SECTION 274116

INTEGRATED AUDIOVISUAL SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes: Audiovisual systems – presentation systems, control systems, and interface with outer systems. Refer to article 1.04 “System Description” for more information.

B. Base bid work

1. Provide equipment and materials, whether specifically mentioned herein or not, needed for a complete and operating audiovisual systems to satisfy the requirements of this section and related drawings. This specification lists major equipment but not every wire, connector, extender, converter, fastener, etc., needed to complete the work.

2. Provide coordination with electrical work necessary to provision AV equipment with power in areas where equipment is relocated. The work may require relocation of power outlets, or extending power outlets to alternate locations within the same room. Refer to the attached campus survey for overall field conditions.

3. Equipment racks or enclosures:

   a. Plenum enclosures: Provide plenum-rated equipment enclosures, including frame, side panels, top panels, access doors, anchorage and seismic bracing, integrated power outlets and cooling provisions as required.

   b. Provide standard or custom accessories and mount adapters for equipment installed in equipment racks or enclosures as needed to properly mount equipment, power supplies, accessories, components, and the like. Provide cable management to properly route and mind wires, cables, and cords.

   c. Provide power receptacle strips in quantities needed to supply power to the equipment within the rack.

   d. Provide spare rack mounting screws. Determine based on rack mount units (RUs) – 1 spare screw per 2 RU installed, minimum.

   e. Provide bonding for racks, cabinets, equipment, equipment support and cable/wire management to an approved grounding point.

4. Cooling provisions

   a. Provide cooling provisions (means to move heat out of enclosed spaces to prevent temperatures from exceeding equipment manufacturer’s specified maximums). Ensure equipment operates within manufacturer’s cooling guidelines. Provide only code-compliant cooling provisions (e.g., exhausting from one space to another).

   b. In racks, enclosures, millwork, cabinets, and other spaces where equipment will be installed and prone to heat buildup, provide thermostatically-controlled active cooling devices to create adequate airflow through the enclosed space. Examples of active cooling devices include vent fans. At a minimum, ensure airflow by installing active cooling devices or systems such as fans.

5. Provide power controllers (such as an IP power strip connected to the network or controllable through the room control system) to devices that cannot inherently be remotely controlled for power cycling. Verify functional operation for specified control operations.

6. Labeling: Provide labeling for audiovisual system components. The components include, but are not limited to, the following:

   a. Equipment racks and equipment enclosures

b. Rack-mounted equipment and devices: Provide a label on the back of each piece of equipment. If a serial number (of a given piece of equipment) is not visible in a final installed condition, provide a label on the equipment on a visible location duplicating the serial number.

c. Wall-mounted equipment and devices: Provide an equipment label on the back of each piece of equipment. If a serial number (of a given piece of equipment) is not visible in a final installed condition, provide a label on the equipment on a visible location duplicating the serial number.

d. Provide an equipment plate for each piece of equipment.

e. Provide a label for each control that is not inherently labeled, such as those in racks and user spaces.

f. Wires and cables: Provide a cable label at each end of each piece of wire, cable and cord.

g. Terminal blocks, patch panels, and other termination apparatus: Provide a label on each termination block, piece of termination apparatus and termination position on patch panels.

h. Handheld, lavalier, wireless, and other microphones and associated equipment (such as receivers)

i. User interface devices/plates

7. Coordination requirements

a. Coordinate with the construction team at large to ensure that equipment and other system components will be installed properly, and that there will be no compromises due to, among other aspects, spatial conflicts or power service incompatibilities.

b. Coordinate with the electrical contractor for power requirements and service connection to the System's equipment.

c. Coordinate with the telecom contractor and other trades/contractors (as needed) placement of cables and wires when sharing pathways (such as cable tray) with other low voltage systems. Do not place cables and wires into pathways provided by others without permission.

d. Coordinate with the telecom contractor (or Owner) for locations within racks for installing equipment"

e. Coordinate with the Owner (or Owner's network provider) for network configurations and/or settings required for the System's proper or correct operation.

C. Related divisions and sections: Consult other divisions where applicable, determine the extent and character of related work. Coordinate the work of this section with, at least but not limited to, the following divisions and sections:

1. Division 0 (for Bidding Requirements, Contract Forms, and Conditions of Contract) and Division 1 (for General Requirements) – provisions listed or specified therein apply to work under this section.

2. Section 270000, "Communications Basic Requirements"

3. Division 26, "Electrical Systems"

4. Division 23, "Heating, Ventilating, and Air Conditioning Systems"

D. Products furnished but not installed under this section

1. None

E. Products installed but not furnished by contractor

1. Telephone instruments for classrooms – OFE

a. The contractor is responsible for providing a 2-post network outlet for an OFE telephone for each classroom.

b. The contractor is responsible for installing the telephone instrument.

c. Network switches, with Power over Ethernet (PoE)

2. Telephone patch cable

F. Products specified but not installed under this section

None

G. Products furnished and installed by this contractor, either directly or by subcontracting to a qualified licensed 3rd party:

1. Rough-in (device boxes, conduits, and related accessories)
2. Relocation or provision of electrical service (e.g., 120 VAC)
3. Telecommunication cabling

H. Alternates: Submit a written request for modification to an installation practice desired or required which is contrary to these specifications or drawings. Obtain written approval from the Owner prior to performing modifications.

I. Unit Prices: Submit unit prices, as derived from the quotations in the Schedule of Values, for adjustments to the contract price. Include in unit prices, material, both explicitly specified, as well as additional components required for a complete and functional installation, labor, shipping, tax, markups (overhead, profit, job expenses, bond), labeling, records, and as-built drawing production costs.

1.02 REFERENCES

A. General

1. Codes, standards, and industry manuals/guidelines listed by reference, including revisions by issuing authority, form a part of this specification section to extent indicated. Consider such codes and/or standards a part of this specification as though fully repeated herein.
2. Standards listed are identified by issuing authority, authority abbreviation, designation number, title or other designation established by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation.
3. Reference to codes, standards, specifications and recommendations of technical societies, trade organizations and governmental agencies shall mean that latest edition of such publications adopted and published prior to submittal of the bid unless otherwise specifically stated.

B. Codes: Perform work and furnish materials and equipment under Division 27 in accordance with applicable requirements of the latest edition of governing codes, rules and regulations including but not limited to the following minimum standards, whether statutory or not:

1. California Code of Regulations (CCR):
   a. Title 8, “Industrial Relations”
      1) Chapter 3.22, “California Occupational Safety and Health Regulations (CAL/OSHA)”
   b. Title 24, “California Building Standards Code”
      1) Part 1, “California Building Standards Administrative Code”
      2) Part 2, “California Building Code” (CBC)
      3) Part 3, “California Electrical Code” (CEC)
      4) Part 11, “California Green Building Standards Code” (CALGeen)”
2. National Fire Protection Agency (NFPA)
   a. NFPA 75, “Protection of Information Technology Equipment”
3. United States Department of Labor (DOL) Occupational Safety and Health Administration (OSHA) Regulations (Standards - 29 CFR)
   a. Part 1910, “Occupational Safety and Health Standards”
   b. Part 1926, “Safety and Health Regulations for Construction”

4. Code of Federal Regulations (CFR) Title 47 “Telecommunication”, Chapter I “Federal Communications Commission (FCC)”:
    a. Part 15, “Radio Frequency Devices and Radiation Limits”
    b. Part 27, “Miscellaneous Wireless Communications Services”
    c. Part 68, “Connection of Terminal Equipment to the Telephone Network”
    d. Part 90, “Private Land Mobile Radio Services”
5. Other applicable national, state, and local binding building and fire codes

C. Standards: Perform work and furnish materials and equipment under Division 27 in accordance with the latest editions of the following standards as applicable:

1. Building Industry Consulting Services International (BICSI):
    a. Telecommunications Distribution Methods Manual (TDMM)
    b. Customer-Owned Outside Plant Design Manual
    c. Wireless Design Reference Manual (WDRM)
    d. Network Design Reference Manual (NDRM)
2. EIA testing standards
3. National Electrical Contractors Association (NECA):
    a. ANSI/NECA 1, “Standard Practices for Good Workmanship in Electrical Construction”
4. Telecommunications Industry Association (TIA):
    a. ANSI/TIA-568-C.0, “Generic Telecommunications Cabling for Customer Premises”
    b. ANSI/TIA-568-C.1, “Commercial Building Telecommunications Cabling Standards - Part 1 General Requirements”
    c. ANSI/TIA-568-C.2, “Balanced Twisted Pair Telecommunications Cabling and Components”
    d. ANSI/TIA-568-C.3, “Optical Fiber Cabling Components”
    e. ANSI/TIA-569-B, “Commercial Building Standard for Telecommunications Pathways and Spaces”
    f. ANSI/TIA/EIA-598-B, “Optical Fiber Cable Color Coding”
    g. ANSI/TIA-606-B, “Administration Standard for Telecommunications Infrastructure”
    h. ANSI-TIA-607-B, “Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises”
    i. ANSI/TIA-758-A, “Customer-Owned Outside Plant Telecommunications Infrastructure Standard”
5. ANSI/TIA-1005, “Telecommunications Infrastructure Standard for Industrial Premises”National Fire Protection Agency (NFPA)
    a. NFPA 262, “Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces”
6. Underwriters Laboratories (UL)
    a. UL 969, “Marking and Labeling Systems”
    b. UL 1419, “Professional Video and Audio Equipment”
    c. UL 60065, “Audio, Video and Similar Electronic Apparatus – Safety Requirements”
7. InfoComm
    a. InfoComm 1M, “Audio Coverage Uniformity in Enclosed Listener Areas”
    b. InfoComm 2M “Standard Guide for AV Systems Design and Coordination Processes”
    c. InfoComm 3M, “Projected Image System Contrast Ratio”
    d. InfoComm F501 01, “Cable Labeling for Audiovisual Systems”

