated sub-grade elevations or dimensions without direction by the Engineer. Unauthorized excavation, as well as remedial work directed by the Engineer, shall be at the Contractor's expense.
- G. Structures: Buildings, footings, foundations, retaining walls, slabs, pump stations, manholes, catch basins, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below ground surface.
- H. Utilities include on-site overhead utilities, underground pipes, conduits, ducts, and cables, as well as underground services within building lines.

1.4 SUBMITTALS

- A. Submit for approval certified gradations, plasticity index and soil classification of each type of material proposed for use.
- B. Submit copies of all laboratory and field soil test results directly to the Engineer within 24 hours of completion of test.

1.5 QUALITY ASSURANCE

- A. Compaction:
 - 1. Top 12" of sub-grade and each 8" loose layer of backfill and fill under structures. Building slabs, steps, and sidewalks shall be compacted to 95 percent maximum density, ASTM D 698, unless otherwise noted.
 - 2. Top 12" of sub-grade and each 8" base layer of backfill and fill under structures. Pavements and wastewater structure base slabs shall be compacted to 95% maximum density, ASTM D 1557, unless otherwise noted.

3. Top 6" of sub-grade and each layer of backfill under lawns or unpaved areas, shall be compacted to 90 percent maximum density, ASTM D 698.
 4. Contractor may use ASTM D 1557 in lieu of ASTM D 698 in all cases.
- B. Grading Tolerances Outside Building Lines:
1. Lawns, unpaved areas, walks, and embankments, plus or minus 1 inch.
 2. Stone and asphalt pavements, plus or minus 1/2 inch.
- C. Grading Tolerance for Fill Under Building Slabs: plus or minus 1/4 inch measured with a 10' straightedge.

1.6 PROJECT CONDITIONS

- A. Contact the Owner and Miss Utility at 1-800-441-8355 at least 48 hours prior to beginning installations.
- B. Existing Utilities: Do not interrupt existing utilities, electrical, yard piping, etc. serving facilities occupied by the Owner or others except when permitted in writing by the Engineer and then only after acceptable temporary utility services have been provided. Provide a minimum 48 hours notice to the Engineer and receive written notice to proceed before interrupting the utility.
- C. All soil testing services shall be performed by an independent testing agency coordinated and paid for by the Contractor.

PART 2 - PRODUCTS

2.1 GENERAL

- A. No classification of excavated materials will be made. Excavation and trenching work shall include the removal and subsequent handling of all materials excavated or otherwise removed in performance of the contract work, regardless of the type, character, composition, or condition thereof.
- B. Materials used for backfill and fill shall be free of clay clods, rock or gravel larger than 2 inches in any dimension and debris, waste, frozen materials, and other deleterious matter.

2.2 SOIL MATERIALS

- A. General: Provide approved satisfactory borrow soil materials from off-site when sufficient approved soil materials are not available from excavations. Materials shall comply with the following specifications and Maryland State Highway Administration Standard Specification.

- B. Satisfactory Soil Materials: ASTM D 2487 soil classification groups GW, GP, GM, SW, SP, SC, and SM; free of rock or gravel larger than 2 inches in any dimension, debris, waste, frozen materials, vegetation and other deleterious matter. Satisfactory soil materials shall conform to Maryland State Highway Administration Section 916.01, Select Borrow.
- C. Unsatisfactory Soil Materials: ASTM D 2487 soil classification groups GC, ML, MH, CL, CH, OL, OH, and PT.
- D. Backfill and Fill Materials: Satisfactory soil materials unless otherwise approved by the Engineer.
- E. Base Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand, conforming to Maryland State Highway Administration Section 901 for Graded Aggregate Base.
- F. Structural Fill: ASTM D 2487 Soil Classification Groups SM and/or SC.
- G. Drainage Fill: Washed, evenly graded mixture of crushed stone, or crushed or uncrushed gravel, ASTM D448, coarse aggregate grading size 57 conforming to AASHTO M43 type No. 57.
- H. Pipe Bedding Material: Artificial foundation using drainage fill.
- I. No soil material shall be considered unsatisfactory due to moisture content. Contractor shall dry soils with excess moisture or add additional moisture to any material at no additional cost to the Owner.

2.3 SUITABLE BACKFILL

All suitable materials removed from the excavation shall be used for backfill and/or sub-grade replacements of unsuitable materials. No excavated material shall be wasted without permission of the Engineer. As material is excavated it shall be separated into suitable and unsuitable material stockpiles for reuse or disposal as the case may be. No payment for select backfill under contingencies will be approved until all suitable soils from excavations have been expended.

2.4 SELECT BACKFILL

- A. Should the Contractor encounter unsuitable material during excavation, he shall remove and dispose of such material at a location approved by the Engineer. The cost of such disposal shall be included in the appropriate prices bid.
- B. Should sufficient suitable material from excavations on the project not be available for backfill, the Contractor shall furnish Select Backfill upon written approval of the Engineer. Select Backfill shall conform to the requirements for satisfactory soil materials per section 2.2. Contractor shall pay for all testing necessary for approval of the select materials including sampling, sieve analysis, Atterberg limits and classification.

- C. Payment for removal of unsuitable sub-grade material and replacement with select backfill as authorized by the Engineer will be made at the unit price bid for the material placed within the payment trench width detailed on the project plans and for the length and depth approved. For backfill around structures, select backfill payment volume will be limited to an area 3'0" outside the foremost edge of the structure on all sides and from the bottom of the structure to the ground surface. This item is for unsuitable sub-grade and backfill material only and does not apply to embankment or fill material required for project construction which is to be included in the lump sum price for the treatment plant.

2.5 ARTIFICIAL FOUNDATION

Artificial Foundation and pipe bedding material shall consist of washed, uniformly graded mixture of uncrushed gravel free from angular edges grading size 57 conforming to Maryland State Highway Administration Section 901.

2.6 TOPSOIL

Topsoil shall mean friable clay loam surface soil suitable for use in grass planting. It occurs as a thin soil layer covering naturally well-drained land covered by a heavy growth of grass or which has been covered with a heavy growth of grass during the latest growing period before start of construction. In addition, the topsoil shall be reasonably free from subsoil, clay lumps, brush, objectionable weeds, and other litter, and shall be free from stones, stumps, and other objects larger than 2 inches in any dimension, roots, and other objectionable material.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
- B. Protect sub-grades and foundation soils against freezing temperatures or frost. Provide protective insulating materials as necessary.
- C. Provide erosion control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.2 STRIPPING

- A. Remove all organic material from the roadways and building construction areas. Stockpile all suitable material for reuse as topsoil during final grading and stabilization process. Remove all unsuitable materials from the site at the end of the project.
- B. The depth of stripping shall be a minimum of 6 inches or as required by actual field conditions.

3.3 GENERAL EXCAVATION

- A. Explosives: The use of explosives shall not be permitted on this project.
- B. Unclassified Excavation: Excavation is unclassified and includes excavation to required sub-grade elevations regardless of the character of materials and obstructions encountered.
- C. Excavated materials shall be segregated as they are excavated, with the suitable and unsuitable materials and topsoil being piled separately according to designated use specified in Part 2 of this section. All suitable materials shall be used for backfill or embankment. Suitable wet materials shall be dried to optimum moisture content at the Contractor's expense and be used for backfill or embankment. All unsuitable materials shall be removed, at the Contractor's expense and disposed of after the project is completed at a location approved by the Engineer. No excavated material shall be deposited at any time so as to endanger partly finished structures either by direct pressure, or indirectly by overloading banks contiguous to the operation.
- D. The Contractor shall employ the services of a soil testing agency acceptable to the Engineer to determine adequacy of excavated material for reuse as backfill or embankment. Submit results of testing to Engineer for approval.
- E. Excavation may be moved directly to areas of fill and embankment. However, the Contractor must schedule the work so that all construction areas will remain free-draining, without any ponding of water. Temporary ditches and dewatering operations shall be constructed, if necessary, to accomplish this end. If, at the time of excavation, it is not possible to place material in its proper location as fill or embankment, it shall be stockpiled for later use and shall be stabilized in an approved manner if not to be utilized within 14 calendar days.

3.4 APPROVAL OF SUBGRADE

- A. Notify Engineer when excavations have reached required sub-grade.
- B. Proof roll sub-grade areas to receive bituminous paving with a loaded tandem wheel dump truck in the presence of the Engineer or his representative prior to compaction to locate any soft areas. Provide penetrometer testing for building, basin and other structural sub-grades.
- C. When Engineer determines that unforeseen unsatisfactory soil or soft areas are present, continue excavation and replace with compacted backfill or fill material as directed.
- D. Reconstruct sub-grades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by the Engineer at no additional cost.

3.5 VERIFICATION OF SOIL BEARING CAPACITY

The Contractor shall be responsible for testing of the available soil bearing capacity below the

foundation of any structure. He shall arrange for such testing by an independent agency approved by the Engineer. The Contractor shall pay the agency for at least two (2) three foot deep penetrometer tests and subsequent bearing capacity evaluation as specified on the drawings per 1000 S.F. area, minimum one (1) per individual structure or basin. If the required value as stated in the structural notes is not reached, the Contractor shall compact the sub-grade by means of vibratory rollers and pay and arrange for retesting until the required values are met.

