SECTION 27 41 16

INTEGRATED AUDIO-VIDEO SYSTEM AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. This document covers the general requirements for the installation of audio-video (AV) systems.

B. Project Overview

1. Design Consultant to provide project overview here.

1.2 RELATED DOCUMENTS

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

B. Related Sections

1. Div 26
2. Section 270000 Communications
3. Section 270526 Grounding and Bonding for Communications Systems
4. Section 270528 Interior Pathways for Communications Systems
5. Section 270543 Exterior Pathway for Communications Systems
6. Section 270553 Identification for Communications Systems
7. Section 271500 Communications Horizontal Cabling

1.3 CODES AND STANDARDS

A. Perform all work in strict accordance with the requirements and recommendations stated in the codes and standards except when requirements are exceeded by the contract documents.

B. The equipment, materials, and installation shall confirm to the latest version of all applicable codes, standards and regulations of authorities having jurisdiction including the following:

1. American National Standards Institute (ANSI)
2. American Society for Testing and Materials (ASTM)
3. Alliance for Telecommunications Industry Solutions (ATIS)
4. Federal Communications Commission (FCC)
5. International Electrotechnical Commission (IEC)
6. Institute of Electrical and Electronics Engineers, Inc. (IEEE)
7. International Organization for Standardization (ISO)
8. International Organization of Standardization/International Electrotechnical Commission (ISO/IEC)
9. National Cable Television Association (NCTA)
10. National Electrical Code (NEC)
11. National Electrical Manufacturers Association (NEMA)
12. National Fire Protection Association (NFPA)

13. National Institute Standards and Technology (NIST)
14. Occupational Safety and Health Administration (OSHA)
15. Telecommunications Industry Association (TIA)
16. Comply with terms and conditions of Americans with Disabilities Act, especially regarding provisions for hearing impaired and wheelchair access in control areas.
17. Execute work in accordance with best AV system installation practices, and applicable state and local codes.
18. Owner's Design Guidelines and Construction Standards

1.4 SUBMITTALS

A. General

1. Refer to Division 1 and section 27 00 00.
2. Submit in quantities, format and timetable as required by General Conditions.

B. Product Submittals

1. Contractor shall submit catalogue cut-sheets that include manufacturer, trade name, and complete model number for each product specified. Model number shall be handwritten and/or highlighted to indicate the exact selection.
2. Contractor shall identify the applicable specification section reference for each product performance for each component specified for approval prior to purchase and installation.
3. Minimum number of Sets: four (4) or one (1) electronic copy.
4. Provide a list of equipment (model and quantity) for each AV space.
5. Timetable
    a. Submit within thirty (30) days after award of contract.
    b. Submit simultaneously with Shop Drawings.
    c. Allow minimum of ten (10) business days for review. All sets minus one (1) will be returned with review comments. If a resubmit is required, resubmit total quantity of complete sets. If second resubmit is required, Contractor shall reimburse Owner for expenses incurred during additional review process.
    d. Review and approval of Product Data is required before equipment purchase and installation.

C. Shop Drawings

1. Minimum Number of Sets: four (4) or one (1) electronic copy.
2. Timetable
    a. Submit within thirty (30) days after award of contract.
    b. Submit simultaneously with Product Data Binders.
    c. Allow minimum of ten (10) business days for review. All sets minus one (1) will be returned with review comments. If a resubmit is required, resubmit total quantity of complete sets. If second resubmit is required, Contract shall reimburse Owner for expenses incurred during additional review process.
3. Description:
    a. Shop Drawings shall be used for coordination between trades and updated as final record drawings.
    b. Bind all Shop Drawings together to form set. Loose drawings will not be accepted.

c. Each drawing shall include: Project, Building, Location, Contractor Name, Architect, AV Consultant, Date and Revision Number.
d. Number and title each drawing in logical manner as a set.
e. Include cover sheet with listing of all drawings included in bound set.
f. Ensure that labeling on Shop Drawings match labeling on equipment.
g. Minimum Scale:
    1) Floor Plans: 1/8 inch = 1 foot.
    2) Rack Elevations: 1-½ inch = 1 foot.
    3) Plate/Panel Details: 6 inches = 1 foot.
    4) Loudspeaker Details: 1 inch = 1 foot.
h. Include as a minimum:
    1) Floor plans indicating locations of all AV devices, vertical risers, pull boxes, and exposed wiring. Include Device ID (PRJ, SCREEN, FRK, FB, AVP, etc., as referenced in design contract documents), as appropriate for projectors, screens, racks, floor boxes, AV plates in walls, etc.
    2) Schematic diagram showing all primary and secondary devices, interconnectivity and signal flow.
    3) Plate details showing size, material, finish, connectors, engraving, etc.
    4) Mounting detail drawings of loudspeakers, racks, and overhead equipment. Hire services of professional structural engineer, licensed by the appropriate governing authority, to review shop drawings, building structural drawings, and any existing structures from which equipment is to be suspended. Include Structural Engineer's stamped report with shop drawing submittal. Report shall include:
        a) Itemization of items reviewed by the Structural Engineer.
        b) Confirmation that proposed methods of suspending equipment as shown on the shop drawings conform to required safety factors.
        c) Confirmation that building structure from which equipment is to be suspended will support equipment including required safety factors.
    5) Rack elevations.
    6) Complete schematic diagram. One-line diagram with detailed descriptions of product inputs and outputs is acceptable. Include terminal strip details and cable label information. If wiring diagram spans more than three (3) sheets, additionally provide simplified block diagram of entire system on one (1) sheet.
    7) Electrical power wiring diagram. Include circuit, switching, and control details.
    8) Wiring diagram of grounding and shielding scheme.
    9) Drawings for custom-fabricated items (i.e., plates, panels, cables, and assemblies).
    10) General construction drawings necessary for completion of work.

D. Operation and Maintenance Manuals

1. Minimum number of Sets: four (4).
2. Bind Operation and Maintenance Manuals using either GBC or 3-ring binders.
3. Format and Minimum Information below:
    a. Section 1 - System Operation.