8. “Sound Systems Engineering”, 3rd Ed., Davis and Davis
9. Electronic Components Industry Association (ECIA)
    a. EIA/ECA-310, “Cabinets, Racks, Panels, and Associated Equipment”

1.03 DEFINITIONS

A. The definitions of Divisions 00 and 01 shall apply to Division 27 sections.

B. In addition to those definitions of Divisions 00 and 01, the following list of terms as used in this specification defined as follows:

1. “AFF”: Above Finished Floor
2. “As directed”: As directed or instructed by the Owner, or their authorized representative
3. “AHJ”: Authority Having Jurisdiction
4. “Cabling”: installed media ready for electronic or optical signal circuit use; a complete media connection comprised of cables, termination apparatus (patch panels, blocks, connectors), outlets, connecting media (path cord, crossconnects), labeling
5. “CBC”: California Building Code (CCR Title 24 Part 2)
6. “CCR”: California Code of Regulations
7. “CEC”: California Electrical Code (CCR Title 24 Part 3)
8. “Connect”: To install patch cords, equipment cords, crossconnect wire, etc. to complete an electronic or optical signal circuit
9. “Cord”: a length of cordage having connectors at each end. The term “Cord” is synonymous with the term “Jumper” and “Lead”
10. “Engineer”: TEECOM
11. “Furnish”: To purchase, procure, acquire, and deliver complete with related accessories
12. “General Contractor”: Devcon
13. “Identifier”: A unique code assigned to an element of the Telecommunications infrastructure that links it to its corresponding record
14. “Install”: To set in place, join, unite, fasten, link, attach, set up or otherwise connect together and test before turning over to the Owner, parts, items, or equipment supplied by contractor or others. Make installation complete and ready for regular operation
15. “IOR”: Inspector Of Record
16. “ISP”: Inside Plant
17. “LED”: Light Emitting Diode
18. “MSDS”: Material Safety Data Sheets
19. “NEC”: National Electrical Code (NFPA 70)
20. “NEMA”: National Electrical Manufacturers Association
21. “NFPA”: National Fire Protection Agency
22. “NIC”: Not In Contract (work or equipment)
23. “OFCI”: Owner-furnished contractor-installed; coordinate the integration of components furnished by the Owner; provide mounting hardware, cable, connectors, etc. to ensure proper integration of OFCI equipment
24. “OFE”: Owner Furnished Equipment

25. “OSP”: Outside Plant
26. “Owner”: Hewlett Packard Enterprise, Inc.
27. “Owner’s Representative”: Tracy Martin
28. “PDF”: portable document format (electronic file format / *.pdf)
29. “Pigtail”: a length of cordage having connectors at one end
30. “Provide”: To furnish, transport, install, erect, connect, test and turn over to the Owner, complete and ready for regular operation
31. “UL”: Underwriters Laboratories:
32. “ACEG”: alternating current equipment ground (an example of this is a ground bus within an electrical panel)
33. “Approved Grounding Point”: an approved grounding point is one that satisfies the applicable electrical code and provides a low impedance path to earth. Examples include the following though may manifest in different means: a telecommunications grounding busbar (such as for bonding an equipment rack within a telecom room), the ACEG of the electrical panel serving the equipment requiring bonding to ground (such as for bonding a credenza rack within a conference room), or the ground conductor of a branch circuit (such as for bonding a single piece of equipment).
34. “A/R”: Indicates that the quantity of an item is as required to meet the design criteria indicated in the audiovisual drawings.
35. “A/S”: Indicates that the quantity of an item is as shown on the drawings.
36. “Audience Area”: the portion of a presentation space intended to be occupied by an audience. An audience area includes the primary seating and standing spaces and may include the adjacent circulation spaces. An audience area generally excludes spaces reserved for presenters.
37. “Custom” indicates systems or components the Contractor fabricates based on these specifications and drawings
38. “EDID”: Extended display identification data
39. “HDCP”: High-bandwidth digital content protection
40. “HDMI”: High-definition multimedia interface
41. “OFE”: Owner Furnished Equipment
42. “Or equal” indicates an item that is equal in function and performance to the specified device or system
43. “RU”: rack unit, as defined in EIA/ECA-310
44. “Shall” denotes a mandatory requirement
45. “Should” denotes an advisory statement
46. “SPL”: sound pressure level
47. “THD”: total harmonic distortion
48. “Will” denotes an informative statement
49. “Project”: The scope of work defined by this specification and its related drawings
50. “Software”: Any executable programs, parameter files, user interfaces, or other coded content that are required to operate, control, or maintain the audiovisual systems in this Project
51. “Custom Created Software”: Any software, parameter files, user interfaces, or other coded content created for the control or operation of the audiovisual systems in this Project

52. “Third-party software:” Any programming developed by a party other than the AV Contractor and the Owner to be used to operate, control, or maintain the audiovisual systems in this Project

53. “System”: The audiovisual components, cabling, and programming incorporated in the descriptions and equipment lists herein

1.04 SYSTEM DESCRIPTION AND PERFORMANCE REQUIREMENTS

A. General

1. In circumstances where the specifications and drawings conflict, the drawings govern quantity and the specifications govern quality.

2. The contract drawings and specifications convey design intent. They are not intended to be used in lieu of shop drawings.

B. ADA compliance: Provide the following:

1. Accessible control systems

2. Assistive listening systems -

C. Audio system

1. Provide echo cancellation for microphones in audio and video conferencing systems.

2. Program audio system:
   a. Frequency Response: 100 Hz to 12,000 Hz. 3 dB per octave roll off below 100Hz and above 12 kHz.
   b. Total Acoustical Harmonic Distortion: Less than 2% at 90 dBC (1 kHz reference) at four feet (1,220 mm) above finished floor in the middle of the room.

3. Distributed audio system:
   a. Frequency Response: 125 Hz to 10,000 Hz. 3 dB per octave roll-off below 125 Hz and above 10 kHz.
   b. Total Acoustical Harmonic Distortion: Less than 2% at 85 dBC (1 kHz reference) at four feet (1,220 mm) above finished floor in the middle of the room.

4. Signal to noise ratio (mixer input to amplifier output): 75 dB from 50 Hz to 15 kHz minimum.

5. Frequency response with equalizers bypassed: less than ±1 dB from 50 Hz to 12 kHz.

6. Distortion: less than 0.5% at 1 kHz at the equipment's rated input signal level.

7. Output levels (in audience areas without objectionable distortion, rattles, or buzzes, employing as test signals several different samples of recorded music and microphones applied at each system input):
   a. Program audio: not less than 95 dB
   b. Speech reinforcement: not less than 85 dB

8. Hum and Noise: inaudible (below the background noise level of the space) under normal operation observed in audience areas.

D. Video system resolutions

1. Provide system components with a minimum resolution capability of 1920 X 1080

2. Provide systems that support the following resolutions: 1,280 x 720, 1,920 x 1,080, 1,920 x 1,200, 3840 X 2160, and 4096 x 2160.

E. Direct-view display systems

1. Provide displays that have no more than seven defective pixels per quadrant, or per manufacturer's spec.

F. Wireless systems

1. Ensure that wireless AV systems do not create radio frequency interference to other systems.
2. Demonstrate at AV acceptance testing that wireless AV systems are not adversely affected by AV-related nor other radio frequency sources.

G. Control system

1. Provide user interfaces, such as control panels, that respect ergonomics and varying levels of technical ability among users. Follow these guidelines:
   a. Avoid abbreviations
   b. Size lettering at 1/8" minimum
   c. Maintain background to lettering contrast
2. Positive logic: Avoid conditions which may cause command synchronization conflicts (i.e., alternate action (toggling) on/off without power reset of feedback. Provide power sensors or other devices where necessary to ensure that positive logic conditions are maintained.
3. Timing: Prevent two or more commands being sent simultaneously to the same piece of equipment.
4. Linking: Provide linking of functions to require the fewest number of user actions to effectively control the equipment.
5. Clearing: Ensure that each media selection clears the previous audio and visual selection (e.g., selecting COMPUTER clears the audio and video section of the previous Blu-ray disk selection).
6. Defaults: Establish default power-up conditions for the system including device audio levels, warm-up routine, power conditions, switcher status and other default conditions as required by the Owner or Owner's representative.
7. Volume Memory: Provide easy-to-use memory for volume settings associated with each source device. Unless directed otherwise in this document, provide programming that maintains these settings between alternate selections during each use – through power-on and power-off.
8. Status indication: Program buttons for both touch panels and pushbutton panels to provide clear status indication using illumination when back-lighting is available or by changing color.
9. Failsafe: Provide program that ensures that no operation or sequence of operations causes the control system to become inoperable or interferes with further processing, correct operations or execution of commands.

H. Centralized Management Procedure

1. Provide server-based software for the management of the AV systems deployed in the facility and the District. Include the following:
   a. Help-desk functionality
   b. Enterprise-wide scheduling and monitoring
   c. Time-stamped AV systems data collection for reporting

I. Room types

1. The audiovisual systems design and documentation are based on standard room types.
2. Each room to receive audiovisual systems is shown on the drawings with a type designation.

3. For each room, adapt the audiovisual system to best suit the architectural layout such that each room of a certain type is similar to others of its type, with minor layout differences to accommodate architecture.
4. Refer to the drawings and survey for the quantities of each type of room and for specific audiovisual interface information per room.
5. Standards Classroom Types
    a. Type 1 – Flexible, dual projection, extended desktop
    b. Type 2 – Lecture style, dual projection, unified desktop
    c. Type 3 – Lecture style, single projector
    d. Type 4 – Flexible style, single projector
6. Special Classrooms
    a. Forum – Large Venue
    b. Theater – Large Venue
    c. Tech Labs

J. It is possible that certain portions of the system described herein will be ready for use prior to the completion of the entire scope of this specification. The Owner reserves the right to use substantially completed systems without obligation to the Contractor and without implying final acceptance of the systems or equipment so used.