3.6 UNAUTHORIZED EXCAVATION

Fill unauthorized excavation under foundations or wall footings by extending indicated bottom elevation of concrete foundation or footing to excavation bottom, without altering required top elevation. Lean concrete fill may be used to bring elevations to proper position when acceptable to the Engineer. Fill unauthorized excavations under other construction as directed by the Engineer.

3.7 FILL AND EMBANKMENT

A. Contractor shall furnish and place, within the prices bid and at no additional cost to the Owner, all structural fill to meet the construction requirements of the Contract Documents. Only material meeting the specifications will be approved for use. Contractor shall dispose of excess material off site within prices bid.

B. Structural Fill and Embankment

1. Structural Fill and Embankment for roadways, embankment, and structures shall be constructed of friable, compatible material from excavation or borrow. The material shall be free from debris, organic matter or excessive amounts of clay. Soils shall be classified as SM and/or SC (Unified Soils Classification).
2. Structural fills shall be constructed in loose layers not exceeding 8 inches loose thickness for the full width of the cross section. Construction shall proceed in such manner as to keep all areas free-draining, without ponding of water. Construction shall be suspended when satisfactory results cannot be achieved on account of wet or freezing weather.
3. Each layer of fill or embankment shall be compacted to not less than 95 percent of maximum density as determined by ASTM D 698, by means of multiple-wheel pneumatic tired rollers, vibratory rollers or other approved types, unless otherwise noted.
4. Compacting shall be continued until the required compaction has been achieved. Displacement of soil under or ahead of the roller shall be sufficient evidence that required compaction has not been achieved.
5. Fills and embankments shall be carried to the finished grades shown, less the necessary allowance for pavement, topsoiling, etc. Fine grade all areas prior to construction of finishing courses.
6. Frozen materials shall not be placed in fills and embankments. Any materials which freeze after being placed shall not be covered over until it has completely

thawed.

7. Embankment and fill material which may be lost or displaced as a result of natural causes such as storms, cloudbursts, etc., shall be replaced by the Contractor with acceptable material at no additional cost to the Owner.

3.8 PIPELINE TRENCH EXCAVATION

- A. The Contractor shall excavate, maintain and backfill all excavation necessary for completing the work under the contract. Unless otherwise specified or approved, excavation shall be open cut. No extra compensation will be allowed for hand excavation and backfill necessary to complete the work as required by the Engineer.
- B. Trenches shall be excavated to the necessary width and depth, as shown on the drawings and as required for the placement and removal of protective sheeting, pull boxes, etc. No extra compensation will be allowed for trenches wider than that detailed on the drawings.
- C. The sides of the trenches shall be practically plumb and shall not be sloped unless approved in writing by the Engineer. Trench sides shall be supported or sheeted as required to protect pavement surfaces, curbing, utilities, structures, etc., and required for safety. Safety regulations shall be as required by State safety codes and OSHA. Refer to Part 3.17 of this section for sheeting requirements.
- D. In paved areas, the Contractor shall remove the paving only as necessary for the excavation of the trench or as detailed. Pavement edges at the trench shall be saw cut neat, straight, and to the full depth of paving prior to the start of any excavation. Should the Contractor disturb or damage pavement for a greater width than detailed on the drawings or should pavement damage result from cave-ins, settlement, etc., the Contractor shall replace such paving at his own expense.
- E. In non-paved areas, strip surface vegetation and suitable topsoil and place in stock piles which are separated from the trench excavated materials. Topsoil shall not be used for general trench refill.
- F. The excavation of all trenches shall be fully completed at least twenty (20) feet in advance of pipe laying, unless otherwise authorized or directed. The Engineer may require the backfilling of open trench, over completed pipelines, or ahead of the pipe laying operation, if in his judgment such action is necessary, and the Contractor shall have no claim for extra compensation.
- G. Should work be stopped for any reason and any excavation is left open for an unreasonable length of time, the Contractor shall refill the excavation at his own expense if so directed by the Engineer, the Inspector or Owner. He shall not reopen the excavation until he is ready to complete the facility. Should the Contractor refuse or fail to refill any excavation completely within forty-eight (48) hours, or immediately if it poses a safety hazard, after a proper notice has been given by the Engineer or Inspector, the Owner shall be authorized to do the work. The resulting expenses shall be deducted from monies due the Contractor.
- H. The Contractor shall complete excavation as nearly as practicable to the lines of the pipeline to be installed as detailed. All cavities in the bottom of the trench shall be filled

to the required level with compacted crushed stone or gravel. Unless the cavities have been made on direction of the Engineer and classified as "Excavation Below Sub-grade" for unsuitable material, no extra compensation shall be due the Contractor.

- I. Excavated materials shall be graded, hauled, stored and protected as such material found suitable will be required for backfilling, or other purposes. Material classified as unsuitable shall be disposed of by the Contractor at a location approved by the Engineer. Hauling of excavated materials for any purpose shall not entitle the Contractor to additional compensation. Only those excavated materials designated by the Owner shall become property of the Contractor.
- J. All stockpiled materials shall be placed in such a way to prevent damage to the trench, structures, drainage areas or private property. Excavated materials shall not be placed on private property unless written permission is obtained from the property Owner by the Contractor.
- K. The Contractor shall remove, relocate or protect all structures including but not limited to signs, mailboxes, overhead and buried utilities and other structure in the path of work as required for construction whether shown on drawings or not. No extra compensation will be allowed for property damage, injury or loss of time due to obstructions encountered which are not shown on the plans.
- L. The Contractor shall be responsible for any damage to curb, gutter, sidewalk, traffic control devices, pavement material, pavement markings and lawns. Any damage resulting directly or indirectly during construction shall be replaced in kind by the Contractor without additional compensation. The reuse of disturbed curb, gutter or sidewalk is prohibited. New sections shall be installed to the nearest undisturbed joint. Cost for replacement shall be included in the appropriate price bid.

3.9 PIPELINE TRENCH BACKFILL

- A. Materials excavated from the trench except topsoil shall be used for trench backfill, provided that, in the opinion of the Engineer, the excavated material is suitable for this purpose. Backfill material shall be free from large lumps, pavement, pieces of concrete and stones.
- B. Suitable material, as approved by the Engineer, shall be carefully deposited in the trench by methods which will not damage or disturb the pipeline or structure, and shall be solidly tamped around the pipe or structure. Backfill material shall be placed in 6" loose layers and hand tamped until the top of pipe is covered by at least 12 inches of compacted material. Above this point, backfill material shall be placed in 8" loose layers. Compaction for 8" layers shall be accomplished by mechanical tampers or other approved methods. Care shall be taken in the use of mechanical tampers not to injure or move the pipe or to cause the pipe to be supported unevenly. Each layer shall be mechanically tamped for the full trench width unless an alternative method is approved in writing by the Engineer.
- C. Every backfill layer shall be compacted to 95% of maximum density at -2 to +2% of optimum moisture content as determined by the Standard Proctor Test, ASTM D-698. Materials containing an excess of moisture shall be permitted to dry until the moisture

content is within the specified range. Materials too dry shall be wetted uniformly, at the Contractor's expense, until the moisture content is in the specified range.

- D. No compacting shall be done when the material is too wet to be compacted properly. At such times, the work shall be suspended until the backfill materials have dried sufficiently to permit proper compaction or such other precautions shall be taken as may be necessary to obtain proper compaction. The Contractor is responsible for hauling, storing and drying of excavated material to be used in backfill operations within the prices bid.
- E. The Contractor shall, at his own expense, maintain all refilled excavations in proper condition. Trench surfaces shall be reshaped when necessary. If the Contractor fails to make repairs within forty-eight (48) hours after receipt of written notice from the Owner, the Owner may refill said depression wherever necessary and the cost of so doing will be retained from any monies due or to become due the Contractor under the Contract. The Contractor shall be fully responsible for any injury or damage that may result from lack of maintenance of any refilled excavation at any time prior to final acceptance.
- F. All unauthorized excavations made by the Contractor shall be immediately backfilled in accordance with the requirements of the specifications for trench backfill at the Contractor's expense.
- G. After completion of backfilling, all material not used shall be disposed of as approved by the Engineer, and all places on the line of the work shall be left clean and in good condition. This cleaning up shall be done by the Contractor without extra compensation. If he fails to do this work within a reasonable time after receipt of notice, it will be performed by the Owner, and the cost will be retained from the monies due the Contractor under the Contract.
- H. No backfilling of pipelines will be allowed until measurements of pipe and an inspection has been performed by the Owner's representative, and until the Engineer has authorized the backfill. Any unauthorized backfill of pipelines shall be uncovered by the Contractor at his expense if required by the Engineer.

3.10 EXCAVATION FOR STRUCTURES

- A. Excavate for structures, walls, foundations, footings, etc., to the depth and width required for construction and stripping of forms. Structural excavation shall consist of the excavation of all earth, rock, boulders, existing concrete and masonry foundations and walls, and all other materials encountered regardless of type, which the Contractor may encounter. No extra compensation will be allowed for excavation greater than 3'0" outside the most exterior point of the structure.
- B. The sides of the excavation shall be practically plumb and shall not be sloped unless approved in writing by the Engineer. Sides shall be supported or sheeted as required to protect pavement surfaces, curbing, utilities, structures, etc., and required for safety. Safety regulations shall be as required by State safety codes and OSHA. Refer to Part 3.17 of this section for Sheet piling, Shoring, and Bracing.