1) Introduction/overview to system components and their functions and locations. Include a brief listing of basic system functions.
2) Complete but simple system operating instructions to accomplish basic system functions, written for non-technical personnel.
3) Certificate indicating names of Owner personnel trained by AV Contactor, date of training, name of AV Contractor representative that provided training, and name of project.

b. Section 2 - System Documentation.
1) Simplified system one-line schematic diagram showing changes made during construction.
2) Complete inventory of system components including serial numbers. Identify location (equipment rack, over stage, stored in control room, etc.) of each component.
3) Cable and terminal strip documentation including cable numbers, functions, originating locations, terminating locations, and signal levels.
4) All Shop Drawings corrected to reflect as-built conditions.
5) Other data and drawings required during construction.
6) Initial Tests and Adjustments data.
7) Final Tests and Adjustments data.
8) Electronic files including all utilized manufacturer's software and saved copies of software configurations (configurations as established during Final Tests and Adjustments).

c. Section 3 - Manufacturer's Documentation.
1) For each equipment model at no additional costs to Owner, even if manufacturer does not include costs of such documentation with purchase of equipment item.
2) Manufacturer's Product Data.
3) Operating instructions.
4) Installation instructions.
5) Service information.
6) Schematic diagrams.
7) Replacement parts list.

d. Section 4 - Maintenance Information.
1) Preventive maintenance schedule letter clearly stating target dates of six month and end-of-warranty preventative maintenance inspections, and list of maintenance tasks performed.
2) Maintenance instructions including manufacturer's recommended maintenance, recommended maintenance schedule and information concerning proper inspection, testing, and replacement of components.
3) Troubleshooting information complete with instructions for procedures during equipment failure.

e. Section 5 - Warranty Information
1) System warranty letter.

4. Provide three (3) sets or an electronic copy that include all material in Operation and Maintenance Manuals in PDF format except for copyrighted material.

5. Submit one (1) set of Operation and Maintenance Manuals at least ten (10) days before Final Tests and Adjustments procedures (minus data from Final Tests and Adjustments). This set will be reviewed by Owner and returned to Contractor. Re-submit after Final Tests and Adjustments and include data. NOTE: Do not schedule Final Tests and Adjustments or perform training of Owner personnel before submitting Operation and Maintenance Manual.

6. Submit remaining number of complete manuals as required by General Conditions within ten (10) days after return of reviewed set(s). Include Final Tests and Adjustment data, warranty period letter, and any other data not included in first submission.

E. Samples.

1. Request for Samples - Upon request, furnish samples (at no additional cost) to Owner and/or General Contractor of submitted items proposed as substitutes for specified items. Products will be reviewed to determine if proposed substitute items meet required function and quality.
2. Product Tests
   a. Products submitted as samples may require testing by independent laboratory. Testing at expense of Contractor.
   b. Obtain written approval of tested products before incorporating into system.

1.5 AS-BUILT DRAWINGS

A. Submit one electronic copy and one hard copy with project deliverables within three (3) weeks subsequent to substantial completion. Minimum Number of Sets: four (4) or one (1) electronic copy.

A. The As-Built drawings shall incorporate all changes made to the building identified in, but not limited to, addendum, change notices, site instructions or deviations resulting from site conditions.
   1. Contractor shall clearly identify any resubmitted drawing sheets, documents or cut sheets either by using a color to highlight or cloud around resubmitted information.
   2. Maintain drawing numbering or page/sheet scheme consistency as per previously issued Shop drawings/documents.

1.6 QUALITY ASSURANCE

A. AV Contractor Qualifications.

1. Be established AV System Contractor, regularly engaged in furnishing and installing AV systems. NOTE: Electrical or general contracting firms responsible for completion of this work, but not meeting above requirement, shall employ services of approved AV Contractor as subcontractor to perform work described herein.
2. Be experienced in installations of similar size and scope within last five (5) years. Submit list of four (4) (minimum) installed jobs of similar magnitude, completed within last five years. For verification, submit complete information, including project name, project address, contact person, daytime telephone number plus month and year of project completion. At Owner’s request, accompany Owner or Owner’s representative on visit to any or all example completed projects submitted.
3. Be Authorized Dealer for all major lines of equipment listed in Part 2 (Biamp, Chief, Extron, Crestron, JBL, Middle Atlantic, Shure, etc.) Must have at least one permanent staff member who is factory trained in the installation and maintenance of each major product line offered.

4. Employ personnel (at all levels of work) experienced in projects of similar size and scope. Provide list of key personnel to be responsible for each of the following aspects of work: Project Management, Technical Documentation, Control System programming, DSP programming and Leadership of Field Work (one who is present for all field work). For each identified employee, indicate number of years employed by contractor, number of years experience in assigned responsibilities, and list of previously completed projects where similar responsibilities were required.
5. Project manager assigned to this project must have a minimum of five (5) years experience in installing and integrating AV systems of similar scale. Project Manager shall also have either an AVIXA CTS-I or CTS-D certification.

1.7 PRODUREMENT

A. Refer to 270000

B. Technology Implementation Plan shall be provided during the submittal review process.

PART 2 - PRODUCTS

2.1 GUIDELINES

A. Infrastructure Products - All conduits, basket tray/cable tray, pull boxes and associated parts required for infrastructure shall be installed by the electrical contractor unless specifically excluded in these specifications or drawings.

B. Performance - Regardless of completeness of descriptive paragraphs herein, each device shall meet its manufacturer’s published specifications. Verify performance.

C. Contract Documents - Drawings and specifications are to be used in conjunction with one another and to supplement one another. In general the specifications determine the nature and quality of the materials, and the drawings establish the quantities, details, and give characteristics of performance that should be adhered to in the installation of the AV system components. If there is an apparent conflict between the drawings and specifications, the items with the greater quantity or quality shall be provided and installed. Clarification with the owner about these items shall be made prior to the ordering and installation.

D. Quantities - All quantities are indicated on AV drawings or in Part 2 AV Products list. Confirm quantities on final Contract Documents. If Contract Documents do not include quantities necessary to deliver complete working system, provide notification of disparity, and install required quantity of devices for complete working system.

E. Small Parts - Systems are described in terms of major products. Even if not specifically mentioned, provide and install patch cables, connectors, hardware, converters, power supplies, labels, terminals, mounting accessories etc. necessary for complete and working system meeting design intent of specifications.

F. Keys - Provide five (5) sets of keys for any AV system product requiring keys.

G. Condition - Provide and install products listed in this section in factory new condition, conforming to applicable provisions of American National Standards Institute.