K. Room Functionality Descriptions

1. Standard Classroom Type 1 – Dual projector, extended desktop
    a. Flexible in configuration, dual projection systems with projector and projection screen, with one projector displaying the main output of the instructor's laptop and the second projector displaying the extended desktop of the laptop
    b. Technology connection point at the front of the room for an instructor lectern containing:
        1) Connection for laptop, including HDMI with multiple adaptors for DisplayPort, Mini DisplayPort and VGA for legacy support including audio
        2) Document camera
    c. Portable device sharing capability (BYOD)
    d. Supporting AV presentation system, including switching and amplification functions
    e. Ceiling-mounted speakers
    f. Control system, self-contained, with push-button style panel, to control all functions of the AV systems
    g. Assistive listening system as required by code
    h. OFE Telephone installed by light switch bank
2. Standard Classroom Type 2 – Dual projector, mirrored image
    a. Fixed seating configuration, dual projection systems with projector and projection screen, with both projectors displaying the main output of the instructor's laptop
    b. Technology connection point at the front of the room for an instructor lectern containing:
        1) Connection for laptop, including HDMI with multiple adaptors for DisplayPort, Mini DisplayPort and VGA for legacy support including audio
        2) Document camera
    c. Portable device sharing capability (BYOD)
    d. Supporting AV presentation system, including switching and amplification functions
    e. Ceiling-mounted speakers

f. Control system, self-contained, with push-button style panel, to control all functions of the AV systems
g. Assistive listening system as required by code
h. OFE Telephone installed by light switch bank

3. Standard Classroom Type 3 – Single projector, wall-mounted speakers
   a. Fixed seating configuration, single projection systems with projector and projection screen, with the projector displaying the main output of the instructor's laptop
   b. Technology connection point at the front of the room for an instructor lectern containing:
      1) Connection for laptop, including HDMI with multiple adaptors for DisplayPort, Mini DisplayPort and VGA for legacy support including audio
      2) Document camera
   c. Portable device sharing capability (BYOD)
   d. Supporting AV presentation system, including switching and amplification functions
   e. Wall-mounted speakers
   f. Control system, self-contained, with push-button style panel, to control all functions of the AV systems
   g. Assistive listening system as required by code
   h. OFE Telephone installed by light switch bank
4. Standard Classroom Type 4 – Single projector, ceiling-mounted speakers
   a. Flexible in configuration, single projection systems with projector and projection screen, with the projector displaying the main output of the instructor's laptop
   b. Technology connection point at the front of the room for an instructor lectern containing:
      1) Connection for laptop, including HDMI with multiple adaptors for DisplayPort, Mini DisplayPort and VGA for legacy support including audio
      2) Document camera
   c. Portable device sharing capability (BYOD)
   d. Supporting AV presentation system, including switching and amplification functions
   e. Ceiling-mounted speakers
   f. Control system, self-contained, with push-button style panel, to control all functions of the AV systems
   g. Assistive listening system as required by code
   h. OFE Telephone installed by light switch bank
5. Special Classroom – Forum
   a. Fixed seating configuration, dual projection systems with projector and projection screen, with one projector displaying the main output of the instructor's laptop and the second projector displaying the extended desktop of the laptop
   b. Technology connection point at the front of the room for an instructor lectern containing:
      1) Connection for laptop, including HDMI with multiple adaptors for DisplayPort, Mini DisplayPort and VGA for legacy support including audio
      2) Document camera
   c. Portable device sharing capability (BYOD)
   d. Supporting AV presentation system, including switching and amplification functions
   e. Wall-mounted speakers, utilizing existing locations through the space
   f. Control system, self-contained, with push-button style panel, to control all functions of the AV systems
   g. Assistive listening system as required by code

h. OFE Telephone installed by light switch bank or as directed by Owner

6. Special Classroom – Theater
   a. Fixed seating configuration, single projection systems with projector and custom projection screen, with the projector displaying the main output of the instructor's laptop
   b. Technology connection point at the front of the room for an instructor lectern containing:
      1) Connection for laptop, including HDMI with multiple adaptors for DisplayPort, Mini DisplayPort and VGA for legacy support including audio
      2) Document camera
   c. Portable device sharing capability (BYOD)
   d. Supporting AV presentation system, including switching and amplification functions
   e. Wall-mounted speakers, utilizing existing locations through the space
   f. Control system, self-contained, with push-button style panel, to control all functions of the AV systems
   g. Assistive listening system as required by code
   h. OFE Telephone installed by light switch bank or as directed by Owner
7. Special Classroom – Tech Labs
   a. Fixed seating configuration, dual projection systems with projector and projection screen, with one projector displaying the main output of the instructor's laptop and the second projector displaying the extended desktop of the laptop
   b. Technology connection point at the front of the room for an instructor lectern containing:
      1) Connection for laptop, including HDMI with multiple adaptors for DisplayPort, Mini DisplayPort and VGA for legacy support including audio
      2) Document camera
   c. Portable device sharing capability (BYOD)
   d. Supporting AV presentation system, including switching and amplification functions
   e. Wall-mounted speakers, utilizing existing locations through the space
   f. Control system, self-contained, with push-button style panel, to control all functions of the AV systems
   g. Assistive listening system as required by code
   h. OFE Telephone installed by light switch bank or as directed by Owner

1.05 SUBMITTALS

A. Submit required submittals to the Owner in the quantities and formats as required under the general contract. In the absence of requirements, provide as described in the following with reference to quantity and format.

B. Failure to comply with requirements in part or whole shall constitute grounds for rejection.

C. Resubmittals: For resubmittals, provide a cover letter with the resubmittal that lists the action taken and revisions made to each product in response to the Engineer's submittal review comments. Lack of this actions-taken cover letter shall constitute grounds for non-review and/or rejection of resubmittal packages.

D. Bid submittal: Submit bids in accordance with project's overall bidding requirements, and include the following requirements of this section.

   1. Site visit: As possible, visit the site before submitting your bid. Coordinate site visit arrangements with the District. Include date of site visit in the bid submittal.

2. Firm information and qualifications: Include detailed information about the firm, including but not limited to the following, in the bid:
    a. Firm's history – how long the firm has been in business, how long the firm has offered audiovisual systems integration services, etc.
    b. Annual revenue for the three most current years
    c. Bonding capacity and bonding insurance agent contact information
    d. Three successfully completed projects of similar scope within the past 24 months. For each project, include the owner/client name, contact information (person's name, position, and telephone number or email address), project location, type of systems installed, total contract amount, date completed, and services included (e.g., engineering, installation, integration, maintenance, etc.).
    e. Industry affiliations
    f. Advanced certifications (CTS-I/D, DMC-D/E, ACE-D/I/P/RMS, XTP, etc.)
    g. Manufacturer certifications
    h. Contractor license number for the state where the work will take place
    i. Union affiliation(s)
3. Personnel and certifications: Include information on key personnel in the bid.
    a. Include résumés and certifications for personnel who will be assigned to the project including but not limited to the Project Manager, Systems Engineer, Field Installation Supervisor, Lead Control System Programmer, and other key personnel.
    b. Include résumé(s) of CTS–I (Certified Technology Specialist – Installation) certified personnel
    c. Include résumé(s) of DMC-E (DigitalMedia Certified Engineer) certified personnel.
    d. Include résumé(s) of Q-Sys Level 2 (QSC Certification) certified personnel.
    e. Include other relevant company-held industry, manufacturer, and educational certifications and designations for involved personnel
4. Subcontract information: Indicate in the bid, all subcontractors and their responsibilities and qualifications.
5. Schedule of values: Include a schedule of values in the bid. Break out the schedule of values into three areas – equipment costs, non-equipment costs, and service contract.
    a. Equipment costs: List equipment costs (each piece of equipment), including required modifications and accessories.
    b. Non-equipment costs: List non-equipment costs, such as the following:
        1) General and Administrative: shipping, insurance, and guarantees, etc.
        2) Fees: e-Waste/disposal, permits, etc.
        3) Engineering: design, drawings, run sheets, instruction manuals, etc.
        4) Pre-installation: fabrication, modification, assembly, rack wiring, etc.
        5) Installation: installation, coordination, supervision, testing, etc.
        6) Owner training: training session(s), manuals, etc.
6. Alternates/substitutions:
    a. Submit bids based on the specified equipment. If the bid includes proposed alternates and/or substitutes, separate these from the costs of the equipment as specified and include for alternate equipment full technical information and cut sheets. Proposed alternate equipment will receive consideration if the differences between the specified and alternate/substituted equipment do not depart from the design intent and function of the system and are in the best interests of the Owner. If the inclusion of substituted equipment will result in a different connection configuration than that in the bid documents, include drawings that illustrate how the proposed system would be connected.
    b. Only one substitution for each product specified will be considered.

c. Where products are noted as "or equal", a product of equivalent design, manufacture, and performance will be considered. Submit product data (product information, catalog cuts, pertinent test data, etc.) to substantiate that the product is in fact equivalent to that specified. The burden of proof that the substituted product is equivalent to the specified product rests with the Contractor. Whenever material, process or equipment is specified in accordance with an industry specification (ANSI, TIA, etc), UL rating, or other association standard, present an affidavit from the manufacturer certifying that the product complies with the particular standard specification. When requested by the Engineer, submit supporting test data to substantiate compliance.

d. Manufacturers' names and model numbers used in conjunction with materials, processes or equipment included in the contract documents are used to establish standards of quality, utility and appearance. Materials, processes or equipment that, in the opinion of the Engineer, are equivalent in quality, utility and appearance will be approved as substitutions to that specified when “or equal” follows the manufacturers' names or model number(s).

e. When the Engineer accepts a substitution in writing, it is with the understanding that the Contractor guarantees the substituted product, component, article, or material to be equivalent to the one specified and dimensioned to fit within the construction according to contract documents. Do not provide substituted material, processes, or equipment without written authorization from the Engineer. Assumptions on the acceptability of a proposed substitution, prior to acceptance by the Engineer, are at the sole risk of the Contractor.

f. Approved substitutions shall not relieve the Contractor of responsibilities for the proper execution of the work, or from provisions of the specifications.

g. Pay expenses, without additional charge to the Owner, in connection with substitution materials, processes and equipment, including the effect of substitution on self, subcontractor's or other Contractor's work.