- C. In paved areas, the Contractor shall remove the paving only as necessary for the excavation of the structure or as detailed. Pavement edges at the structure shall be saw cut neat, straight, and to the full depth of paving prior to the start of any excavation. Should the Contractor disturb or damage pavement for a greater width than detailed on the drawings or should pavement damage result from cave-ins, settlement, etc., the Contractor shall replace such paving at his own expense.
- D. In non-paved areas, strip surface vegetation and suitable topsoil and place in stock piles which are separated from the trench excavated materials. Topsoil shall not be used for general trench refill.
- E. Should work be stopped for any reason and any excavation is left open for an unreasonable length of time, the Contractor shall refill the excavation at his own expense if so directed by the Engineer, the Inspector or the Owner. He shall not reopen the excavation until he is ready to complete the facility. Should the Contractor refuse or fail to refill any excavation completely within forty-eight (48) hours, or immediately if it poses a safety hazard, after a proper notice has been given by the Engineer or Inspector, the Owner shall be authorized to do the work. The resulting expenses shall be deducted from monies due the Contractor.
- F. The Contractor shall complete excavation as nearly as practicable to the depths of the structure to be installed as detailed. All cavities in the bottom of the excavation shall be filled to the required level with compacted crushed stone or gravel. Unless the cavities have been made on direction of the Engineer and classified as "Excavation Below Sub-grade" for unsuitable material, no extra compensation shall be due the Contractor.
- G. Excavated materials shall be graded, hauled, stored and protected as such material found suitable will be required for backfilling, or other purposes. Material classified as unsuitable shall be disposed of by the Contractor at the end of the project at a location approved by the Engineer. Hauling of excavated materials for any purpose shall not entitle the Contractor to additional compensation. Only those excavated materials designated by the Owner shall become property of the Contractor.
- H. All stockpiled materials shall be placed in such a way to prevent damage to the structures, drainage areas or private property. Excavated materials shall not be placed on private property unless written permission is obtained from the property Owner by the Contractor.
- I. The Contractor shall remove, relocate or protect all structures including but not limited to signs, mailboxes, overhead and buried utilities and other structure in the path of work as required for construction whether shown on drawings or not. No extra compensation will be allowed for property damage, injury or loss of time due to obstructions encountered which are not shown on the plans.
- J. The Contractor shall be responsible for any damage to curb, gutter, sidewalk, traffic control devices, pavement material, pavement markings and lawns. Any damage resulting directly or indirectly during construction shall be replaced in kind by the Contractor without additional compensation. The reuse of disturbed curb, gutter or sidewalk is prohibited. New sections shall be installed to the nearest undisturbed joint. Cost for replacement shall be included in the appropriate price bid.

3.11 BACKFILL FOR STRUCTURES

- A. Backfill around structures with suitable material from the excavation to the original surface grades shown on the plans or defined by the Engineer. If additional material is needed to backfill around the structure, Special Off-Site Backfill approved by the Engineer shall be furnished and placed by the Contractor within the lump sum price bid.
- B. No backfill shall be placed against new concrete or masonry structures until properly cured.
- C. Backfill shall be placed in eight (8) inch loose layers and compacted by mechanical tampers or other approved methods. Compaction shall conform to the requirements for compaction already set forth in this specification.
- D. The Contractor shall exercise caution in backfill and compaction to prevent damage to structures.

3.12 GRADING

A. PREPARATION

- 1. Prepare subsoil surface for finish grading by dressing and shaping to provide for uniform placement of topsoil or other surface as specified.
- 2. Cut and fill to within 0.2 foot of the correct sub-grade elevations. Set elevation to top of sub-grade under paved areas to bottom of the pavement base. Set elevation of the top of sub-grade under areas to receive topsoil, 4 inches below finished grades.
- 3. Furnish additional material required for rough grading, backfill or fill.
- 4. Remove surface rock or other foreign objects exceeding 2 inches in greater dimension. Dispose of such rock and debris in a lawful manner off-site.
- 5. Provide smooth transition between existing adjacent grades and new grades.

B. PERFORMANCE

- 1. Placement of Topsoil: Place topsoil over areas indicated for new grading contours. However, before topsoil construction work in these areas shall have been completed. Observe precautions as follows:
 - a. Do not place topsoil over areas indicated to receive paving or sidewalk.
 - b. Do not work topsoil or liner material while frozen or wet. Do not work materials in a dusting condition but moisten same to prevent a dust nuisance.
 - c. Scarify subsoil to a depth of 2 inches for bonding topsoil with subsoil.
 - d. On sloped areas, work topsoil or liner material into subsoil to blend so as to eliminate any semblance of slip-planing between the two soils; but leave a sufficient cover of topsoil to insure seed germination. Perform such blending of soils by ridging or serrating the subsoil on the slopes.
 - e. Place topsoil as needed for dressing-up minor depressions due to settling and erosion and to eliminate any other minor regularities.

2. Finished Elevations and Lines of Grassed Areas: Grade topsoiled areas of the site to within a tolerance of 1 inch of the elevations and lines indicated and in accordance with the following.
 - a. Grade a uniform longitudinal fall in swales and other surface drainage areas to provide a drainage flow line that can easily be maintained and traversed with normal lawn maintenance equipment.
 - b. Establish finish grade of topsoil ½ to ¾ inches below top of abutting walks or paving to provide positive drainage of same.
 - c. Place and grade topsoil to a depth not less than 4 inches nor greater than 12 inches.
 - d. Compaction: Compact finish grades as the final operation using a light roller weighing not over 120 pounds per foot-width of roller.
 - e. Tillage: Till finish graded soil over areas indicated for lawn regardless of type of lawn work performed. Use equipment and methods common to such work and till soil to a two inch depth minimum.
 - f. Seed and mulch in accordance with Section 323400 and the project plans.

3.13 QUALITY CONTROL TESTING DURING CONSTRUCTION

- A. Compaction and Density testing shall be coordinated by the Contractor with the Engineer and performed by an independent testing agency approved by the Engineer. The Contractor shall pay the testing laboratory for all tests performed inclusive of sample collection, preparation and transportation. Whenever test results indicate compaction densities less than specified, the Contractor shall, at his own expense, secure the specified compaction and subsequent retesting with methods approved by the Engineer. The testing agency, so employed by the Contractor, shall submit a copy of all testing reports directly to the Engineer. Each report shall contain the project identification name and number, name of Contractor, name of testing agency, and location of sample tested by station, location and depth as minimum.
- B. Perform field in-place density tests according to ASTM D 1556 (sand cone method) ASTM D 2167 (rubber balloon method) or ASTM D 2937 (drive cylinder method), as applicable.
 1. Field in-place density tests may also be performed by the nuclear method according to ASTM D 2922, provided that calibration curves are periodically checked and adjusted to correlate to tests performed using ASTM D 1556. With each density calibration check, check the calibration curves furnished with the moisture gages according to ASTM D 3017.
- C. When field in-place density tests are performed using nuclear methods, make calibration checks of both density and moisture gages at beginning of work, on each different type of material encountered, and at intervals as directed by the Engineer.
- D. Footing Sub-grade: At footing sub-grades, perform at least one test of each soil stratum to verify design bearing capacities. Subsequent verification and approval of other footing

sub-grades may be based on a visual comparison of each sub-grade with related tested strata when acceptable to the Engineer.

- E. Paved and Building Slab Areas: At sub-grade and at each compacted fill and backfill layer, perform at least one field in-place density test for every 2000 sq. ft. or less of paved area or building slab, but in no case fewer than three tests.
- F. Foundation Wall Backfill: In each compacted backfill layer, perform at least one field in-place density test for each 100 feet or less of wall length, but no fewer than two tests along a wall face.
- G. Trench Backfill: In each compacted initial and final backfill layer, perform at least one field in-place density test for each 200 feet or less of trench, but no fewer than two tests.
- H. When testing agency reports that sub-grades, fills, or backfills are below specified density, scarify and moisten or aerate, or remove and replace soil to the depth required, recompact and retest until required density is obtained.

3.14 MISCELLANEOUS EXCAVATION AND BACKFILL

- A. The Contractor shall do such miscellaneous excavation as may be necessary or directed. Such excavation shall be subject to the same conditions and requirements as specified for trench excavation.
- B. Miscellaneous Excavation shall include the digging of test pits, extra width of trench beyond the specified trench payment width made necessary by change in its alignment, or excavation for any special structures outside the trench that may not be shown on the drawings or described in the specifications, where such excavation is done at the direction of the Engineer.
- C. Test pits shall be dug by the Contractor whenever directed to determine location, depth or materials of existing utilities. The depth and size of test pits shall be such as required by the Engineer.
- D. Test pits shall also be dug by the Contractor, as authorized by the Engineer, along the lines of the trenches as shown on the drawings in advance of the excavation, or prior to use of mechanical moles, for the purpose of satisfying himself as to the location and elevation of underground obstructions or conditions.
- E. Test pits dug which are noted on the project plans or in advance of pipe laying operations to verify utility locations or additional excavation required to use sheeting or trench boxes shall be included in the prices bid in the proposal.