H. Designations - Each major product item is given unique designation (such as MIX1 for mixer number 1). The product designations are unique in this section only and may be repeated in other specification sections.

I. Security Screws - Use Bryce Security Penta-Plus button-head screws and bits to secure rack components, LCD mounts, Projector mounts and any other location deemed necessary by Owner. Use nylon washers (not provided by Bryce) to protect equipment surfaces. Account for appropriate tip wear when ordering quantity and do no use a bit beyond the manufacturer's recommendations. Provide ten (10) additional unused driver bits and deliver to the customer after completion.

J. AV Electrical Power - Coordinate with Electrical Contractor regarding proper placement of isolated-ground duplex outlets for any AV equipment. Electrical circuits should be connected (and outlets wired) by the Electrical Contractor to the AV system circuit breaker panel (N.I.C.). Ensure that "Star" ground configuration is properly implemented by the Electrical Contractor. Ensure that ground wires from each outlet are isolated from conduit, neutrals, and each other.

K. AV Screens - For any screen specified, size as indicated in drawings. Unless otherwise indicated in drawings or specifications, set limits so projected images are 48" above finished floor, and include additional black drop as appropriate considering screen size and mounting height.

L. AV Racks:

1. Provide blank faceplate in any area marked BLANK in drawings.
2. Provide shelf for mounting of any device for which rack mount kit is not available.
3. Provide one (1) Panelcrafters AAA-XXXXX-RHIM-01 designer/integrator information plate or approved alternate per rack. Install information plate at the top of each rack unless 1RU space is not available. Contact Panelcrafters sales department to add AV Contractor graphic to the "integrator" section (approximately 8.5" x 1.75" of the right-hand side). All alternates must include AV Consultant graphic. Submit to AV designer for approval of final plate design prior to purchasing and installation.

M. AV Floor Boxes:

1. Clean floor boxes of all dust and debris prior to installation of any active or connectorized plate.
2. Any floor box with active or connectorized AV plates found to have any dust, debris or water in bottom of box are subject to replacement of all plates and components. A re-test of all associated components must be completed.

N. Wireless Microphones - Coordinate frequency selection with other radio-frequency sources in the area and with manufacturer's recommendations.

O. Control System Programming:

1. Program each panel to provide simple, intuitive control of all basic AV functions including:
   a. program and speech volume levels
   b. video source and destination routing
   c. screen control

d. video projector lift control (where applicable)
e. AV system power
f. media player transport functions
g. video conferencing CODEC controls including call initiation (where applicable)
h. video conferencing PTZ camera control (where applicable)
i. combine/uncombine settings for all combinations of controlled rooms
j. local lighting and blackout shade controls (where applicable)

2. Utilize AVIXA's "Dashboard for Controls" concept unless directed otherwise by Owner.
3. Provide layout of each and every touch panel and hard-button panel pages in the product data submittal for approval by Owner.
4. Provide web-control for each touch panel in AV system. Include page tracking, and track current button feedback between touch panel and web-control panel.
5. Staff member certified by control system manufacturer shall program control system.
6. After programming is approved, all control system code and programming, including touch panel code and graphics, will become the property of Owner. AV Contractor shall provide Owner an electronic copy of both raw and compiled code.
7. Provide follow up meeting with Owner after 6 months of operation to make updates as requested to control programming.

P. Audio System Programming - Owner shall coordinate layout and logical branching of DSP audio system. Include screen layout and menu branching drawings in AV submittal. After AV system is approved, all audio control system code and programming will become property of Owner. AV Contractor shall provide Owner an electronic copy of both raw and compiled code.

Q. AV Design Bid

1. System design is around products listed in Part 2. Intent of product specification is to provide standard of quality and function for installed materials. Certain performance specifications are given to clarify job requirements.
2. Bid AV system with products specified in Base Bid section below unless noted otherwise from Owner.

2.2 PRODUCT SUBSTITUTION

A. City of Houston has established standards on the IT and Communications system products in order to meet the performance, compatibility, system warranty, and cybersecurity requirements of the critical IT infrastructure system. As such substitution for certain products including but not limited to the following are not permitted:

1. Cisco for video conferencing products
2. HD2 for Digital Signage Players
3. Evoko for Room Schedulers
4. Extron for AV Control/Switching

B. Products listed as "No Substitution" or "Substitution not permitted" shall not be substituted. Substitution may only be considered when a product becomes unavailable through no fault of the Contractor.

B. For products listed as “or approved equal”, substitution products from different manufacturers are allowed. Include written substitution request with product submittal for review and approval.

C. Product substitution shall not void, alter or change manufacturers’ structured cabling system warranty.

D. Document substitution requests with complete data substantiating compliance of proposed substitution with Contract Documents. Include the following in each request for substitution:
   1. Product identification, manufacturer’s name and address
   2. Reason for the substitution
   3. Product Data:

      a) Description, performance and test data, reference standards, finishes and colors.
      b) Samples: Finishes.
      c) Complete and accurate drawings indicating construction revisions required (if any) to accommodate substitutions.
      d) Data relating to changes required in construction schedule.
      e) Cost comparison between specified and proposed substitution.

E. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.

F. HITS will be the final judge of acceptability, with review by IT Consultant and the distribution of the acceptance by the Architect.

G. No substitute shall be ordered, installed or utilized without written verification of acceptance from HITS.

2.3 AV PRODUCTS - ACTIVE EQUIPMENT

A. Room Scheduling System

   1. Room Scheduler Product: Evoko Lisa Room Manager ERM2001 (no substitution)
   2. Provide one (1) Data drop and mounting bracket for each scheduler.
   3. All schedulers shall be furnished and installed by contractors, and configured by HITS. Coordinate with HITS in advance for IP address and device configuration.

B. Digital Signage System

   1. Digital Signage Player
      a. HD2-FHD100 (Full HD, default option for typical installation)
      b. HD2-BXP100 (4K, only used at locations with space constraints)
      c. No Substitution.
      d. Provide one (1) Enterprise license for each digital signage player installed
      e. The digital signage player should be connected to the IT network via WiFi. Verify the WiFi coverage before installation.
   2. Digital Signage TV
      a. Samsung # QA65QN90CAUXTW (4K QLED Smart 65” TV)
      b. Consult with HITS and provide larger display (up to 85”) where viewing distance exceeds 8-ft.

c. Consult with End User department and HITS for the size and model of Outdoor display devices.