7. System enhancements: Include in the bid recommendations, if any, that will enhance the performance and/or functionality of the system, or will reduce costs without loss of performance/functionality. Recommendations that are of value to the Owner will be taken into consideration in the evaluation of the bids. Make such proposed recommendations as "alternates", with the appropriate cost modifications shown separate and apart from the costs of the system "as specified".

8. Exceptions: In the bid, explain exceptions, if any, to these specifications and related drawings. In the absence of exceptions, these specifications and related drawings are binding in letter and intent.

9. Guarantee compliance with requirements and regulations in effect on the job site. Explicitly state any such non-compliances or conflicts in the bid submittal. The bidder has the responsibility to investigate potential contract, union, and scheduling issues, and to notify the general contractor of such.

E. Pre-construction submittals

1. Product data: Prior to purchase and installation, submit as a PDF file information (such as cut sheets, etc.) for equipment, components, products, etc., that will be installed as part of the work of this section.

a. Include in the submittal, a Table of Contents, listing equipment, components, products, etc., by room, by system, and/or by other logical designation. A continuous list of all products with no reference to where the products will be installed will be rejected. Incomplete lists will be rejected.

b. Indicate (arrow, highlight or other designator) on each product’s cut sheet the manufacturer, model/part number, accessories (as applicable), options (as applicable), color (as applicable), and other information to indicate the exact item to be installed. Where this information is not already provided on the cut sheet, manually input this information and a brief description (as applicable).

2. Shop drawings: Submit shop drawings prior to installation and in accordance with the Conditions of Contract and Division 1, including the following.
    a. Prior to the start of work, submit shop drawings and obtain written approval from the Engineer for the shop drawings submittal.
    b. Quantity and Media: Submit shop drawings as described in Division 01. In the absence of requirements given, submit shop drawings as directed in writing either an electronic submittal (preferred) via approved means (email, e-transmit, FTP upload) or four printed and bound sets on bond.
    c. Format:
        1) Use the same sheet size as the contract drawings.
        2) Use the same title block as the contract drawings, modified to include contractor information.
        3) Text: 3/32" - 1/8" high when plotted at full size.
        4) Use identical symbols as those in the contract drawings.
        5) Screen background information.
        6) Plot system components (symbols, outlet, devices, pathways, cable routes, etc.) and text using a heavier line weight sufficient enough to stand out against background information.
        7) Scaling:
            a) Scale floor plans and reflected ceiling plans at 1/8"=1'-0"
            b) Scale enlarged room plans at 1/4"=1'-0"
            c) Scale wall elevations at 1"=1'-0"
            d) Scale rack elevations at 1"=1'-0"
    d. Functional line diagrams for all systems – clearly tag each item with name, manufacturer, and manufacturer's model number (e.g., "Program Amplifier LabGruppen LUCIA 60/2M") and show the terminal number or input/output designation (e.g., "Mic 1-In", or "Record Out-Left").
    e. Provide schematic diagrams of custom circuitry such as receptacle pin numbers and component callouts; show details of custom resistive attenuation and/or combining networks, filters, or pads which may be required in the assembly; show point to point wiring drawings for control system modules and interfaces, and for switches and relays in audio, video, or control systems
    f. Equipment rack elevations and patch panel assignments – clearly and consistently label rack elevations, patch panels, and on equipment controls.
    g. Provide pushbutton and handheld remote control panel layouts –tag each button with function and ID matching installed labels
    h. Factory and custom panels, plates, and designation strips, showing material, finish, color and engraving (exact lettering)
    i. Equipment modifications (if any), including details of modifications that change or void manufacturers' warranties.
    j. Cable run lists – clearly show at each terminal point the type of connector to be used; include typical wiring details of each connector; note where shields are connected and where they will float to ensure the integrity of the shielding system; indicate cable types and, where appropriate, color codes; assign wire numbers and patch bay locations to every wire and patch point in the drawing
    k. Wattage tap setting per loudspeaker.
3. Touch screen submittal:
    a. Provide a PDF per system containing a page for each menu, submenu, and popup in that system's user interface. Include menus that are manually triggered and those that automatically appear as the result of events such as the connection of a source device. Ensure that the PDF is unlocked so that the Engineer may annotate it.

b. If the development environment allows, provide an executable menu simulation file or web link for control systems in addition to a PDF-based submittal.

4. Network coordination: Submit as an Excel file or cloud-based collaborative spreadsheet (such as Google Sheets) a list of equipment that will be connected to the network, including but not limited to the following (e.g., spreadsheet column headers):
   a. Item number
   b. Description
   c. Manufacturer
   d. Model/part number
   e. MAC address
   f. IP address type (DHCP or static)
   g. Power-over-Ethernet (PoE) requirements (yes or no)
   h. Specific network and/or subnet configuration requirements
   i. Specific QOS requirements
   j. Anticipated network traffic

5. Testing equipment and procedures:
   a. Submit a list of test equipment, including manufacturer, model number, and description that will be used for testing and adjustment of the installed systems.
   b. Submit testing procedures to be performed during pre-functional testing and acceptance testing, including the minimum acceptable outcome for each test.

F. At the completion of the installation

1. Initial Testing and Tuning Report: After completing initial testing and tuning, checkout, settings, as-built drawings, and operational documentation, submit written notification to the Owner and Architect that initial checkout is complete. Include in this notification a completed Initial Testing and Tuning Report that satisfies the requirements of Part 3. In the Report, document the results for tests performed during initial testing and tuning. Organize the report per room, per system, and per test. Include the testing tools/equipment, manual and automated tests, testing procedures, and expected result per test. If the test equipment stores test results and has the capability to produce reports, also include these reports.

2. Wireless microphones frequencies. Submit a list of wireless microphone frequencies and associated channels used for each microphone and system.

G. Closeout Submittals

1. Acceptance Testing Report: After completing final acceptance testing, final tuning and settings, submit an Acceptance Testing Report that documents the results for tests performed during final testing and tuning. Organize the report per room, per system, and per test. Include the testing tools/equipment, manual and automated tests, testing procedures, and expected result per test. If the test equipment stores test results and has the capability to produce reports, also include these reports. Include the system's normal settings.

2. As-built drawings: Submit as-built drawings in accordance with the Conditions of Contract and Division 1, including the following.

3. Quantity and Media: Submit as-built drawings as described in Division 01. In the absence of requirements given, submit as-built drawings as directed in writing as electronic files via approved media (or four printed and bound sets on bond, if approved).

4. Format:
   1) Use the same sheet size as the contract drawings.

2) Use the same title block as the contract drawings, modified to include contractor information.
3) Text: 3/32" - 1/8" high when plotted at full size.
4) Use symbols identical to the symbols shown on the contract drawings.
5) Screen background information.
6) Plot system components (symbols, outlet, devices, pathways, cable routes, etc.) and text using a heavier line weight sufficient enough to stand out against background information.
7) Electronic files shall be native format and plotted PDF files. The file names shall include the sheet number.

b. Submit as-built drawings that fully represent actual installed conditions and that incorporate modifications made during the course of construction.
c. Symbols List
d. Diagrams, such as (but not limited to) point-to-point diagrams, block diagrams, riser diagrams, line diagrams, and other diagrams that conceptually describe the system
e. System functional line drawings for all systems; clearly tag each item with name, manufacturer, and manufacturer's model number (e.g., "Program Amplifier Lab.Gruppen LUCIA 60/2M") and show the terminal number or input/output designation (e.g., "Mic 1-In", or "Record Out-Left").
f. Point-to-point wiring diagrams for switches and relays in audio, video, and control systems; point-to-point wiring diagram for control system modules and interfaces
g. Schematic diagrams of custom circuitry such as receptacle pin numbers and component callouts; show details of custom resistive attenuation and/or combining networks, filters, or pads which may be required in the assembly
h. Equipment rack elevations and patch panel assignment drawings. Clearly label the rack elevations, patch panels, and equipment controls.
i. Cable run lists – clearly show at each terminal point the type of connector to be used; include typical wiring details of each connector; note where shields are connected and where they will float to ensure the integrity of the shielding system; indicate cable types and, where appropriate, color codes; assign wire numbers and patch bay locations to every wire and patch point in the drawing
j. Pushbutton and handheld remote-control panel layouts, including tagging each button with function and ID that matches installed labels
k. Factory and custom panels, plates, and designation strips, showing material, finish, color and engraving (exact lettering)
l. Wattage tap setting per loudspeaker.

5. System Operation and Maintenance (O&M) manual:
   a. Describe typical procedures necessary to activate each system for full functionality as required under the System Description.
   b. Describe normal settings for equalizer, amplifier, signal processing, and user operated controls (as established during system check out) in tabular or pictorial form.
   c. Outline a recommended maintenance schedule with reference to the applicable pages in the manufacturer's maintenance manuals. Where inadequate maintenance information is provided by the manufacturer, provide the information necessary for proper maintenance.
   d. Outline a recommended plan for a normal maintenance period of at least one year, including a list of necessary and recommended replacement parts.
   e. Assume the reader of this manual to be technically competent, but unfamiliar with this particular facility.
   f. Submit equipment manufacturers' operation and maintenance manuals for each piece of equipment.

6. Programming/software:
    a. Submit the project's control system programming and audio processor configuration files – refer to "Software License" below.

1.06 QUALITY ASSURANCE

A. Audiovisual Contractor requirements: Demonstrate that your firm meets or exceeds the following requirements:

1. Five years' experience, minimum, with the design, engineering, assembly, installation, start-up and maintenance of audiovisual systems of similar or greater complexity to those identified in this specification
2. Provide the necessary professional design, engineering, fabrication, installation, and project management personnel to execute the work of this section, and to guarantee a complete, functional system in compliance with the design intent
3. Successfully completed in the past 24 months a minimum of three projects of similar scope
4. Current state contracting license, as required to perform the work under this section
5. Bondable to 100% of contract value
6. Be an authorized supplier and installer for equipment listed in this section
7. Maintain permanent fabrication, service and support facilities within 100 miles of the Project site.