3.15 EXCAVATION BELOW SUBGRADE AND GRAVEL REFILL

- A. Materials below the excavation limit for pipelines and structures (below sub-grade), which in the judgment of the Engineer should be removed, shall be removed as directed.

All spaces created by the removal of unsuitable material below sub-grade shall be refilled and compacted with crushed stone or gravel, specified in paragraph 2.5 of this section. Payment for Excavation Below Sub-grade and Gravel Refill shall be made at the unit price bid only for the length width and depth authorized.

- B. Should the Contractor elect to excavate suitable material below sub-grade and install stone for the purpose of securing a dry trench bottom, in lieu of dewatering by mechanical methods, no payment will be made for Excavation Below Sub-grade and Gravel Refill.

3.16 DEWATERING

- A. All excavations must be kept free of water below the sub-grade of the work while work is in progress. This may be accomplished by ordinary pumping methods or by well points, whichever will produce the required results. The Contractor shall obtain all necessary dewatering permits at no additional expense. Upon removal of dewatering equipment, the Contractor shall backfill all holes and restore disturbed areas to their original condition.
- B. Dewatering for the structures and pipelines shall commence when groundwater is first encountered and shall be continued until such time as backfill has been completed. No concrete or pipe shall be laid in water nor shall water be allowed to rise over them until the concrete or mortar has set at least eight (8) hours. Groundwater shall not be allowed to rise around the pipe until the trench is backfilled.
- C. The Contractor shall dispose of the water from the work in a suitable manner without damage to adjacent property. No water shall be drained into work built or under construction without prior consent of the Engineer. Water shall be disposed of in such a manner as not to be a menace to the Public Health.
- D. In the event the Contractor's dewatering operations affect any water supplies within the project area, the Contractor shall take whatever steps that may be required to provide uninterrupted water service.
- E. The Contractor shall remove any siltation deposits in storm sewer systems, resulting from his dewatering or construction operations. He shall also be responsible for conveyance of dewatering flows and for erosion and sediment control.

3.17 SHEETING, SHORING AND BRACING

- A. The Contractor shall furnish and install all sheeting, shoring and bracing and other protective systems necessary to insure safe working conditions, to prevent subsidence of earth and caving embankments, and to prevent damage to public and private property and structures. The Contractor is responsible for obtaining proper design of such protective systems. The Contractor shall employ an on-site "Competent Person" as defined by OSHA 1926.650 (b), who is responsible for, but not limited to: the locations and protection of underground installations; recognize and control hazards due to water accumulation; daily inspections of excavations, adjacent areas and protective systems;

determine the impact of distress and/or surcharge loads and adjust the protective systems accordingly.

- B. Sheeting, shoring and bracing and other protective systems shall be removed as backfilling progresses, except at such locations as the Engineer may direct or approve it to be left in place.
- C. The condition of all excavations made by the Contractor shall be the responsibility of the Contractor. No extra compensation will be allowed for property damage, injury or loss of time, due to excavation slides or cave-ins at any time under any circumstances.
- D. The Contractor shall cut off any sheeting left in place, at least eighteen (18) inches below finished grade, and shall remove the material cut off without compensation.
- E. Where necessary, in quicksand, soft ground, or for the protection of any structure or property, sheeting shall be driven to such depth below the bottom of the trench as may be required to protect all existing and/or proposed work.
- F. The cost for furnishing, placing and removal of sheeting, shoring or bracing shall be included in the prices bid.
- G. A trench box is an acceptable alternative for pipeline installation to sheeting, shoring or bracing providing such boxes conform, to safety codes and work is monitored by the Contractor's "Competent Person".

3.18 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and re-establish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or lose compaction due to subsequent construction operations or weather conditions.
 - 1. Scarify or remove and replace material to depth directed by the Engineer; reshape and re-compact at optimum moisture content to the required density.
- C. Settling: Where settling occurs during the Project correction period, remove finished surfacing, backfill with additional approved material, compact, and reconstruct surfacing.
 - 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work and eliminate evidence of restoration to the greatest extent possible.

3.19 DISPOSAL OF SURPLUS AND WASTE MATERIALS

Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off the Owner's property.

3.20 INSTALLATION OF DETECTABLE WARNING TAPE

Pipeline detectable warning tape shall be installed continuously above all underground utilities including but not limited to underground electrical wiring and duct banks, gas, oil, steam, telephone lines and duct banks, water mains, gravity sewer and force mains, chemical feed piping, stormwater mains, or other utility which may be installed or distributed as part of this project. Detectable tape of the color and label required by the particular utility shall be installed in 2 places, 12 inches above the pipe and 12 inches below the ground surface or as recommended by the tape manufacturer. Detectable tape shall be a minimum of 2" wide and be imprinted with the words "Warning! Underground (Utility Type) Below" continuously along the tape. Provide tape colors to utilities as follows:

1. Red: Electric.
2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.

END OF SECTION

SECTION 32 13 13
CONCRETE PAVING

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.

1.2 SUMMARY

- A. Section Includes:
 - 1. Walks.
 - 2. Concrete Pavement
 - 3. Concrete Pads
 - 4. Concrete Curb
 - 5. Concrete paver units
 - 6. Bedding and joint sand
 - 7. Edge restraints
- B. Related Sections:
 - 1. Division 03 Section "Cast-in-Place Concrete" for general building applications of concrete.
 - 2. Division 32 Section "Concrete Paving Joint Sealants" for joint sealants in expansion and contraction joints within concrete paving and in joints between concrete paving and asphalt paving or adjacent construction.
- C. Delaware Department of Transportation (DelDOT) Standard Specifications.
- D. Delaware Department of Natural Resources and Environmental Control (DNREC) Sediment and Erosion Control Handbook.
- E. Interlocking Concrete Pavement Institute (ICPI) Technical Bulletins

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, and ground granulated blast-furnace slag.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Indicate pavement markings, lane separations, and defined parking spaces. Indicate, with international symbol of accessibility, spaces allocated for people with disabilities.
- C. Other Action Submittals:
 - 1. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
- D. Material Certificates: For the following, from manufacturer:
 - 1. Cementitious materials.
 - 2. Steel reinforcement and reinforcement accessories.
 - 3. Admixtures.
 - 4. Curing compounds.
 - 5. Applied finish materials.
 - 6. Bonding agent or epoxy adhesive.
 - 7. Joint fillers.
 - 8. Aggregates and sand materials.
 - 9. Concrete paver units. Include Two representative full-size samples of each paver type, thickness and color finish
- E. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with the DelDOT Standard Specifications.
- B. Testing Agency Qualifications: Qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
 - 1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
- C. Pre-installation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to concrete paving, including but not limited to, the following:

- a. Quality control of concrete materials and concrete paving construction practices.
2. Require representatives of each entity directly concerned with concrete paving to attend, including the following:
 - a. Contractor's superintendent.
 - b. Concrete paving subcontractor.
3. Paving Subcontractor Qualifications:
 1. Utilize an installer having successfully completed concrete paver installation similar in design, material, and extent indicated on this project.
 2. Utilize an installer holding a current certificate of completion from the Interlocking Concrete Pavement Institute Concrete Paver Installer Certification program.

1.6 PROJECT CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

PART 2 - PRODUCTS

2.1 FORMS

- A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces in accordance with the DelDOT Standard Specifications.
- B. Form-Release Agent: In accordance with the DelDOT Standard Specifications

2.2 STEEL REINFORCEMENT

- A. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, fabricated from steel wire into flat sheets as shown on the plans and in accordance with the DelDOT Specifications.

2.3 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of same type, brand, and source throughout Project:
 - a. Portland Cement: Per the DelDOT Standard Specifications.
- B. Normal-Weight Aggregates: Per the DelDOT Standard Specifications.

C. Water: Per the DelDOT Standard Specifications.

D. Air-Entraining Admixture: Per the DelDOT Standard Specifications.

2.4 CURING MATERIALS: All curing shall be in accordance with the DelDOT Standard Specifications.

2.5 RELATED MATERIALS

A. Joint Fillers: In accordance with the DelDOT Standard Specifications.

2.6 CONCRETE MIXTURES

A. All concrete shall be Type "B" (3,000 PSI) in accordance with the DelDOT Standard Specifications.

2.7 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete in accordance with the DelDOT Standard Specifications.

2.8 CONCRETE PAVERS

A. Manufacturer: Belgard, Nicolock or approved equal

B. Interlocking Concrete Pavers:

a. Material Standard: Comply with material standards in ASTM C936.

b. Color to be selected by owner.

c. Color Pigment Material Standard: Comply with ASTM C979.

d. Size: Per plans.

e. Average Compressive Strength (ASTM C140): 4000 psi

f. Average Water Absorption (ASTM C140): 5% with no unit greater than 7%.

g. Freeze/Thaw Resistance (ASTM C1645): 28 freeze-thaw cycles with no greater loss than 225 g/m² of paver surface area or no greater loss than 500 g/m² of paver surface area after 49 freeze-thaw cycles when immersed in a 3% saline solution. Use -15° C as the lowest test temperature for applications subject to deicers. Freeze-thaw testing requirements shall be waived for applications not exposed to freezing conditions

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.
- B. Proof-roll prepared subbase surface below concrete paving to identify soft pockets and areas of excess yielding.
 - 1. Completely proof-roll subbase in one direction. Limit vehicle speed to 3 mph.
 - 2. Proof-roll with a pneumatic-tired and loaded, 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
 - 3. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch according to requirements in Division 31 Section "Earth Moving."
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.
- B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 STEEL REINFORCEMENT

- A. General: In accordance with the DelDOT Standard Specifications.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.
- C. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

3.5 JOINTS

- A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.
 - 1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.
- B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.
 - 1. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.
 - 2. Provide tie bars at sides of paving strips where indicated.
 - 3. Butt Joints: Use bonding agent at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.
 - 1. Locate expansion joints at intervals of 50 feet for paving and 20 feet for sidewalks and curbing unless otherwise indicated.
 - 2. Extend joint fillers full width and depth of joint.
 - 3. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
 - 4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
 - 5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
 - 6. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
- D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness at 25-foot intervals for paving and 5-feet for sidewalks.
 - 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/4-inch radius. Repeat grooving of contraction joints after applying surface finishes.
- E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes.