3. Digital Signage Display Mounting Bracket
   a. Chief # LTA1U
4. In-Wall Storage Box (for all installations on drywall partitions)
   a. Chief PAC525FW
5. All digital signage system shall be furnished and installed by contractors, and configured by HITS. Coordinate with HITS in advance for IP address and device configuration.
6. All installations shall be ADA-compliant.

C. Huddle Room (25-75 sqft, 1-2 people) – Standard Solution

1. Provide Cisco Desk product for video conferencing, AV presentation, digital whiteboarding and annotation
2. AV Products
   a. One (1) Cisco Desk (24” touch screen for 1-person) or Cisco Desk Pro (27” touch screen for 2-person)

D. Small Conference Room (100-150 sqft, 1-5 people) – Standard Solution

1. Provide a TV and all-in-one video conference bar for video conferencing and AV presentation (No touch screen for digital whiteboarding).
2. AV Products
   a. One (1) Cisco Room Bar
   b. One (1) Cisco Room Navigator
   c. One (1) 55” 4K TV (Samsung QM55C or approved equal)
   d. One (1) Chief LTA1U Tilt Wall Mount
   e. One (1) Chief PAC525FW In-Wall Storage Box

E. Small Conference Room (100-150 sqft, 1-5 people) – Special Request

1. Provide an interactive TV with built-in system for video conferencing, AV presentation, digital whiteboarding
2. AV Products
   a. One (1) Cisco Board Pro 55
   b. Wall Mount or wheel stand option

F. Medium Conference Room (150-390 sqft, 6-10 people) – Standard Solution

1. Provide a TV and all-in-one video conference bar for video conferencing and AV presentation (No touch screen for digital whiteboarding).
2. AV Products
   a. One (1) Cisco Room Bar Pro
   b. One (1) Cisco Room Navigator
   c. One (1) 75” 4K TV (Samsung QM75C or approved equal)
   d. One (1) Chief LTA1U Tilt Wall Mount
   e. One (1) Chief PAC525FW In-Wall Storage Box

G. Medium Conference Room (150-390 sqft, 6-10 people) – Special Request 1

1. Provide (2) TV and all-in-one video conference bar for video conferencing and AV presentation (No touch screen for digital whiteboarding).

2. AV Products
    a. One (1) Cisco Room Bar Pro
    b. One (1) Cisco Room Navigator
    c. Two (2) 55” 4K TV (Samsung QM55C or approved equal)
    d. Two (2) Chief LTA1U Tilt Wall Mounts
    e. Two (2) Chief PAC525FW In-Wall Storage Box

H. Medium Conference Room (150-390 sqft, 6-10 people) – Special Request 2

1. Provide an interactive display with built-in system for video conferencing, AV presentation, digital whiteboarding
2. AV Products
    a. One (1) Cisco Board Pro 75
    b. Wall Mount or wheel stand option

I. Large Conference Room (400+ sqft, 10-20 people) – Standard Solution

1. Provide TVs and video conference devices for video conferencing and AV presentation (No touch screen for digital whiteboarding).
2. AV Products
    a. One (1) Cisco Codec Pro
    b. One (1) Cisco PTZ 4K Camera (on back wall)
    c. One (1) Cisco Quad Camera (on front wall)
    d. One (1) Cisco Room Navigator
    e. Two (2) 75” 4K TV (Samsung QM75C or approved equal) on front wall
    f. One (1) 75” 4K TV (Samsung QM75C or approved equal) on back wall
    g. Three (3) Chief LTA1U Tilt Wall Mount
    h. Three (3) Chief PAC526FW In-Wall Storage Box (one per TV)
    i. One (1) Ceiling Array Microphone+Speaker (Shure MXA902)

J. Large Conference Room (400+ sqft, 10-20 people) – Special Request

1. Provide TVs and video conference devices for video conferencing and AV presentation with one touch screen for digital whiteboarding.
2. AV Products
    a. One (1) Cisco Room Kit EQX (includes Codec EQ, Quad Camera, Room Navigator and mounting kit)
    b. One (1) Cisco PTZ 4K Camera (on back wall)
    c. Two (2) 75” 4K TV (Samsung QM75C or approved equal) on front wall
    d. Two (2) Chief PAC525FW In-Wall Storage Box
    e. One (1) Cisco Board Pro 75” (in companion mode), with wall mount or wheel stand
    f. One (1) Ceiling Array Microphone+Speaker (Shure MXA902)
    g. One (1) Ceiling Storage Box (Chief CMS492)

K. Training Room (400+ sqft, 20+ people) – Standard Solution

1. Provide TVs and video conference devices for video conferencing and AV presentation (No touch screen for digital whiteboarding).
2. AV Products
    a. One (1) Cisco Codec Pro
    b. One (1) Cisco Navigator

c. Two (2) Cisco PTZ 4K Camera (one front wall, one at center of finish ceiling)
d. Two (2) 85” 4K TV (Samsung QM85C or approved equal) on front wall
e. One (1) 65” 4K TV (Samsung QM65C or approved equal) on back wall
f. Three (3) Chief LTA1U Tilt Wall Mount
g. Three (1) Chief PAC525FW In-Wall Storage Box (one per TV)
h. One (1) Shure QLXD 124/85 Wireless Receiver Combo
i. Ceiling Speakers Extron SF 26CT (Qty: as needed based on the size of the room)
j. One (1) Audio Amplifier (Extron XPA2001)
k. One (1) HDMI connection at lectern location
l. Wall mounted equipment rack: Middle Atlantic
m. Power Distribution Unit: Middle Atlantic PDS-615R

L. Auditorium/Courthouse

1. Customized AV solution is needed for these spaces. Consult with the End User department and HITS Representative for exact function and system requirements.
2. Video Transmission, Switching and Control
   a. Product Manufacturer: Extron
3. Wireless Presentation Gateway
   a. Product Manufacturer: Clickshare C-10 (one button)
4. Audio DSP
   a. Product Manufacturer: Extron/Biamp
5. Audio Amplifier
   a. Product Manufacturer: Crown/QSC
6. Audio Mixer
   a. Product Manufacturer: Allen & Heath (SQ5, UON)
7. Microphones
   a. Product Manufacturer: Shure
8. Speakers
   a. Product Manufacturer: Electro Voice / Community
9. Projectors (laser projector only)
   a. Product Manufacturer: Epson/Sony/Christie
10. Electric Projection Screen
    a. Product Manufacturer: Da-lite / Draper
11. Equipment Cabinet
    a. Product Manufacturer: Middle Atlantic
12. Flat Panel Display (4K LED)
    a. Product Manufacturer: Samsung, LG, Panasonic, Sony
13. TV mount bracket
    a. Product Manufacturer: Chief

2.4 CABLES

A. Interconnect Wiring – Provide and install following cable as required for connections in all areas. Meet provisions of N.E.C. Provide plenum rated cable where required.