B. Audiovisual Contractor certifications: Demonstrate that your firm has the following certifications:

1. An InfoComm CTS-I (Certified Technology Specialist-Installation) certified employee to actively manage this project – the Engineer will verify CTS credentials at the InfoComm website.
2. An Extron Control Specialist-certified employee to be actively involved in the design, implementation and commissioning of systems in this project – the Engineer will verify Control Specialist with Extron.
3. A QSC Q-Sys Level 2 certified employee to be actively involved in the design, implementation and commissioning of systems in this project – the Engineer will verify Q-Sys credentials with QSC.

C. Manufacturer/equipment supplier requirements: Demonstrate that your firm meets or exceeds the following:

1. Operate their business for not less than five years

D. Subcontractor quality:

1. Specifically identify in the bid submission, for Owner, Architect, or Engineer's approval, all subcontractors that will be used.
2. Regardless of any subcontract arrangement, your firm will have sole responsibility for the successful implementation of the work in this section.

1.07 PROJECT MANAGEMENT AND COORDINATION

A. Project Management and Coordination Services

1. Provide a project manager for the duration of the project to coordinate this Work with other trades. Coordination services, procedures and documentation responsibility include, but are not limited to, the items listed in this section.
2. Review of Shop Drawings Prepared by Other Subcontractors:
    a. Obtain copies of shop drawings for equipment provided by others that require telecommunication service connections or interface with work.

b. Thoroughly review other trades' shop drawings to confirm compliance with the service requirements contained in the Division 27 contract documents. Document discrepancies or deviations as follows:
   1) Prepare memo summarizing the discrepancy
   2) Submit a copy of the specific shop drawing, indicating via cloud, the discrepancy
c. Prepare and maintain a shop drawing review log indicating the following information:
   1) Shop drawing number and brief description of the system/material
   2) Date of the review
   3) Name of the individual performing the review
   4) Indication if follow-up coordination is required

3. Should existing conditions prohibit construction progress as submitted and approved, coordinate the adjusted installed locations with the other contractors (AV, electrical, etc).

B. Concurrent Installation

1. The network will be installed concurrent with the work of Division 27. Coordinate your work with the Owner's/network integrator's work. For example, coordinate scope and dates for rack and cabling (terminations) readiness to allow the network integrator to plan and schedule installation of the network equipment (for example, access switches).

C. Role of the Engineer

1. The Owner has retained the Engineer's services through construction. During construction, the Engineer will work with and assist the Contractor as follows (in general):
   a. Review product data and shop drawings submittals for general compliance with the contract drawings and specifications.
   b. Provide interpretation and clarification of project contract documents
   c. Reply to (and 'process') relevant Requests for Information (RFIs)
   d. Review changes as they arise, and confirm that the proposed solutions maintain the intended functionality of the system.
   e. Interpret field problems for Owner, and translate between Owner and Construction Team.
   f. Review the testing procedures to confirm compliance with industry-accepted practices.
   g. Observe the work for general compliance with the contract documents and to ensure that the installation meets the design intent of the system, and report progress to the Owner.

D. Assign a project manager to this project for the entire duration. They shall oversee the design, submittals, implementation, testing, and close out – the entire process from start to finish. The project manager shall also coordinate this work of this section with other trades.

1.08 DELIVERY, STORAGE AND HANDLING

A. Delivery

1. Do not deliver products to the site until protected storage space is available.
2. Coordinate materials delivery with installation schedule to minimize storage time at jobsite.
3. Deliver materials in manufacturer's original, unopened, undamaged packaging and containers with identification labels (name of the manufacturer, product name and number, type, grade, UL classification, etc.) intact.
4. Immediately replace equipment damaged during shipping at no cost to the Owner, so as not to impact the construction schedule.

B. Storage and Protection

1. Store materials in clean, dry, ventilated space free from temperature and humidity conditions (as recommended by manufacturer) and protected from exposure to harmful weather conditions.

2. Comply with manufacturer's storage requirements for each product. Comply with recommended procedures, precautions or remedies as described in the MSDS as applicable.

3. Maintain factory wrapping or provide a heavy canvas/plastic cover to protect units from dirt, water, construction debris, and traffic.

4. Storage outdoors covered by rainproof material is not acceptable.

5. Provide heat where required to prevent condensation or temperature related damage.

C. Handling

1. Handle materials and equipment in accordance with manufacturer's written instructions. Handle with care to prevent damage, breakage, denting, and scoring.

D. Do not install damaged materials and equipment. Replace damaged equipment at no cost to the Owner.

1.09 WARRANTY

A. Warrant the System for a minimum of one year from the date of system acceptance by the Owner. Honor component warranties per manufacturers' terms if greater than one year.

1. Include service as described in 3.13 "Maintenance and Extended Service" in the warranty.

B. Activate manufacturers' equipment warranties in the Owner's name. The warranty period shall commence on the date of System Acceptance by the Owner.

1. In the case of contractor-modified equipment (where the manufacturer's warranty could be voided), warrant such equipment equivalent to that of the original manufacturer.

C. Warrant the Software and version updates – see "Software" below.

1.10 SOFTWARE LICENSE

A. Nondisclosure

1. During or after the termination of this Agreement, the Owner agrees not to disclose any proprietary information provided by the AV Contractor, to maintain such information as confidential and not use such information provided in Project documents for any purpose other than maintenance and support of in-house systems. This does not apply to any of the information that becomes generally known to the public due to publication or other legal means and through no fault of the Owner.

B. Obligations governing the Software

1. The AV Contractor shall own the copyright of any custom created software/parameter files ("Software") and hereby grants the Owner a royalty-free, non-exclusive license to use the Software for use with the audiovisual and other connected systems in this project. This license cannot be transferred.

2. The Owner shall not rent, loan or re-license rights to use the Software to any third party.

3. Any Third-party software provided or made available to the Owner by the AV Contractor, but not created by the AV Contractor, is sublicensed to the Owner through the AV Contractor. The AV Contractor agrees that such sublicense is granted with consent of the third-party at no cost to the Owner, and the Owner shall be entitled to use such software under the same terms as the AV Contractor.

4. The AV Contractor and third-party suppliers are not restricted from licensing the Software or any portion thereof to other customers.
5. At acceptance testing, provide the source code for custom created software, applications required to use the source code, descriptions of the required equipment, and instructions detailing the modification and installation of the Software to the Owner.

C. For project and custom Software, the following apply.

1. Provide the source code to the Owner either directly via file transfer or make it available through other means, such as cloud storage, an FTP site, etc. Maintain older versions within a folder structure and make them available to the Owner at the Owner's request. At the end of the warranty period, release the current and older versions of the source code to the Owner. If the AV contractor ceases to exist during the warranty period, release the source code to the Owner upon termination of the business.
2. Provide the Software in a form suitable for immediate access by the System.
3. The AV contractor grants the Owner the right to modify and to enhance the Software as furnished and licensed under the terms of this Agreement at its own risk and expense, and further agrees such modifications and enhancements developed by the Owner to be the property of the Owner. Any changes to the custom created software parameter files do not affect copyright ownership.
4. During the warranty period, if the Owner discovers that the Software is no longer functioning in the same manner as had been approved at the beginning of the warranty period, they shall document the fault in sufficient detail to allow errors to be reproduced, and they will notify the AV contractor. Within two business days of this notification, update the software, provide or post updated Software files as detailed above, demonstrate that the error has been resolved, and maintain updated Software files as detailed above.
5. Defend any suit brought against the Owner and pay any damages due to the resulting judgment from any suit brought against the Owner as it pertains to a violation of copyrights or patents of the Software or licenses. The Owner shall notify the AV contractor in writing promptly and give authority, information and assistance at the AV Contractor's expense.
6. The AV contractor at its own expense and option shall, if able, procure for the Owner the right to continue to use the Software as licensed or to replace it with a non-infringing release. This shall not include any agreement by the AV Contractor to accept liability for patent or copyright infringement for beyond the Software as licensed and furnished for the Project. This also excludes any agreement by the AV contractor to accept liability for patent or copyright infringements for methods and processes to be carried out by using said Software except those inherent in the furnished System.
7. All contracts with Third-party software suppliers will transfer from the AV Contractor to the Owner at Project acceptance by the Owner.
8. The Owner shall apprise the AV Contractor of activities it takes with Third-party software providers during the warranty period. Included activities would include discontinuing the use of any Software component, installing updated or alternate versions of the Software, revising the configuration of affected systems.
9. The Owner can contact the AV Contractor for questions at no additional cost during the warranty period, providing:
    a. The queries are related to the audiovisual systems defined in this document.
    b. The query is asked by the Owner's staff or authorized representative.
    c. The inquirer has attended the AV Contractor's or the manufacturer's training in the use of the systems defined in this document.
    d. The question is not intended as design consultation.

10. The Owner can only make copies as backup files of the Software and they are required to include the AV Contractor's copyright notice. The Owner shall make a reasonable effort to secure this Software to prevent theft or unlicensed usage.

D. Software license terms

1. The Software license is granted by the AV Contractor for the devices provided for the Systems. If any devices in the system fails, the license can be transferred to a replacement device on a temporary or permanent basis if the original device is to be phased out. The transference may only occur with written notification to the AV Contractor.

2. Additional licenses or changes to the Software are subject to a supplemental agreement between the AV Contractor and the Owner.

PART 2 - PRODUCTS

2.01 GENERAL

A. Materials used shall present no environmental or toxicological hazards as defined by current industry standards and shall comply with OSHA and EPA standards, other applicable federal, state, and local laws.

B. Product numbers are subject to change by the manufacturer without notification. In the event a product number is invalid or conflicts with the written description, notify the Owner in writing prior to ordering the material and performing installation work.