3.6 CONCRETE PLACEMENT

- A. Placement of concrete shall be as shown on the plans and in accordance with the DelDOT Standard Specifications.

3.7 FLOAT FINISHING

- A. Float finishing shall be in accordance with the DelDOT Standard Specifications.

3.8 CONCRETE PROTECTION AND CURING

- A. Concrete protection and curing shall be in accordance with the DelDOT Standard Specifications.

3.9 PAVING TOLERANCES

- A. Paving tolerances shall be in accordance with the DelDOT Standard Specifications.

3.10 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
 - 1. Testing Frequency: In accordance with the DelDOT Standard Specifications.
 - 2. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
 - 3. Compressive-Strength Tests: ASTM C 39/C 39M; test one specimen at seven days and two specimens at 28 days.
 - a. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.
- C. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
- D. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design

compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

- E. Concrete paving will be considered defective if it does not pass tests and inspections.
- F. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.11 REPAIRS AND PROTECTION

- A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.
- B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.
- C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.
- D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 32 13 13

SECTION 32 18 00 - SYNTHETIC TURF SHOCK PAD

PART I – GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

- A. General Conditions, Special Conditions and Section “Scope of Work” are part of and govern work under this section.
- B. For construction of the aggregate base layer, see Section 321125, Synthetic TurfSubgrade and Stone Aggregate Drainage Layer.
- C. For synthetic turf carpet, see Section 321820, Synthetic Turf Carpet.

1.2 SCOPE OF WORK

- A. Furnish all labor, materials, tools, and equipment necessary to install, in place, a 19 mm E-layer pad, as indicated on the plans and as specified herein. The installation of all new materials shall be performed in accordance with these specifications, in strict accordance with the manufacturer's written installation instructions, and in accordance with all approved shop drawings.

1.3 SUBMITTALS

- A. Submit with bid:
 - 1. Elastic-Layer Shock Pad - one (1) sample, approximately 100 sq.in. x 19 mm thick.
 - 2. Manufacturer's data offering product technical documentation.
 - 3. Certified list of existing installations.
- B. Prior to order of materials, the Contractor shall submit details on construction, especially any details that may deviate from these plans and specifications.

1.4 QUALITY ASSURANCE

- A. Bidder/Manufacturer/Installer's experience:
 - 1. The Bidder/Prime Contractor shall have been actively and directly engaged in constructing stadium athletic fields for a period of five (5) years or more.

2. The Contractor shall employ only qualified, experienced supervisors and technicians skilled in the installation of this system. All E-layer technicians shall be full-time statutory employees of the installer.

1.5 EXISTING CONDITIONS

- A. Contractor will be responsible for any damage to any existing pavement, curbs, utilities, vegetation or structures and shall restore any damage to original or better condition.

1.6 SURFACE AREA

- A. See Site Plans for layout. Contractor to verify all measurements.

1.7 UTILITIES

- A. Owner will supply necessary water, adequate lighting and electricity for installation.

1.8 Warranty

- A. The Shock pad shall be covered by a 25-year limited warranty

PART 2 – PRODUCTS

2.1 MATERIALS

2.1. Synthetic Turf Shock Pad

- A. The approved Shock Pad shall be as follows or approved equivalent.
 - a. ProPlay-Eco Sport
Schmitz Foam Products
412-575-7993
 - b. Brock Power Base
Brock USA
303-544-5800
 - c. Ecore BL-41
Ecore
(866) 795-2732

PART 3 - EXECUTION

3.1 GENERAL

- A. All installation operations shall be performed by personnel directly employed by the manufacturer, fully familiar with the materials and their application, under the fulltime direction and supervision of a qualified technical supervisor employed by the installer of the E-layer. Installation supervisors shall have a minimum of five (5) years' experience and job resumes shall be submitted to the Owner with the bid.
- B. The surface to receive the shock pad shall be inspected and certified by the manufacturer as ready for the installation of the system, must be perfectly clean as installation commences, and shall be maintained in that condition throughout the process.
- C. Furnish a written Certification or Letter of Acceptance of the porous aggregate base construction, prior to commencing installation of the E-layer pad.

3.2 INSTALLATION

- A. The aggregate drainage base shall be inspected by the Contractor and checked with a laser level for proper slope and planarity utilizing a minimum of 400 elevation shots; and make corrections as specified herein as required including proper stability and consolidation. Turf installer shall not approve the aggregate base layer as acceptable for pad placement without reviewing also survey elevations.
- B. The shock pad shall be installed by the manufacturer's personnel per the manufacturer's specification and installation procedures.
- C. Specialized paving equipment shall be operated by a minimum of two skilled technicians at all times. Seams shall be hand rolled and troweled. Cold joints shall be primed with polyurethane primer. Pad thickness shall be continuously monitored for consistency, as well as the mixing ratio. The finished surface shall not vary more than 1/8" in 10 feet as measured in any direction with a 10 foot straight edge.

- D. Testing of the E-layer shock pad shall be performed as a “system” in conjunction with the synthetic turf and shall be performed by a recognized sports testing facility.

3.3 CLEAN UP

- A. The contractor shall provide the labor, supplies and equipment as necessary for final cleaning of surfaces and installed items.
- B. The Contractor shall keep the area clean throughout the project and clear of debris.
- C. Surfaces, recesses, tuck slot, etc., shall be cleaned as necessary to leave the work area in a clean, immaculate condition ready for immediate occupancy and use by the synthetic turf Contractor in installing the finished carpet.

END SECTION

SECTION 32 18 13 - SYNTHETIC TURF CARPET

PART I – GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

- A. General Conditions, Special Conditions and Section “Scope of Work” are part of and govern work under this section.
- B. For crushed stone aggregate base layer, see Section 321125, Subgrade and Stone Aggregate Drainage Layer.
- C For new elastomeric layer shock pad, see Section 321800, Shock Pad.

1.2 SCOPE OF WORK

- A. Furnish all labor, materials, tools, and equipment necessary to install, in place, all synthetic turf carpet, as indicated on the plans and as specified herein. The installation of all new materials, including testing, shall be performed in accordance with these specifications, in strict accordance with the manufacturer's written installation instructions, and in accordance with all approved shop drawings.

1.3 SUBMITTALS

- A. Submit with bid:
 - 1. Synthetic Turf - one (1) sample, approximately 100 sq.in., one with infill, properly labeled.
 - 2. Elastic-Layer shock pad - one (1) sample, approximately 100 sq.in.
 - 3. Seam - one (1) sample, seam length of 6" minimum, sewn or glued, properly labeled.

4. Knitted-in 4" white line.
5. Manufacturer's data offering full product technical documentation.
6. Submit to Owner for approval three (3) copies of quality assurance information as required herein, for initial testing and installation, and for ongoing testing responsibility.
7. Certified list of existing installations, including owner representative and telephone number, attesting compliance with quality assurance information.
8. Laboratory test reports for fabric, backing, ribbon, in accordance with ASTM designated test numbers. Tests shall include, but not be limited to pile height and weight, tuft bind, grab tear strength, backing strength.
9. Laboratory test data for rubber crumb infill.
10. Complete warranty information, including sample warranty.

B. Additional submittals required for this Bid are:

1. Five years of audited financial statements, or as a minimum, five years of financial statements.
2. Litigation in the past five years.
3. Proof that the Turf Manufacturer is a member, in good standing of the Synthetic Turf Council.
4. Projects that have not been completed on time.
5. Principals of the firm with background information.

6. Disclosure of bankruptcies in which any of the principals have been involved in the past ten years.
 7. Disputes over warranty claims in the past five years.
- C. Prior to order of materials, the Contractor shall submit the following:
1. Field layout indicating striping plans for all specified sports.
 2. Seam layout of the field.
 3. Details on construction, especially any details that may deviate from these plans and specifications, including, but not limited to edge details, goal post details, other inserts, covers, etc.
- D. Prior to Final Acceptance, the submit to the Owner three (3) copies of Maintenance Manuals, which will include all necessary instructions for the care and preventative maintenance of the synthetic turf system, including painting and striping.
- E. Prior to the beginning of installation, the manufacturer/installer of the synthetic turf as well as the shock pad subcontractor shall inspect the existing stone aggregate base layer and shock pad, and supply a Certificate of Acceptance for both surfaces for obtaining manufacturer's warranty for the finished synthetic playing surface.