1. Analog Audio/Microphone cable - West Penn D25291.
2. Digital Audio Plenum Rated Cable: West Penn DA252401/ DA252402/ DA252406, or AES/EBU compliant equivalent.
3. Analog Composite Video Plenum Rated Cable: West Penn 25806.
4. RGBHV Plenum Rated Cable: West Penn 258195.

5. Control Plenum Rated Cable: West Penn D25350.
6. Low Impedance Loudspeaker Cable
   a. For cable distance <50': 14-guage 2-conductor West Penn #25226B
   b. For cable distance from 50' to 100': 12-guage 2-conductor West Penn #25227B
   c. For cable distance > 100', consult with manufacturer and engineer before ordering/installation.
   d. Terminate with Neutrik "Speakon" type connectors when available.
7. High Impedance Loudspeaker Cable (25v/70v)
   a. For cable distance <300': 18-guage 2-conductor West Penn #25224B
   b. For cable distance from 300' to 500': 16-guage 2-conductor West Penn #25225B
   c. For cable distance > 500', consult with manufacturer and engineer before ordering/installation.
   d. Terminate with Neutrik "Speakon" type connectors when available.
8. HDMI cables: Belden HD-800 series. All HDMI cables used shall be certified to meet the performance of the display devices over the actual cable length. Provide HDMI transmitters and receivers as needed.
9. HDBaseT Cable: Belden 2183P (or as manufacturer recommended).

PART 3 - EXECUTION

3.1 INSTALLATION

A. General Guidelines

1. Quality of Work - Perform labor to accepted industry standards and state and local codes to accomplish complete and working system.
2. Material and Labor - Provide specified products and other incidental materials, appliances, tools, and transportation required for complete and functioning systems. Provide personnel to perform labor who are skilled in techniques and can demonstrate technical knowledge AV infrastructure system installations.
3. Provide a complete functioning sound system that's been fully tested and properly balanced, configured, and equalized. Be of maximum assistance to the Owner during the warranty period of the system, to the degree that maximum Owner satisfaction is assured.
4. Observe proper circuit polarity and loudspeaker wiring polarity. No cables shall be wired with a polarity reversal between connectors with respect to either end. Special care shall be taken when wiring microphone cables, to ensure that constant polarity is maintained. Balanced audio connectors shall be wired as follows.

Wire	Connector	Signal
Black	Pin #3 or Ring	Low or Negative
Red or White	Pin #2 or Tip	High or Positive
Bare	Pin #1 or Shield	Ground

5. Provide all audio circuits balanced and floating, except as noted in the Specifications or directed by the Consultant at the time of final equalization and testing. Shields of audio cables shall be grounded at one end only, at the outputs of the various equipment items in the system

6. Route cables and wiring within equipment racks and cabinetry according to function, separating wires of different signal levels (video, microphone level, line level, amplifier output, 120VAC, intercom, control, etc.) by as much physical distance as possible. Neatly arrange and bundle all cables loosely with plastic cable ties. Cables and wires shall be continuous lengths without splices.
7. All system wire, except spare wire, after being cut and stripped, shall have the wire strands twisted back to their original lay and be terminated by approved soldered or mechanical means. No unterminated wire ends will be accepted. Heat-shrink type tubing shall be used to insulate and dress the ends of all wire and cables. Include a separate tube for the ground or drain wire.
8. All cables in conduits shall be insulated from each other and from the conduit the entire length and shall not be spliced. All cables and wires are to be continuous lengths without splices.
9. All solder joints and terminations shall be made with resin-core silver solder. Temperature regulated soldering irons rated at least 60 watts shall be used for all soldering work. No soldering guns or temperature unregulated irons shall be used on the job site.
10. Each mechanical connector shall be attached using the proper size controlled-duty-cycle ratcheting crimp tool which has been approved by the manufacturer of the connectors. Conventional non-ratcheting type crimping tools are unacceptable, and shall not be used on the job site.
11. Label all wires in racks and console as to destination and purpose with permanent labels. Clearly and permanently label all controls and connections at the front and back of the rack, with permanent labels. Wall plates and custom panels shall be engraved and filled with contrasting paint, unless otherwise noted. All labeling shall be completed prior to final system inspection.
12. Documents at Job Site - Keep following documents at job site during entire construction period:
    a. Complete Specifications and Drawings.
    b. Approved Shop Drawings.
    c. Approved Product Data.
    d. Progress Set of Project Record Documents.
13. Mounting - Mount equipment and enclosures plumb and square. Ensure that permanently installed equipment is firmly and safely held in place. Design equipment supports to support loads imposed with project safety factor of five (5) or greater. For devices hung overhead, obtain review by Structural Engineer licensed by the appropriate governing authority prior to installation.
14. Locate wireless microphone system and hearing assist system antennas at or above ceiling or at bar joist height in areas without ceilings. Coordinate exact location with Owner to provide adequate coverage in the area served by the system. Adjust antenna location for best possible reception/transmission in area of coverage.
15. Provide adequate protective vandal guards for all devices located in areas subject to damage from activities or vandalization, such as school gym, sports field, school cafeteria.
16. Provide hearing assist transmitter(s) and receivers for each sound reinforcement system. The quantity of hearing assist receivers for each system shall be equal to a minimum of four (4) percent of the total seating capacity, but in no case less than ten (10) receivers for the area of coverage of each local sound reinforcement system.
17. Dimension Verification - Verify dimensions and space requirements to assure that proper mounting, clearance, and maintenance access space is available for system components.