C. Provide products, equipment and software that are the latest version of the specified model or type available at the time of procurement, providing the updated devices provide the same or better capabilities and performance required by the system design.

D. Where denoted “or equal”, equal products will be considered. The manufacturers, product numbers, and types listed at those instances establish minimum performance. Unless noted on the equipment list, it is not intended to exclude other products whose performance is equivalent to those named.

E. Substitutions: The Engineer may consider substitutions for certain equipment if the Contractor demonstrates that the substitution meets or exceeds the functional requirements described in the System Description and Performance Standards. Follow the requirements of section 012500 “Substitutions” for substitution requests.

1. Substitutions: Submit substitution requests based on the specified equipment and including associated equipment costs separate from the costs of the equipment as specified.

a. Proposals for alternate equipment will receive consideration if the differences between the specified and alternate/substituted equipment do not depart from the overall intent of the design and operation of the system and are in the best interests of the Owner.

b. Include full technical information and cut sheets for the proposed substitutions.

c. If the inclusion of substituted equipment will result in a different connection configuration than that in the bid documents, produce drawings that illustrate how the proposed system would be connected.

F. Demolition:

1. The contractor is responsible for removing unused or abandoned equipment in the classroom and moving it to a location within the facility designated by the Owner.

2. The contractor is responsible for removing and disposing of abandoned or unused conduit in the classrooms under the scope of work.

2.02 EQUIPMENT SCHEDULE

A. Quantities: Quantities are either listed herein with a number, as "A/S" (as shown), or as "A/R" (as required). If listed as A/R or the quantity is marked with an asterisk, determine quantities as required for a fully operational system. Confirm the quantity listed here against the drawings.

B. Centralized Software-Based Management

1. Provide a web-based AV resource management and remote control application to manage, monitor, and control AV equipment and other devices using a standard TCP/IP network.
   a. Extron Global Viewer/Global Configurator
   b. Or Equal

C. Wi-Fi HD Camera System

1. Provide a Wi-Fi enabled camera system, minimum 1080P resolution, to view and transmit wirelessly to the room's projector or video system.
2. The system shall be portable, applicable to rooms where skills need to be demonstrated.
3. Include portable cart or stand and receiving devices for a turn-key solution.
   a. Mevo
   b. Or Equal

D. Room Types

1. Standard Classroom Type 1 – Dual projector, extended desktop

Description	Make	Model	Qty.	Notes
CATEGORY: AUDIO				
Speakers, ceiling-mounted	Extron Or Equal	SF—3C-LP	A/R	Provide option for FF120
Assistive Listening System	Listen Technologies Or Equal	Portable 72	A/R	
CATEGORY: VIDEO				
Video Projector, Laser, 5,400 LM	Panasonic Or Equal	PT-RZ570	2	Include lens, mounts and accessories
Video Projector, Laser, 6,500 LM	Panasonic Or Equal	PT-RZ670	2	Include as alternate
Standard Lens	Panasonic Or Equal	ET-DLE170	2	Include as alternate
Ultra-Short-throw Lens	Panasonic Or Equal	ET-DLE030	2	Include as alternate
Presentation System	Extron Or Equal	PVS407D	1	

Description	Make	Model	Qty.	Notes
Video Extender Set, HDMI, shielded CAT6 interconnect	Extron Or Equal	DTP T HWP 4K 231 D DTP HDMI 4K 230 RX	A/R	
Collaboration System, Wireless	Extron Or Equal	ShareLink 200N	1	
Document Camera, HDMI, interactive	Elmo Or Equal	TT-12iD	1	
CATEGORY: CONTROL				
Control Keypad	Extron Or Equal	MLC Plus 200	1	
CATEGORY: ACCESSORIES				
Wall Plate, HDMI	Extron Or Equal	PVT HDMI	1	
Wall Plate, HDMI/VGA	Extron Or Equal	PVT HDMI/VGA	1	
Projection Screen, Manual, 16:10, 109" Diagonal	Da-Lite Or Equal	Model B CSR	2	Include 119" Diagonal as alternate
Equipment Cabinet, Plenum-rated	Extron Or Equal	PlenumVault PVM220	1	

2. Standard Classroom Type 2 – Dual projector, mirrored image

Description	Make	Model	Qty.	Notes
CATEGORY: AUDIO				
Speakers, ceiling-mounted	Extron Or Equal	SF—3C-LP	A/R	Provide option for FF120
Assistive Listening System	Listen Technologies Or Equal	Portable 72	A/R	
CATEGORY: VIDEO				
Video Projector, Laser, 5,400 LM	Panasonic Or Equal	PT-RZ570	2	Include lens, mounts and accessories
Video Projector, Laser, 6,500 LM	Panasonic Or Equal	PT-RZ670	2	Include as alternate
Standard Lens	Panasonic Or Equal	ET-DLE170	2	Include as alternate

Description	Make	Model	Qty.	Notes
Ultra-Short-throw Lens	Panasonic Or Equal	ET-DLE030	2	Include as alternate
Presentation System	Extron Or Equal	PVS407D	1	
Distribution Amplifier, HDMI	Extron Or Equal	DA2 HD 4K	1	
Video Extender Set, HDMI, shielded CAT6 interconnect	Extron Or Equal	DTP T HWP 4K 231 D DTP HDMI 4K 230 RX	A/R	
Collaboration System, Wireless	Extron Or Equal	ShareLink 200N	1	
Document Camera, HDMI, interactive	Elmo Or Equal	TT-12iD	1	
CATEGORY: CONTROL				
Control Keypad	Extron Or Equal	MLC Plus 200	1	
CATEGORY: ACCESSORIES				
Wall Plate, HDMI	Extron Or Equal	PVT HDMI	1	
Wall Plate, HDMI/VGA	Extron Or Equal	PVT HDMI/VGA	1	
Projection Screen, Manual, 16:10, 109" Diagonal	Da-Lite Or Equal	Model B CSR	2	Include 119" Diagonal as alternate
Equipment Cabinet, Plenum-rated	Extron Or Equal	PlenumVault PVM220	1	

3. Standard Classroom Type 3 – Single projector, wall-mounted speakers

Description	Make	Model	Qty.	Notes
CATEGORY: AUDIO				
Speakers, wall-mounted	Extron Or Equal	SM3	2	
Assistive Listening System	Listen Technologies Or Equal	Portable 72	A/R	

Description	Make	Model	Qty.	Notes
CATEGORY: VIDEO				
Video Projector, Laser, 5,400 LM	Panasonic Or Equal	PT-RZ570	1	Include lens, mounts and accessories
Video Projector, Laser, 6,500 LM	Panasonic Or Equal	PT-RZ670	1	Include as alternate
Standard Lens	Panasonic Or Equal	ET-DLE170	1	Include as alternate
Ultra-Short-throw Lens	Panasonic Or Equal	ET-DLE030	1	Include as alternate
Presentation System	Extron Or Equal	PVS407D	1	
Video Extender Set, HDMI, shielded CAT6 interconnect	Extron Or Equal	DTP T HWP 4K 231 D DTP HDMI 4K 230 RX	A/R	
Collaboration System, Wireless	Extron Or Equal	ShareLink 200N	1	
Document Camera, HDMI, interactive	Elmo Or Equal	TT-12iD	1	
CATEGORY: CONTROL				
Control Keypad	Extron Or Equal	MLC Plus 200	1	
CATEGORY: ACCESSORIES				
Wall Plate, HDMI	Extron Or Equal	PVT HDMI	1	
Wall Plate, HDMI/VGA	Extron Or Equal	PVT HDMI/VGA	1	
Projection Screen, Manual, 16:10, 109” Diagonal	Da-Lite Or Equal	Model B CSR	1	Include 119” Diagonal as alternate
Equipment Cabinet, Plenum-rated	Extron Or Equal	PlenumVault PVM220	1	

4. Standard Classroom Type 4 – Single projector, ceiling-mounted speakers

Description	Make	Model	Qty.	Notes
CATEGORY: AUDIO				
Speakers, ceiling-mounted	Extron Or Equal	SF—3C-LP	2	Provide option for FF120
Assistive Listening System	Listen Technologies Or Equal	Portable 72	A/R	
CATEGORY: VIDEO				
Video Projector, Laser, 5,400 LM	Panasonic Or Equal	PT-RZ570	1	Include lens, mounts and accessories
Video Projector, Laser, 6,500 LM	Panasonic Or Equal	PT-RZ670	1	Include as alternate
Standard Lens	Panasonic Or Equal	ET-DLE170	1	Include as alternate
Ultra-Short-throw Lens	Panasonic Or Equal	ET-DLE030	1	Include as alternate
Presentation System	Extron Or Equal	PVS407D	1	
Video Extender Set, HDMI, shielded CAT6 interconnect	Extron Or Equal	DTP T HWP 4K 231 D DTP HDMI 4K 230 RX	1	
Collaboration System, Wireless	Extron Or Equal	ShareLink 200N	1	
Document Camera, HDMI, interactive	Elmo Or Equal	TT-12iD	1	
CATEGORY: CONTROL				
Control Keypad	Extron Or Equal	MLC Plus 200	1	
CATEGORY: ACCESSORIES				
Wall Plate, HDMI	Extron Or Equal	PVT HDMI	1	
Wall Plate, HDMI/VGA	Extron Or Equal	PVT HDMI/VGA	1	
Projection Screen, Manual, 16:10, 109” Diagonal	Da-Lite Or Equal	Model B CSR	2	Include 119” Diagonal as alternate

Description	Make	Model	Qty.	Notes
Equipment Cabinet, Plenum-rated	Extron Or Equal	PlenumVault PVM220	1	