1.4 SHOP DRAWINGS

- A. Shop drawings shall be prepared at the scale of the construction documents and contain all pertinent information regarding installation. These drawings shall be submitted to the Owner for approval prior to the manufacturing and shipment of materials.
- B. Submit drawings for:
1. Seaming plan; seams of pad are not to coincide with seams of synthetic turf nor interfere with subsurface drain system.

2. Installation details; edge detail, goal post detail, other inserts, etc.
3. Striping plan; lay-outs for football and soccer for all fields, showing field lines, markings and boundaries as required by the respective sports sanctioning organization.

1.5 QUALITY ASSURANCE

A. Bidder/Manufacturer/Installer's experience:

1. The Bidder/Prime Contractor shall have been actively and directly engaged in constructing stadium athletic fields for a period of five (5) years or more.
2. The manufacturer and installer shall have been actively and directly engaged in constructing stadium athletic fields for a period of five (5) years or more, and provide proof of ten (10) or more tufted, polyethylene grass-like fabric sports field installations completed by them within the last three (3) years, five of which must be synthetic turf fields in locations and operating conditions similar to those in Delaware.
3. The manufacturer/installer must provide a quality control program, for initial installation and testing, and for ongoing testing regarding responsibility, methodology and protocol. An independent recognized third party testing facility, experienced with synthetic turf, acceptable to the Owner and Architect shall be utilized to test for compliance and acceptance.
4. In addition, the Owner may make such investigations as he deems necessary to determine the ability of the bidder to perform the work, and the bidder shall furnish to the Owner all such information and data for this purpose as the Owner may request. The Owner reserves the right to reject any bid if the evidence submitted by, or investigation of such bidder fails to satisfy the Owner that such bidder is properly qualified to carry out the obligations of the contract and to complete the work specified herein.

5. The Contractor shall employ only qualified, experienced supervisors and technicians skilled in the installation of this system. All turf technicians shall be full-time statutory employees of the turf manufacturer/installer. Submit resumes of the top two (2) technicians and supervisors with the bid.

B. Prospective bidders must meet the following criteria:

1. Have proper license, in good standing, and have never had a license revoked.
2. Are able to substantiate currently available bonding capacity in excess of \$1,000,000 per project and an aggregate bonding line in excess of \$5,000,000.
3. Have not had a Surety or Bonding company finish work on any contract within the last five (5) years.
4. Have not been disqualified or barred from performing work for any public Owner or other contracting entity.
5. Shall have demonstrated financial strength to fully service and warrant the systems throughout the provision of audited financial statements for the past three years.

B. Warranty: The Manufacturer's Warranty, which guarantees usability and playability of the synthetic turf system shall not be prorated nor limited to the amount of usage. The form of warranty must be furnished and submitted together with the bid for consideration by the Owner and Owner's legal counsel.

1. The warranty submitted must have the following characteristics and must be satisfactory to Owner in all other respects:
 - (a) Must provide full coverage without pro-ration or reduction in amount,

for eight (8) years from the date of Substantial Completion.

- (b) Must warrant materials, workmanship, installation and performance.
- (c) Must warrant that the materials installed meet or exceed product specifications.
- (d) Must have a provision to either repair or replace, without cost to Owner, such portions of the installed materials that are no longer adequate as a serviceable and playable surface. The repair or replacement must provide a serviceable and playable surface comparable to a new surface.
- (e) Must be a warranty from a single source covering workmanship, installation and all self-manufactured or procured materials.
- (f) Guarantee the availability of replacement materials for the synthetic turf system installed for the full warranty period.
- (h) The insured warranty policy must be from an A+ "rated" or better carrier, and must be in force at time of bid, and shall have a minimum of \$1 million dollars per Claim and minimum \$25 million annual policy aggregate.
- (g) The warranty shall be insured by a third party, written to the owner, and be fully pre-paid in advance and be non-pro-rated, and shall have no deductible amounts or self-retention participation

2. Full warranty information regarding the warranty offered and warranty performance of each warrantor shall be provided with the bid, for evaluation by the Owner and Architect.

1.6 EXISTING CONDITIONS

- A. Contractor will be responsible for any damage to any pavement, curbs, fencing, utilities, vegetation or structures during installation of the synthetic turf system, and shall restore any damage to original or better condition.

1.7 SURFACE AREA

- A. See Site Plans for layout. Contractor to verify all measurements.

1.8 UTILITIES

- A. Owner will supply necessary water, adequate lighting and electricity for installation.

PART 2 - PRODUCTS

2.1 MATERIALS – BASIC REQUIREMENTS

- A. Th Synthetic Turf System: A synthetic turf system tufting 10,800 denier monofilament fibers made from a singularly extruded combination of stabilized polyethylene and nylon polymers with proper compatibilizers. Fibers shall be tufted into a suitable primary backing and coated with a secondary metered polyurethane adhesive coating. Pile height shall be nominal 2.0". Fibers shall be tufted to a primary backing and a mechanically applied adhesive secondary backing.
- B. The tufted fiber's face weight shall not weigh less than 52 ounces per square yard. The tufted rows of fiber are to be spaced no more than 1/2" apart. ASTM tests proving the fiber meets these qualifications must be provided with the bid. Turf systems that do not meet this specification will be disqualified.
- C. The carpet's primary backing shall have a minimum weight of 7.0 oz per square yard. The carpet shall then be coated with a secondary backing of polyurethane synthetic coating material with a minimum application rate of 20 ounces per square yard and then perforated for adequate drainage. Carpets that are not perforated for adequate drainage shall not be acceptable.

- D. The carpet shall be delivered in 15' wide rolls. The rolls shall be of sufficient length to go from sideline to sideline. Head seams, other than at sidelines, will not be acceptable.
- E. The infilled pile surface shall provide good traction in all types of weather with the use of conventional sneaker type shoes, composition molded sole athletic shoes, and screw- in style football cleats.
- F. The pile surface shall be suitable for both temporary and permanent line markings using acrylic paint, as per the turf provider's recommendations.
- G. All adhesives used in bonding the seams shall be resistant to moisture, freeze/thaw, bacteria and fungus attacks, and resistant to ultraviolet radiation. The adhesive shall be made especially for the adhesion of synthetic turf seams and inlaid field markings and graphics.
- H. The seam specific adhesive system shall have been utilized on at least 25 full installations. Provide this information with the bid. It shall consist of a factory-made adhesive bed applied to a non-woven fabric seaming tape. The adhesive bed shall be a metered amount suitable for the application. It shall be heat and pressure activated. A special heat application machine and pressure application using weighted rollers is mandatory.
- I. Supply field groomer and sweeper or single maintenance apparatus that performs both basic maintenance functions.
- J. Perimeter edge details required for the system shall be as detailed and recommended by the turf provider, and as approved by the turf provider.
- K. The carpet shall be anchored to the new track drain and/or concrete curbing, in accordance with the drawings and manufacturer's recommended details, which shall be submitted for approval.
- L. Lines and field markings shall be installed as specified, utilizing manufactured lines at the end of each 15' roll and inlaid lines and markings as specified.
- M. Infill composition shall consist of a ballast layer of silica sand topped by

ambient SBR rubber performance infill in a ratio by weight of 65% rubber / 35% sand. B. Silica sand infill:

Must be clean, sub-angular silica sand

Must be a 20-40 sieve size. C. SBR infill:

Must be ambient SBR Rubber

Must be a 10-20 sieve size.

Immediately after infill layers are installed, infill depth must be measured per testing protocol detailed in Section 1.3 C. 2 above to ensure that infill layer is at least 1.46” deep.

- N. The entire carpet and pad system shall provide a uniform, comfortable and safe playing surface, free from defects and providing consistent footing in all directions. Footing includes wet and dry traction, slip resistance and rotational resistance. The design of the turf fibers shall minimize skin abrasions, and minimize fly-out of rubber crumb infill.
- O. Impact Absorption (force reduction) of the finish field surface and underlying pad shall provide the current industry standard of less than 165 G-max (ASTM F355) over the entire surface, measured at any given test point throughout the entire warranty period. It is understood that G-max values may vary from point-to-point. Initial G-max shall not exceed 110 nor be less than 85 at the time of installation. Submit test results in accordance with Part 4, Post Installation Testing.
- P. Finished field surfaces shall provide adequate stability for athlete body control, and provide consistent and predictable ball performance reaction characteristics.
- Q. The finished field surfaces shall have 15 ft. turf panels, each possessing consistent color and shade, without significantly noticeable streaks, irregularities, or off-color areas, when observed in any direction.

2.2 SYNTHETIC TURF SYSTEM

- A. Provide complete synthetic turf carpet system, as one of the following:

- 1. AstroTurf Rootzone 3D3 Blend 52
AstroTurf Corporation

(706) – 277-8873

2. Spike Zone Pro 2.00
Shaw Sports Turf
(866) 703-4004
 3. ULTRABLADE DFE EXTREME 52 with Thatch Zone
Sprinturf
(877)686-8873
- B. All materials, installation and warranty shall be in accordance with the latest manufacturer's specification and in accordance with the Contract Documents.

2.3 ATTIC STOCK

- A. Provide a minimum of 750 square feet of synthetic turf carpet for the Owners use for future repairs for each field to be installed.