18. Clean-Up - Leave project clean each day. Place debris where designated by General Contractor. Debris includes but not limited to: solder splatter, cable ends, stripped insulation, spent crimp connectors, gypsum board and ceiling tile dust, and product wrappings and cartons. After completion of installation, thoroughly clean areas worked, including non-visible areas such as equipment rack interiors, rack top panels, and inside lockable floor and wall boxes.
19. Coordinate installation of AV infrastructure and equipment with other trades in order to follow project schedule.
20. Maintain any licensing required by the appropriate governing authority to install and terminate low voltage systems.

B. Labeling

1. Equipment Labels - AV Contractor shall provide engraved lamicoid labels on front and rear of rack-mounted equipment. Mount labels plumb and square. Include schematic reference design, item name, and system or area controlled by labeled component. On program preamps and mixers, provide label for each input indicating which source is controlled by labeled channel. Unless otherwise indicated, provide permanently-mounted black labels engraved with 1/8-inch white block characters. Handwritten, self-laminating, or embossed plastic (Dymo) labels are not acceptable. Provide labels for major equipment with two (2) lines (minimum) of engraving, coded as follows:
   a. Line 1: Generic name of device, such as MIXER AMPLIFIER.
   b. Line 2: Schematic designation of device, such as AV-MSW-1.
2. Control Labels - AV Contractor shall provide engraved label over each user-operated control that describes the function or purpose of control. Provide label of proper size to fit available space.
3. Terminal Strip Labels - AV Contractor shall label each terminal strip with unique identification code in addition to numerical label (Cinch MS series) for each terminal. Show terminal strip codes on system schematic drawings included with Project Record Documents.
4. Rear Equipment Labels - AV Contractor shall provide adhesive label on rear of equipment where cables attach, to indicate designation of cable connected at each point.
5. Cable and Wire Labels - Label cables and wiring logically, legibly and permanently for easy identification. Labels on cables shall be adhesive strip type, covered with clear heat shrink tubing. Factory stamped heat shrink tubing may be used. Hand-written or self-laminating type labels are not acceptable.
6. Cable Label Codes and Locations - Label each cable with unique alpha-numeric code. Locate cable designation at start and end of each cable run, within three (3) inches of termination point. For cable runs that have intermediate splice points, label cable with same designation throughout, with additional suffix to indicate each segment of run. Provide cable designation codes to schematic drawings included with Project Record Documents and Operation and Maintenance Manuals.

C. Power and Grounding

1. Power Coordination - Coordinate final connection of power and ground wiring to rack. Electrical contractor will provide power to AV systems. Before installation, verify load requirements for systems as accepted.

2. Bus Bars - Install 1-inch by 1/4-inch copper ground bus bar, top to bottom in floor mounted AV racks. Ground and bond equipment chassis of each rack-mounted component without three-pin grounding plug to bus bars with #12 AWG insulated green wire using 6-32 or larger nuts, bolts, lock-washers, and appropriate NEMA connectors. Electrical Contractor (Division 26) shall provide and connect #4 AWG green insulated wire from Bus Bars to ground point in AV technical electrical panel.

D. Equipment Racks

1. Ventilation - Provide ventilation adequate to keep temperature in rack below 85 degrees Fahrenheit. Use “whisper” type ventilation fans in racks, adjusted to come on when temperature in rack rises above 85 degrees Fahrenheit, only if adequate cooling cannot be provided by Owner.

E. Wiring

1. Wiring Standards - Execute wiring in strict adherence to best AV engineering practices.
2. Field Connection Devices - Connect cable to active components through screw terminal connections and spade lugs when appropriate. For BNC connections use three-piece, dual crimp BNC properly sized for cable with insulating bushings. Wire nut or “Skotchlock” connectors are not acceptable. Do not wrap audio cable splices or connections with adhesive backed tape. Punch connectors or telephone-style punch blocks are not acceptable anywhere in the installation unless specifically authorized by Owner.
3. Run cable in ceiling plenums neatly parallel to building walls, supported every three feet to structure with plenum rated ties.
4. Raceways - Run vertical wiring inside rack in Panduit (or equivalent) plastic raceways with snap-on covers, sized to allow at least 50% future wiring. Mount raceways on full length 3/4-inch flat black plywood backboards, attached to rack sides. If between-rack wiring chases are provided, Panduit raceways are not required. Horizontal wiring in rack shall be neatly tied in manageable bundles with cable lengths cut to minimize excess cable slack, but still allow for service and testing. Provide horizontal support bars if cable bundles sag. Individually bundle excess AC power cable away from rack mounted equipment with plastic cable ties. Electrical tape and adhesive backed cable tie anchors are not acceptable.
5. Accessibility - Ensure that wiring and connections are completely visible and labeled in rack. Mount termination resistors, if required, on terminal strips, fully visible and not concealed within equipment or connectors.
6. Loudspeaker Polarity - Connect loudspeakers electrically in phase, using same wire color for loudspeaker wiring throughout project.
7. Physical Damage Prevention - Take necessary precautions to prevent physical damage to cables and equipment. Damaged cables or equipment will not be accepted. Separate, organize, and route cables to restrict channel crosstalk and feedback oscillation.
8. Racks - Looking into the rack from the rear, locate AC power, control, data and speaker wiring on the left; line level audio, control, video, and RF wiring on the right. Keep several inches of space between power cables and other signals.
9. Other Connections - Make connections using rosin core solder or approved mechanical connectors. Where spade lugs are used, crimp properly with ratchet type crimping tool. Solder spade lugs mounted on #22 AWG or smaller cable after crimping.

3.2 FIRESTOPPING

A. Refer to section 27 00 00.

3.3 STORAGE AND HANDLING

A. Power up any electronic equipment to ensure its proper functioning before its arrival onsite.

B. Ensure that materials (especially electronic and electro-acoustic devices) are protected against physical, environmental, and electronic damage until final acceptance by Owner.

C. Schedule delivery to minimize delays in the project.

D. Provide storage protection against temperature and humidity extremes, theft, vandalism, physical damage, and environmental damage.