5. Special Classroom - Forum

Description	Make	Model	Qty.	Notes
CATEGORY: AUDIO				
Speakers, wall-mounted, with mounting accessories	Extron Or Equal	SM-26	A/R	Provide option for SM-28
Assistive Listening System	Listen Technologies Or Equal	Portable 72	A/R	
CATEGORY: VIDEO				
Video Projector, Laser, 6,500 LM	Panasonic Or Equal	PT-RZ670	2	Include mounts and accessories
Standard Lens	Panasonic Or Equal	ET-DLE170	2	Include as alternate
Ultra-Short-throw Lens	Panasonic Or Equal	ET-DLE030	2	Include as alternate
Presentation System	Extron Or Equal	PVS407D	1	
Video Extender Set, HDMI, shielded CAT6 interconnect	Extron Or Equal	DTP T HWP 4K 231 D DTP HDMI 4K 230 RX	A/R	
Collaboration System, Wireless	Extron Or Equal	ShareLink 200N	1	
Document Camera, HDMI, interactive	Elmo Or Equal	TT-12iD	1	
CATEGORY: CONTROL				
Control Keypad	Extron Or Equal	MLC Plus 200	1	
CATEGORY: ACCESSORIES				
Wall Plate, HDMI	Extron Or Equal	PVT HDMI	1	
Wall Plate, HDMI/VGA	Extron Or Equal	PVT HDMI/VGA	1	

Description	Make	Model	Qty.	Notes
Projection Screen, Manual, 16:10, 137" Diagonal	Da-Lite Or Equal	Tensioned Contour Electrol	2	Include 164" Diagonal as alternate
Equipment Cabinet, Plenum-rated	Extron Or Equal	PlenumVault PVM220	1	

6. Special Classroom - Theater

Description	Make	Model	Qty.	Notes
CATEGORY: AUDIO				
Speakers, wall-mounted, with mounting accessories	Extron Or Equal	SM-26	A/R	Provide option for SM-28
Assistive Listening System	Listen Technologies Or Equal	Portable 72	A/R	
CATEGORY: VIDEO				
Video Projector, Laser, 6,500 LM	Panasonic Or Equal	PT-RZ670	1	Include mounts and accessories
Standard Lens	Panasonic Or Equal	ET-DLE170	1	Include as alternate
Ultra-Short-throw Lens	Panasonic Or Equal	ET-DLE030	1	Include as alternate
Presentation System	Extron Or Equal	PVS407D	1	
Video Extender Set, HDMI, shielded CAT6 interconnect	Extron Or Equal	DTP T HWP 4K 231 D DTP HDMI 4K 230 RX	A/R	
Collaboration System, Wireless	Extron Or Equal	ShareLink 200N	1	
Document Camera, HDMI, interactive	Elmo Or Equal	TT-12iD	1	
CATEGORY: CONTROL				
Control Keypad	Extron Or Equal	MLC Plus 200	1	
CATEGORY: ACCESSORIES				
Wall Plate, HDMI	Extron Or Equal	PVT HDMI	1	

Description	Make	Model	Qty.	Notes
Wall Plate, HDMI/VGA	Extron Or Equal	PVT HDMI/VGA	1	
Projection Screen, Manual, 16:10, 137" Diagonal	Da-Lite Or Equal	Tensioned Contour Electrol	1	Include 164" Diagonal as alternate
Equipment Cabinet, Plenum-rated	Extron Or Equal	PlenumVault PVM220	1	

7. Special Classroom – Tech Lab

Description	Make	Model	Qty.	Notes
CATEGORY: AUDIO				
Speakers, wall-mounted, with mounting accessories	Extron Or Equal	SM-3	A/R	Provide option for SM-26
Assistive Listening System	Listen Technologies Or Equal	Portable 72	A/R	
CATEGORY: VIDEO				
Video Projector, Laser, 5,400 LM	Panasonic Or Equal	PT-RZ570	2	Include lens, mounts and accessories
Video Projector, Laser, 6,500 LM	Panasonic Or Equal	PT-RZ670	2	Include as alternate
Standard Lens	Panasonic Or Equal	ET-DLE170	2	Include as alternate
Ultra-Short-throw Lens	Panasonic Or Equal	ET-DLE030	2	Include as alternate
Presentation System	Extron Or Equal	PVS407D	1	
Video Extender Set, HDMI, shielded CAT6 interconnect	Extron Or Equal	DTP T HWP 4K 231 D DTP HDMI 4K 230 RX	A/R	
Collaboration System, Wireless	Extron Or Equal	ShareLink 200N	1	
Document Camera, HDMI, interactive	Elmo Or Equal	TT-12iD	1	

Description	Make	Model	Qty.	Notes
CATEGORY: CONTROL				
Control Keypad	Extron Or Equal	MLC Plus 200	1	
CATEGORY: ACCESSORIES				
Wall Plate, HDMI	Extron Or Equal	PVT HDMI	1	
Wall Plate, HDMI/VGA	Extron Or Equal	PVT HDMI/VGA	1	
Projection Screen, Manual, 16:10, 109" Diagonal	Da-Lite Or Equal	Model B CSR	2	Include 119" Diagonal as alternate
Equipment Cabinet, Plenum-rated	Extron Or Equal	PlenumVault PVM220	1	

2.03 CABLES AND WIRES

A. Provide cables and wires that are continuous - without splices.

B. Cable selection

1. Refer to functional diagrams for signal type between equipment.
2. Select a cable with the appropriate rating and configuration required by the applicable building code, electrical code, AHJ, and applicable codes and regulations governing the installation.
3. For cables that will be installed in conduit within on-grade concrete, select a cable rated for underground construction.
4. For cables that will be installed outdoors in underground conduit, aerial, and/or corrosive environments, select a cable rated for outdoor construction.
5. For signal extenders, use extender the manufacturer's recommended cable type and within the maximum cable run length to be used.

C. Unless otherwise called for in these specifications and drawings, the following cables are approved for the associated application or signal type. Ensure the chosen cable is appropriate for the signal type, available pathway capacity, and run length.

Application	Non-Plenum Product	Plenum Product
Ethernet	Refer to PCCD Telecom Standards	Refer to PCCD Telecom Standards
HDBaseT	West Penn 4246F Belden AV6SHR Extron XTP DTP 24 Superior Essex 6H-246-xA Or equal by Liberty, Crestron	West Penn 254246F Belden AV6SHP Extron XTP DTP 24P Superior Essex 6H-246-xB Or equal by Liberty, Crestron

Application	Non-Plenum Product	Plenum Product
Control cable	West Penn 77350 Liberty LLINX-U Or equal by Belden, Crestron	West Penn D25350 Liberty LLINX-U-P Or equal by Belden, Crestron
Microphone and line-level audio cable	West Penn 454 Liberty 20-2C-SH-GRY Or equal by Belden, Canare, Mogami	West Penn 25291B Liberty 20-2C-PSH-WHT Or equal by Belden, Canare, Mogami
Program loudspeaker cable	West Penn 227 Liberty 12-2C-GRY Or equal by Belden, Canare	West Penn 25227B Liberty 12-2C-P-BLK Or equal by Belden, Canare
Distributed loudspeaker speaker cable	West Penn 224 Liberty 18-2C-GRY Or equal by Belden, Gepco	West Penn 25224B Liberty 18-2C-P-BLK Or equal by Belden, Gepco
ALS emitter	See Antenna cable (wireless microphone) – 50-ohm, below	
Antenna cable (wireless microphone) – 50-Ohm	West Penn 813 Liberty RG8-CMR-BLK Or equal by Belden	West Penn 2598G8 Liberty RG8-CMP-BLK Or equal by Belden
Antenna cable (wireless microphone) – 75-Ohm	See CATV trunk and drop cables, below	
Analog video coaxial cable, RG59-type	Extron 815 Liberty RG59-CCTV-CM-BLK Or equal by Belden, Canare, West Penn	Extron 25815 Liberty RG59-CCTV-PL-BLK Or equal by Belden, Canare, West Penn
Serial digital coaxial cable	West Penn 819 Liberty 20-CMR-VIDEO-BLK Or equal by Belden, Gepco	West Penn 25825 Liberty 20-CMP-VID-COAX-BLK Or equal by Belden, Gepco
CATV trunk cable	West Penn 811 Liberty RG11-CATV-BLK Or equal by Belden, Gepco	West Penn 25821 Liberty RG11-CCTV-PL-WHT Or equal by Belden, Gepco
CATV drop cable	West Penn 806 Liberty 18-CMR-SD-BLK Or equal by Belden, Gepco	West Penn 25841 Liberty 18-CMP-VID-COAX-BLK Or equal by Belden, Gepco

2.04 CUSTOM REMOTE CONTROL PANELS AND INTERFACE PLATES

A. For custom remote control panels and interface plates, use 1/8 inch (3mm) thick #6061 T6 aluminum, with a brushed, anodized, black finish (or as approved by the Architect via submittals).

2.05 EQUIPMENT PLATES

A. For equipment plates, utilize 1/32" to 1/16" thick by 1/4" high aluminum with a brushed anodized black finish.

B. Provide engraved lettering 1/8" to 3/16" high.

2.06 EQUIPMENT LABELS

A. For equipment labels, utilize white, self-laminating, machine-printable, permanent adhesive-backed tape, 3/8” to 1/2” high.