PART 3 - EXECUTION

3.1 GENERAL

- A. The installation shall be performed in full compliance with approved shop drawings.
- B. Inspect synthetic materials prior to installation for damage or defects, missing goods or insufficient quantities, correct turf pile height, correct backing perforation spacing and diameter, and other materials out-of-tolerance with the specification.
- C. All installation operations shall be performed by personnel directly employed by the manufacturer, fully familiar with the materials and their application, under the fulltime direction and supervision of a qualified technical supervisor employed by the turf manufacturer. Installation supervisors shall have a minimum of five (5) year's experience and job resumes shall be submitted to the Owner with the bid.

- D. The surface to receive the synthetic turf shall be inspected and certified by the manufacturer as ready for the installation of the system and must be perfectly clean as installation commences and shall be maintained in that condition throughout the process.
- E. Furnish a written Certification of Acceptance of the porous aggregate base and shock pad construction, as applicable, prior to commencing installation of the turf carpet.

3.2 INSTALLATION – SYNTHETIC TURF CARPET

- A. The stone aggregate base and shock pad shall be inspected by the Contractor and checked with a laser level and string line for slope and planarity, and require corrections as may be required. Turf installer shall not approve the stone aggregate base and the shock pad as acceptable for carpet placement without reviewing and approving the complete installation as specified herein.
- B. Testing prior to shipment shall be performed by random sampling of carpet rolls by the manufacturer, certifying that they meet specifications. Testing shall be for pile composition, pile weight, total height, tuft bind and grab tear strength. Test results shall be conveyed in writing, and provided with the shipment(s).
- C. Synthetic turf shall be installed across the playing field and attached to the perimeter edge detail in accordance with the manufacturer's specification and installation procedures. Turf shall be of sufficient length to permit full cross playing field installation. No head or cross seams will be allowed. The turf carpet system shall be installed to provide stability that will prevent panels from shifting or bunching.
- D. Seams shall be sewn or glued per the manufacturer's specification and installation procedures. Seams shall be flat, tight, and permanent with no separation or fraying. Seam gaps shall be uniform, width not to exceed the gauge of the tufting.
- E. Infill installation is critical to performance and must closely follow manufacturer's recommendations. In addition:
 - 1. Apply when in a dry condition, and when the field is dry.
 - 2. Install uniformly, properly mixed infill and glue materials.

3. Equipment utilized for infill must erect the fiber, place the infill materials, and incorporate a metering method to provide consistent distribution. Equipment shall not distort or displace any base materials, or damage the system.
- F. Fiber conditioning: It is essential to maintain the integrity and uniformity of the fiber throughout the manufacturing, shipping handling, installation and maintenance, in order to prevent damage which could alter performance.

3.3 FIELD LAYOUT AND MARKINGS

- A. The synthetic turf fields will have inlaid football lines, soccer lines, football numbers and football hash marks, as shown and detailed on the plans and per approved shop drawings; approved by the Owner and the Architect.

3.4 CLEAN UP

- A. Contractor shall provide the labor, supplies and equipment as necessary for final cleaning of surfaces and installed items.
- B. All usable remnants of new material shall become the property of the Owner.
Provide sufficient material for suitable repairs of minor tears, burns, or other minor damage.
- C. The Contractor shall keep the area clean throughout the project and clear of debris.
- D. Surfaces, recesses, enclosures, etc., shall be cleaned as necessary to leave the work area in a clean, immaculate condition ready for immediate occupancy and use by the Owner.

PART 4 – POST INSTALLATION TESTING

4.1. The Contractor shall test for the following:

- (1) After receipt of turf on site – When requested, verify turf identification specification by examination of approximately 2 square feet from two turf rolls taken on delivered material. Examination shall include a DSC (Differential Thermal Scan) for identification of the fiber.

- (2) Perform in-situ testing of the installed turf for Force Reduction.
 - (3) When requested, verify the amount of infill: (minimum 3 locations) Vacuum the infill from 1 square foot, dry and sieve and weigh.
 - (4) When requested, provide additional performance tests on the completed turf and pad system at 5 locations (UEFA pattern) for Standard Deformation, Ball Rebound, Rotational Resistance (Traction) and Ball Roll. G-max testing is required for all fields, per (2) above.
- 4.2. Tests shall be performed by a professional and experienced testing laboratory specializing in Sports Testing, acceptable to the Owner and the Architect.
- 4.3. Contractor shall provide a quality control, post construction testing program requiring testing at the end of year one, and at the end of year three, and providing the above tests for the Owner's records. Testing thereafter will be at the Owner's discretion, throughout the life of the surface.

PART 5 – MAINTENANCE

- 5.1. Long-term maintenance is necessary for the turf to obtain its maximum useful life. The turf Contractor shall provide detailed written maintenance instructions, suggested guidelines for the system, and training of the Owner's maintenance personnel.
- 5.2. Maintenance consists of but is not limited to cleaning, stain removal, minor seam repairs, dragging or redistribution of any infill material, and management of infill compaction, as well as proper utilization of maintenance equipment.
- 5.3. It will be the Owner's responsibility to maintain a log of field maintenance performed, as recommended and warranted by the turf Contractor.
- 5.4. Periodic cleaning, utilizing sweeping and vacuuming with equipment compatible with field surface will be performed by the Owner per guidelines provided by the turf Contractor.

END SECTION

SECTION 32 31 19
DECORATIVE METAL FENCES AND GATES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Decorative louvered and square mesh aluminum fences and gates.
- B. Automatic gate operators.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete.
- B. Section 08 71 00 - Door Hardware : gate hardware.
- C. Division 26: Electrical power for gate operators.
- D. Division 28: Access control systems.

1.03 REFERENCE STANDARDS

- A. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes 2023.
- B. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus 2019.
- C. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes 2021.
- D. ASTM D523 - Standard Test Method for Specular Gloss 2014 (Reapproved 2018).
- E. ASTM D714 - Standard Test Method for Evaluating Degree of Blistering of Paints 2002 (Reapproved 2017).
- F. ASTM D822/D822M - Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings 2013 (Reapproved 2018).
- G. ASTM D1654 - Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments 2008, with Editorial Revision (2017).
- H. ASTM D2244 - Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates 2023.
- I. ASTM D2794 - Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact) 1993 (Reapproved 2019).
- J. ASTM D3359 - Standard Test Methods for Rating Adhesion by Tape Test 2023.
- K. ASTM D3363 - Standard Test Method for Film Hardness by Pencil Test 2022.
- L. ASTM F2200 - Standard Specification for Automated Vehicular Gate Construction 2020.
- M. ASTM F2408 - Standard Specification for Ornamental Fences Employing Galvanized Steel Tubular Pickets 2016 (Reapproved 2023).
- N. CLFMI WLG 2445 - Wind Load Guide for the Selection of Line Post and Line Post Spacing 2023.
- O. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.
- P. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- Q. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations Current Edition, Including All Revisions.
- R. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations Current Edition, Including All Revisions.
- S. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to start of work of this section; require attendance by affected installers.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Submit manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
- C. Design Calculations: For high wind load areas, provide calculations for fence panels and accessory selection as well as line post spacing and foundation details. See CLFMI WLG 2445 for line post and spacing guidance.
- D. Shop Drawings:
 - 1. Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, gates, and schedule of components.
- E. Samples: Submit two samples of fence panels, louvered and mesh infill , 12 inch (305 mm) by 12 inch (305 mm) in size minimum, illustrating construction and finish.
- F. Manufacturer's Qualification Statement.
- G. Installer's Qualification Statement.
- H. Manufacturer's Warranty.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum five years documented experience.
- B. Installer Qualifications: Experienced with type of construction involved and materials and techniques specified and approved by fence manufacturer.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Store materials in a manner to ensure proper ventilation and drainage. Protect against damage, weather, vandalism and theft.

1.08 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a two year period after Date of Substantial Completion.
- C. Provide ten year manufacturer warranty for powder coat finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Decorative Metal Fences and Gates:
 - 1. American Fence Company, DBA PalmSHIELD: www.palmshieldlouvers.com/#sle.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Automatic Gate Operators:
 - 1. HySecurity; SlideDriver: www.support.hysecurity.com.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Specialty Hardware:
 - 1. Card Reader Pedestals: Pedestalpro; www.pedestalpro.com.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 FENCES

- A. Fences: Complete factory-fabricated system of posts and panels, accessories, fittings, and fasteners; finished with electrodeposition coating, and having the following performance characteristics:
- B. Electro-Deposition Coating: Multistage pretreatment/wash with zinc phosphate, followed by epoxy primer and acrylic topcoat.
 - 1. Total Coating Thickness: 2 mils (0.058 mm), minimum.
 - 2. Color: As selected by Architect from manufacturer's standard range.
 - 3. Coating Performance: Comply with general requirements of ASTM F2408.
 - a. Adhesion: ASTM D3359 (Method B); Class 3B with 90 percent or more of coating remaining in tested area.
 - b. Minimum hardness measured in accordance with ASTM D3363 2H.
 - c. Corrosion Resistance: ASTM B117, ASTM D714 and ASTM D1654; 1/8 inch (15.8 mm) coating loss or medium No.8 blisters after 1,500 hours.
 - d. Impact Resistance: ASTM D2794; 60 inch pounds (6.8 N m).
 - e. Weathering Resistance: ASTM D523, ASTM D822/D822M and ASTM D2244; less than 80 percent loss of gloss after 1 year exposure in South Florida with test panels tilted 45°.
- C. Aluminum: ASTM B221.
 - 1. Tubular Pickets, Rails and Posts: 6005-T5 alloy.
 - 2. Extrusions for Posts and Rails (Outer Channel): 6005-T5 alloy.
 - 3. Extrusions for Pickets and Rail (Inner Slide Channels): 6063-T5 alloy.
- D. Fasteners: ASTM A276/A276M, Type 302 stainless steel; finished to match fence components.