3.4 WARRANTY

A. Refer to Division 1.

B. Warranty - Submit letter providing warranty covering labor and materials supplied under this contract. Bind in Operation and Maintenance Manuals. Terms as described in General Conditions. Minimum terms as follows:

1. System - Systems shall be free of manufacturing or installation defects for a minimum period of one (1) year from the date of final acceptance. Clearly designate begin and end dates of system warranty period.
2. Parts and Labor - Provide parts and labor to repair defects in materials and workmanship during system warranty period.
3. Response Time - Within system warranty period, provide initial on-site service response within one (1) business day of service call. Provide resolution to any system defects within 72 hours or within 48 hours of receipt of repaired or replaced product from manufacturer.
4. Replacement Products - If any item must be removed for repair during system warranty period, provide replacement item of similar quality at no charge.
5. Repair Limit - Do not repair any piece of equipment found defective during installation or system warranty period more than two (2) times. After second repair, replace defective item with similar approved item at no additional cost to Owner.
6. Extended Manufacturer’s Warranties - Identify products with manufacturer’s warranties extending beyond one (1) year. Provide terms and conditions of such warranties.
7. Service Personnel Information - Provide name(s) and telephone number(s) of service personnel to be contacted regarding repair and maintenance.

C. Extended Warranty - Provide cost to extend complete AV system warranty from one (1) year to three (3) years. Included a list of all provided services including maintenance schedules.

3.5 INITIAL TESTS

A. Purpose - These tests are to ensure that the AV system is installed and functioning as specified, and to ensure the system is ready for Final Tests and Adjustments (described later).

B. Testing Standards - Perform testing in accordance with ANSI standards.

C. Inspection - Verify prior to beginning actual tests and adjustments on systems:

1. Proper grounding of all electronic components (through third prong of power connector or separate connection between component chassis and ground bus bar).
2. Cables dressed, routed, and labeled, connected with proper polarity.
3. Insulation and shrink tubing in place.
4. Dust, debris, solder splatter, etc. removed.
5. Proper frequency settings (or modules) at crossovers and controllers.
6. All equalizer bands and tone controls set for flat frequency response.
7. Survey temperatures of each piece of equipment after four (4) hours use (minimum). Note and report any hot equipment.

D. Electrical Power Quality - While all sound and AV system components are unplugged from electrical power outlets, AV Contractor shall turn on power to outlets, and confirm proper voltages at each outlet across the following pairs of terminals: hot and neutral, hot and ground, and neutral and ground (zero volts across neutral and ground). AV Contractor to document measurements.

E. General Function Tests - Test each piece of equipment to ensure that it performs its intended function. Include all portable equipment in tests. Intent of initial tests is to verify complete, functioning system before Final Tests and Adjustments. Correct problems found during initial testing before beginning Final Tests and Adjustments. Document whether all pieces performed intended functions; note any unresolved malfunctions.

F. Initial Tests and Adjustments Data - Submit written report of Initial Tests and Adjustments data upon completion to Owner. Include printed name(s) of technician(s) performing tests, date(s) and time(s) of tests, model and serial numbers of test equipment, results of each initial test, descriptions of problems encountered and their solutions, and statement that system is ready for Final Tests and Adjustments. Initial Tests and Adjustments Data to include signatures of technician(s) performing tests.

3.6 FINAL TESTS AND ADJUSTMENTS

A. Purpose - These tests are to be witnessed by AV Consultant to determine if system is complete and functioning as designed and specified. Also, AV Consultant will perform listening and viewing tests and witness adjustments of all images for optimum clarity.

B. Timetable - Coordinate with Owner, General Contractor, and AV Consultant to schedule Final Tests and Adjustments after submittal of Initial Tests and Adjustments data.

C. System and Site Conditions - AV Consultant will witness Final Tests and Adjustments. Have systems fully functional and ready for observation and testing upon AV Consultant's arrival. Coordinate with all trades for quiet conditions throughout the listening areas and for the duration of the test schedule. If upon AV Consultant's arrival, systems do not meet criteria, site is not sufficiently quiet, or if Owner or AV Consultant is required to make additional trips to job site to witness additional testing or perform additional reviews of installed equipment, Contractor shall reimburse Owner for labor and expenses incurred by having incurred costs deducted from payments to contractor.

D. Test Labor - Provide technician familiar with this project's AV systems and operation of test equipment to perform testing. Provide additional technician to assist in the tests and to perform troubleshooting, repairs, and adjustments. Include labor for these technicians to be present for one (1), eight (8)-hour day during Final Tests and Adjustments.

E. Tools - Provide standard hand tools including screwdrivers, pliers, wire strippers, nut drivers, soldering iron, and other tools appropriate for troubleshooting system problems.

F. Ladders and Scaffolds - Provide ladders and scaffolds to inspect/adjust loudspeakers and rigging points.

G. Verification of Initial Tests and Adjustments - Verify that Initial Tests and Adjustments have been performed and meet criteria. During Final Tests and Adjustments, AV Consultant may require portions of the Initial Tests and Adjustments to be repeated. Repeat measurements as requested without claim for additional payment.

H. Installer shall perform thorough preliminary testing of the AV Systems prior to the final inspection by the Consultant. All systems and subsystems shall be tested to ensure that they are in proper working order and meet the performance specifications. Perform preliminary programming and setup of digital signal processors as necessary to conduct these tests.

I. The testing and equalization work shall be performed after the installation work has been completed, but prior to any use of the system. During the testing and equalization work, the Installer shall have on the job site one (1) competent technician who is familiar with the project, and who will be prepared to stay as long as his services are needed. It is estimated that approximately eight (8) hours will be required for this work

J. The process of equalizing and testing the system may necessitate moving and adjusting certain loudspeakers. Adjustments shall be performed without claim for additional payment.

K. Coordinate as necessary to ensure a totally quiet room during the sound reinforcement systems testing and balancing period.

L. Prior to requesting systems testing, verify the following:

1. All systems are in first-class working condition and free of short circuits, ground loops, parasitic oscillations, excessive system noise beyond published.
2. All specified equipment, including loose equipment, is on the job site for proper accounting.
3. All loudspeaker circuits have been tested, are connected to the proper crossover frequency, and are in perfect working order. Furnish impedance measurements of each circuit in PDF format prior to final tests.

4. All video systems and associated control systems have been tested and are in perfect working order.
5. All equipment controls shall be labeled, even if unused. If permanent labels cannot be furnished prior to system inspection, temporarily label every control on the front and in the rear of the racks as to its function with write-on tape. Supply printer labels or markers suitable for permanently indicating knob settings after equalization is performed.
6. Operation manuals for every equipment item furnished are on hand at the job site.
7. Installer shall provide all signal processing software loaded on a portable PC and ready for use at time of testing. Installer shall provide a calibrated RTA and microphone, and pink noise generator at time of testing.

M. Should the performance testing show that the Installer has not properly completed the systems, the Installer shall make all necessary corrections or adjustments and a second demonstration shall be arranged at the Installer's expense.

N. The final acceptance of the system by the Owner will be based upon the report of the Consultant following inspection, testing, and demonstration. A list of items in need of completion or correction shall be generated by the Consultant, which must be corrected by the Installer before final acceptance will be granted.

3.7 SOUND SYSTEM PERFORMANCE

A. After equalization and testing, the sound system shall meet or exceed the following specifications:

1. System shall be free of short circuits, ground loops, parasitic oscillation, excessive system noise, hum, RF interference, and instability of any form.
2. Minimum SPL with band-limited pink noise input to the system in the targeted space shall be 95 dB before audible distortion occurs.
3. Seat-to-seat variation in SPL at 4kHz octave band pink noise shall be within a tolerance of plus or minus 3dB SPL.
4. Acoustic response of the system shall be plus or minus 1.5dB along a line which is flat from 50 Hz to 4000 Hz and which rolls off at 1dB per octave to 16kHz.

B. The following tests and adjustments shall be performed by the Contractor.. Make all necessary corrections to bring systems into specification compliance. Record the results of these tests in project record drawings. Submit written results of tests to Architect and Engineer prior to scheduled equalization and final inspection date.

1. Measure and record impedance of each speaker line at frequency of 1,000 Hz, with loudspeakers connected to their respective lines.
2. Measure and record overall system hum and noise level of each input channel with controls set so that -50 dBm microphone input or +4 dBm input would drive the system to full amplifier output. Terminate inputs with resistor (150 to 600 ohms) and disconnect power to noise generator for this test.

3. Adjust the gain of each active device to provide both optimum signal - to noise ratio, and at least 10 dB headroom at each active device. Observe the output of each active device with an oscilloscope of 5 MHZ band width, and verify visually that the signal required for full amplifier output is free of overload, clipping, parasitics, and radio frequency components. Adjust gain structure of all active components and record the input and output signal levels of all active components and record the input and output signal levels of all active components in both dBm and volts, during normal program levels.
4. Measure and record system electrical frequency response for each input channel through power amplifier. Required is flat response with permissible deviation of +/- 1 dB within the range of 30 Hz to 16 kHz.
5. Check system to assure freedom from oscillations or stray RF pickup. Check inputs with no signal and with typical program material driving system to full output Detect unwanted signals on Oscilloscope at termination.
6. Check phasing of loudspeakers by applying constant power per octave (pink) noise to system and walking through the transition areas of coverage from one loudspeaker to the next. Transition should be smooth with no apparent shift in source from one speaker to the next. Apply sine wave sweet signal to each loudspeaker system sweeping from 50 Hz to 5,000 Hz and at a level of 10 Db below full amplifier output, and listen for rattle or objectionable noises Correct if apparent.
7. Achieve uniform distribution of sound from each loudspeaker (with bleachers in their extended position in gymnasium where applicable). Drive system with broadband, constant power per octave (pink) noise, and measure the SPL using a sound level meter incorporating an octave-band filter centered at 4 kHz. Adjust noise level until the meter readings are between 75 and 80 dB. Use a sound level meter filter that meets ANSI S1 4-1971 Type 2 and ANSI S1 11-1971 standards set for slow meter damping. Take all readings at seated ear height. Adjust speaker as necessary to achieve +/-3 dB over entire area covered by this system.

3.8 FINAL ACCEPTANCE BY OWNER

A. Certificate - Submit Certificate of Final Acceptance form signed by Owner verifying complete installation and proper operation of systems upon fulfillment of all requirements and upon recommendation by Owner.

B. General Adjustments - Adjust, balance, and align equipment for optimum quality, meeting manufacturers published specifications.

C. Input/Output Jack Demonstration - Demonstrate proper performance and phase of each system input and output jack (all audio input and output jacks) as received at AV and network systems.

D. Inventory - Inventory all installed and portable equipment for correct quantities.

E. Functional Demonstration - Demonstrate operation of each function of each major piece of equipment.

F. Other Tests - Perform any other tests on any part of the AV system as requested by Owner.

G. Final Equipment Settings - Record final settings of all equalizer bands, tone controls, filters, delays, limiters, etc., including those established through computer software settings. Include descriptions of settings (including software settings) in Operation and Maintenance Manual. Include software copy of configuration file(s) in Operation and Maintenance Manual.

H. Security Inspection - Inspect equipment for security from tampering (covers, shaft-locks, etc.).

I. Review of Labels - Review installed labels on cables, equipment, controls, and terminal strips.

3.9 OWNER TRAINING

A. Provide Owner training as described in General Conditions. As a minimum, provide eight (8) hours instruction (within two (2) trips to site) regarding AV Systems operation to Owner-designated personnel. Schedule instruction time(s) with Owner to occur after completion of Final Tests and Adjustments. Coordinate with Owner in advance to schedule instruction time. Document date, time, and attendees of the training session and include documentation in Operation and Maintenance Manuals to serve as record of trained personnel.

3.10 SUPPORT DURING OWNER'S FIRST USE OF COMPLETED SYSTEM

A. Provide personnel familiar with design, installation, and operation of each system to be present at Owner's first use of each completed system (up to eight (8) hours total in a single session). During first use of each system, respond to Owner requests for troubleshooting, adjustments, and additional training. If no one contractor employee or representative can provide expertise in all aspects of the system, provide multiple personnel for the eight (8) hours per session as required. Schedule presence of personnel in advance with Owner. Should significant elements of the new system be operational prior to final completion, Owner may elect to schedule contractor presence for Owner function prior to final completion of system. Should Owner exercise this option, contractor presence will not be required at first use following final completion.

END OF SECTION 27 41 16