2.03 ALUMINUM LOUVERED SECURITY FENCE (TYPE 1):

- A. Approved Louvered Fence System, Manufacturer:
 - 1. "Palm Shield", American Fence Company
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Louver Panel Description:
 - 1. Louver Panel Height: 7 feet.
 - 2. Louver Panel Width: Not to exceed 6 feet.
 - 3. Louver fencing system consisting of horizontal, fixed louver, modular fence panels fabricated with extruded aluminum framing bars and supported by extruded aluminum fence posts.
 - a. Extended Flange to allow for a minimum of ½ inch overlap of louvers for 100% direct visual screening.
 - b. Fixed Louver Bars: 0.125 inch thick louver with an installed profile of 2 inch x 2.873 inch tall.
 - c. Louver Vertical Framework: 3 inch x 3 inch x ¼ inch aluminum angle. Framework supporting the louvers shall be solid welded and mitered.
 - d. Louver Horizontal Top Cap: 3 inch x 3 inch x ¼ inch aluminum top cap.
 - e. Louver Horizontal Bottom Cap: 3 inch x 3 inch x ¼ inch angle bottom cap.
 - f. Cross Bar: 2 inch x 1/8 inch aluminum flat bar.
- C. Fence Posts:
 - 1. Panel posts shall be 4 inch square by ¼ inch minimum extruded tubular aluminum sections with solid aluminum caps. Length as specified on the contract drawings.
 - 2. Post spacing: as specified by manufacturer.
 - 3. All fence posts to be plated with 10" x 10" x ¾" aluminum plates with four ¾" hole for anchors.

- D. Fittings and accessories: All fittings and accessories shall be stainless steel and sized as specified by the fence manufacturer. Fence panels to be attached to posts with ¼" x 1" stainless steel screws. Panels and posts are predrilled to support level installation.
 - E. Anchor Bolts: Anchor bolts shall be _____ and adequate to support loads based on screening height, exposures and loading.
 - F. Gates: Swing to exterior of enclosure, size as shown on contract drawings.
 - 1. Louver spacing, style and appearance shall be identical to fence panels.
 - 2. Gate hinges to be Gorilla barrel hinge with ¾" rod, ball bearing, and grease zert. Hinge plate to be ½" thick plates offset to create a 5/8" gap. Standard hardware as required by the gate manufacturer for complete functional operation. Hinges to be bolted to gate frame and field welded to steel gate posts.
 - 3. Gate hardware: See Section 08 71 00 .
 - 4. Welded frame, size as shown on the contract drawings, extruded aluminum tubing with aluminum fixed louver panels to match fencing material.
 - 5. Drop rods to be 1" schedule 40 pipe and through bolted to gate frame.
 - 6. Gate shall have welded frame fabricated from extruded aluminum tubing with aluminum fixed louver panels to match fencing material. Frame configurations shall be as indicated on the contract drawings.
 - 7. Gate posts: as determined by manufacturer. Gate posts to be specified to support gates.
- 2.04 ALUMINUM SQUARE MESH SECURITY FENCE (TYPE 2):
- A. Approved Square Mesh Fence System, Manufacturer:
 - 1. "Palm Shield", American Fence Company
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.
 - B. Square Mesh Panel Description:
 - 1. Square openings: 2 inches .
 - 2. Wire size: 0.25 inch .
 - 3. Aluminum, Alloy 1350-H18, Woven - Lock Crimp Weave.
 - C. Panel Description:
 - 1. Panel Height: As indicated.
 - 2. Square mesh fencing system: Consisting of horizontal, fixed square mesh, modular fence panels fabricated with extruded aluminum framing bars and supported by extruded aluminum fence posts.
 - 3. Square mesh panel width: Not to exceed 4' but to be evenly spaced in each run of screening.
 - 4. Vertical Framework: 3 inch x 3 inch x ¼ inch aluminum angle. Framework supporting the square mesh sheet shall be solid welded and mitered.
 - 5. Horizontal Top Cap: 3 inch x 3 inch x ¼ inch aluminum top cap.
 - 6. Horizontal Bottom Cap: 3 inch x 3 inch x ¼ inch angle bottom cap.
 - 7. Cross Bar: 2 inch x 1/8 inch aluminum flat bar.
 - D. Fence Posts:
 - 1. Panel posts shall be 4 inch square by ¼ inch minimum extruded tubular aluminum sections with solid aluminum caps. Length as specified on the contract drawings.
 - 2. Post spacing: as specified by manufacturer.
 - 3. All fence posts to be plated with 10" x 10" x ¾" aluminum plates with four ¾" hole for anchors.
 - E. Fittings and accessories: All fittings and accessories shall be stainless steel and sized as specified by the fence manufacturer. Fence panels to be attached to posts with ¼" x 1" stainless steel screws. Panels and posts are predrilled to support level installation.

1. Anchor Bolts: Anchor bolts shall be _____ and adequate to support loads based on screening height, exposures and loading.
 - F. Gates: Swing to exterior of enclosure, size as shown on contract drawings.
 1. Square mesh panel style and appearance shall be identical to fence panels.
 2. Gate hinges to be Gorilla barrel hinge with $\frac{3}{4}$ " rod, ball bearing, and grease zert. Hinge plate to be $\frac{1}{2}$ " thick plates offset to create a $\frac{5}{8}$ " gap. Standard hardware as required by the gate manufacturer for complete functional operation. Hinges to be bolted to gate frame and field welded to steel gate posts.
 3. Gate hardware: See Section 08 71 00 .
 4. Welded frame, size as shown on the contract drawings, extruded aluminum tubing with aluminum square mesh panels to match fencing material.
 5. Drop rods to be 1" schedule 40 pipe and through bolted to gate frame.
 6. Gate shall have welded frame fabricated from extruded aluminum tubing with aluminum fixed square mesh panels to match fencing material. Frame configurations shall be as indicated on the contract drawings.
 7. Gate posts: as determined by manufacturer. Gate posts to be specified to support gates.
- 2.05 AUTOMATIC GATE OPERATORS
- A. Sliding Gates: Prewired, pedestal-mounted gate operator for horizontal sliding gates, per ASTM F2200 and UL 325.
 1. Operating type: Drive belt.
 2. Control Functions: Open, Pause, Close.
 3. Maximum Open/Close Time: 20 seconds.
 4. Access: Card.
 5. Maximum gate weight: 1,000 pounds (373 kilograms).
 6. Horsepower Rating: Suitable for connected load.
 7. Entrapment Protection Devices: Provide sensing devices and safety mechanisms complying with UL 325.
 8. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
 - a. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
 - 1) Outdoor Locations: Type 3R.

2.06 ACCESSORIES

- A. Card Reader Mounting Supports: Where not factory installed, provide mounting supports for card reader installation.
 1. Products:
 - a. PedestalPro: www.pedestalpro.com
 - 1) Vehicular Gates: Model 72-DSP-3-12-12
 - 2) Pedestrian Gates: Model 42-3-12
 2. Substitutions: See Section 01 60 00 - Product Requirements.
 3. Locations: As indicated.
- B. Caps: Aluminum alloy; sized to post diameter, set screw retainer.
- C. Fittings: Sleeves, bands, clips, rail ends, tension bars, fasteners and fittings; steel.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that final grading in fence location is completed and without irregularities which will interfere with fence installation. Variations in height, slopes, stairs steeping shall be shown on

contract drawings and on submittal drawings.

- B. Field verify all fence dimensions and layout prior to commencing installation.
- C. Do not begin installation until substrates have been properly prepared.
- D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Set fence posts in accordance with the manufacturer recommended spacing.
- C. Space gate posts according to the manufacturers' drawings, dependent on standard out-to-out gate leaf dimensions and gate hardware selected.
 - 1. Base type and quantity of gate hinges on the application, weight, height, and number of gate cycles.
- D. Install operator in accordance with manufacturer's instructions and in accordance with NFPA 70.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Layout: Verify that fence installation markings are accurate to design, paying attention to gate locations, underground utilities, and property lines.
- C. Fence Height: Randomly measure fence height at three locations or at areas that appear out of compliance with design.
- D. Gates: Inspect for level, plumb, and alignment.
- E. Workmanship: Verify neat installation free of defects.

3.04 CLEANING

- A. Clean jobsite of excess materials; scatter excess material from post hole excavations uniformly away from posts. Remove excess material if required.
- B. Clean fence with mild household detergent and clean water rinse well.
- C. Touch up scratched surfaces using materials recommended by manufacturer. Match touched-up paint color to factory-applied finish.

3.05 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair, or replace damaged products before Date of Substantial Completion.

END OF SECTION 32 31 19