B. Provide text using black 12-point Helvetica, or a visually similar, san-serif typeface.

C. Manufacturer, or equal:

1. Brady
2. Brother
3. DYMO XTL or Rhino
4. Panduit
5. Thomas and Betts

2.07 WIRE AND CABLE LABELS

A. Use either of the following label types for wire and cable labels:

1. Tape – machine-printable, wrap-around, self-laminating, permanent adhesive-backed tape
2. Machine-printable, shrink-wrapped labels

B. Provide labels with a white face stock (print area).

C. Size as needed per wire/cable size.

D. Provide labels that meet UL 969 requirements.

E. Manufacturer, or equal:

1. Brady
2. Brother
3. DYMO XTL or Rhino
4. Panduit
    a. #S100X075YAJ; self-laminating cable label, white face stock 1" wide, diameters 0.08"-0.16"
    b. #S100X125YAJ; self-laminating cable label, white face stock 1" wide, diameters 0.12"-0.28"
    c. #S100X150YAJ; self-laminating cable label, white face stock 1" wide, diameters 0.16"-0.32"
    d. #S100X225YAJ; self-laminating cable label, white face stock 1" wide, diameters 0.24"-0.48"

2.08 RACK BONDING

A. Rack busbars

1. Application: for consolidating bonding connections to approved ground, with pre-drilled holes for approved bonding connections.
2. Material: Copper (referred) or copper alloy

3. UL Listed
4. Manufacturer, or equal:
    a. CPI #10610-019; horizontal rack busbar, 19"
    b. CPI #40160-036; vertical rack busbar, 36"
    c. CPI #40160-072; vertical rack busbar, 72"

B. Bonding conductors
1. Type: THHN (THWN will be accepted)
2. UL Listed as type THHN per Standard 83.
3. Conductor: soft drawn annealed copper, stranded
4. Gauge: 6 AWG, minimum, or as shown on the drawings
5. Insulation: PVC, high-heat and moisture resistant
6. Jacket: Nylon, abrasion, moisture, gasoline and oil resistant
7. Color: green
8. Flame Resistance: Meet the flame resistance requirements of IEEE 383, CSA FT-4 and UL VW-1.
9. Manufacturer, or equal:
    a. Southwire

C. Bonding connectors
1. Two-hole, standard (or long) compression-type barrel lug, 1/4" dia. x 5/8" on center
2. UL Listed, for the purpose used
3. Manufacturer, or equal:
    a. Panduit #LCD6-14A-L, compression lug for 6 AWG conductor
    b. Thomas & Betts #54205, compression lug for 6 AWG conductor

PART 3 - EXECUTION

3.01 GENERAL

A. Perform work in accordance with the standards and best practices defined by the InfoComm International coursework for Installation 1: System Fabrication and Installation 2: Setup and Verification.

B. Install products per manufacturers' instructions.

C. Install panels, equipment, boxes, etc., plumb and square.

D. Seismic safety:
1. Mount, anchor and/or brace permanently-installed equipment to the building structure using anchors, fastenings, supports, and methods approved by structural engineer with a safety load factor of at least 1.5. Provide installations that meet the most stringent of applicable codes and regulations to minimize potential damage to personnel and equipment from foreseeable seismic events.
2. Brace hanging audiovisual and associated equipment both to minimize sway and to prevent detachment from the overhead structure in accordance with applicable codes.
3. Firmly secure equipment in place unless requirements of portability dictate otherwise.

3.02 EXAMINATION

A. Prior to starting the work of this section, examine areas to receive system components and pathways to receive cabling to verify conditions are ready for work of this section and to verify conformance with manufacturer and specification tolerances.

1. Verify that pathways, including conduit, junction boxes, cable trays, ceiling enclosures, etc., are in place prior to placing cables into pathways and as required by applicable codes.
2. Verify that rough-in (including conduit, device boxes, floor boxes, and the like) is ready to receive wiring, cabling, devices, equipment, and the like prior to installing into the rough-in.
3. Verify that electrical power service is ready and stable prior to connecting equipment.
4. Check ceiling types, ceiling heights, and clearances above ceilings to ensure conditions are appropriate per manufacturer's installation requirements.

B. Verify that the network is operational and ready to receive connection from and configuration for the System. "Ready" includes settings on the network required for the System to function properly. Coordinate with the network contractor as needed to ensure the network settings have been adjusted to support full functionality of the System.

C. Proceed with installation work only after unsatisfactory conditions are corrected.

3.03 INSTALLATION

A. Plenum-type equipment racks / enclosures

1. Completely assemble equipment racks / enclosures. Include parts and accessories, such as electrical power distribution devices, cable dressing accessories, and blank and vent panels, required for a complete result.
2. Anchoring/bracing: Anchor enclosures to the underside of the slab at four points per approved structural details using anchors and methods approved by a structural engineer.
3. Bonding/Grounding: Connect the equipment rack frame to an approved ground point using a bonding conductor (12 AWG up to 6 AWG) and approved connectors. (Here, an approved ground point may be the ground of the branch circuit serving the rack or an approved conductor to the ground bus of the electrical panel serving the rack.)
4. Cooling provisions: Coordinate cooling provisions (means to prevent equipment from overheating) within rack/credenza/etc., such as inlet and exhaust openings, exhaust fans, etc. All of the installed equipment must be capable of working continuously with the enclosure closed normally while staying within manufacturers' operating temperature specifications. Acceptance testing will include temperature verification.

B. Projection systems

1. Projector Supports
   a. Anchor poles to structure using means approved by a structural engineer.
   b. Install lateral and/or transverse bracing to poles for seismic bracing as required.
   c. Securely install mounts onto poles using compatible adapting components.
2. Projectors
   a. Securely install projectors to mounts.
   b. Fully assemble and install projectors, lenses, and mirrors such that the final condition will be no observable movement in the image induced by motor vibration or other mechanical operations.

c. Install accessories onto mounts or projectors using approved attachment methods that guarantee the longevity of the installation. Accessories may be attached mechanically, if allowed by the projector/mount manufacturer, or by using 3M TB3571/3572 hook and loop fastener tape or an approved equal.

3. Align projection systems so projected images fill the viewing areas of the associated projection screens and exhibit no geometric distortion.
4. Only use physical and/or optical adjustments to correct geometric distortion.
5. Only use electronic or digital correction when called for in this document package.
6. Confirm that the total averaged light output from all projectors, in lumens, is at least 85% of that specified by the projector manufacturer.
7. Confirm that the light falloff from the center of the projected image to four corners, as measured at the projected image plane, does not exceed 50%.

C. Loudspeaker tap settings

1. Where loudspeaker tap wattages are specified in the design documents, set transformers per these. Otherwise, set taps per best practices.
2. Set taps such that the total wattage of a series of loudspeakers will not exceed 75 percent of the associated amplifier's rated wattage.
3. Record tap settings per loudspeaker for inclusion on the as-built drawings.

D. Loudspeakers, wall recessed mounted

1. Prior to installing loudspeakers, line niches using glass fiber loosely filled to 2 pounds per cubic foot density.
2. Provide cabling service loops to allow loudspeakers to be removed from niches prior to disconnection.

E. Loudspeakers, wall surface-mounted

1. Install loudspeakers per manufacturers' recommendations and the design documents.
2. Install loudspeakers plumb and square.
3. Use security mounting hardware where loudspeakers will be mounted below 10' AFF.
4. Provide security cables per codes and best practices.
5. Where manufacturer labels are visible on loudspeaker grills and are rotatable, align these to read correctly.
6. Where loudspeakers will be exposed to humidity or water spray, ensure water will not be able to penetrate cable connections.

F. Loudspeakers, acoustical tile ceiling mounted

1. Coordinate ceiling tile work (such as cutting holes) with the ceiling contractor.
2. Unless directed otherwise, center ceiling loudspeakers to ceiling tiles and evenly space loudspeakers.
3. Cut ceiling tiles to fit loudspeaker such that no gaps are visible after the loudspeaker cover/grille is installed.
4. Install ceiling loudspeakers with safety wires attached to the building structure per applicable codes and best practices.
5. Use tile rails and other support components to ensure loudspeakers do not sag.

6. Where manufacturer labels are visible on loudspeaker grills and are rotatable, align these consistently.
7. Replace ceiling tiles damaged during loudspeaker installation work.

G. Loudspeakers, gypsum ('hard lid') ceiling mounted

1. Coordinate ceiling work (such as cutting holes) with the framing contractor.
2. Unless directed otherwise, align and evenly space loudspeakers.
3. Cut wallboard to fit loudspeaker such that no gaps are visible after the loudspeaker cover/grille is installed.
4. Install ceiling loudspeakers with safety wires attached to the building structure per applicable codes and best practices.
5. Where manufacturer labels are visible on loudspeaker grills and are rotatable, align these consistently.

H. Cabling and wiring – at racks

1. Do not use electrical tape for bonding, splicing, joining, or any other purpose.
2. As a general practice, run power cables, control cables, and other cables with higher voltage levels on the left side of an equipment rack as viewed from the back; run other cables with lower voltage levels on the opposite side. Where wiring issues or wire routing facilities preclude this configuration, it is acceptable to deviate from the directions above, if separation is maintained between signal and electrical power cables.
3. To reduce signal contamination, group cables per the signals being carried. Maintain appropriate distances between cable groups, especially between high-current (power; loudspeaker) and low-current (microphone) groups. Form separate groups for the following cables/signal types:
    a. Power
    b. Control
    c. Analog video
    d. Digital audio and video
    e. Analog microphone audio
    f. Analog line audio
    g. Loudspeaker audio
    h. Radio frequency
4. Within racks, install wires and cables with service loops. Provide sufficient cable to allow each piece of equipment to be removed from the front of the rack for servicing.
5. At boxes or points of termination, install wires and cables with service loops. Provide sufficient cable to allow each piece of equipment to be removed and laid flat on a surface for servicing.
6. At slide-out equipment racks, dress cables to allow racks to be extended to the maximum length of the rack slides. For slide-out rotating racks, provide sufficient cable to allow full extension and rotation.
7. For cables that interface with racks, cabinets, consoles, or equipment modules, use screw-type terminal blocks, terminal strips, or connectors. Telephone-style punch-down blocks (e.g., 110 blocks) are not acceptable.
8. Do not bend any cable or wire tighter than the manufacturer's minimum bend radius.
9. Install wires and cables such that the cable exerts no strain on its termination.
10. Label wires and cables, regardless of length, using a cable label with a unique number or letter per the instructions below under "Labeling".

11. Cable Shield Bonding: For cables with shields, connect them using approved connectors per an approved grounding topology.
12. Encase umbilicals connecting moveable racks and cabinets to walls and other fixed locations in braided sleeving. Where racks and cabinets are installed in view of non-technical people, coordinate sleeving colors with the Architect.

I. Cabling and wiring – overhead distribution

1. Use cabling appropriate to loudspeaker impedance, cabling distance, and installation conditions (such as plenum versus non-plenum).
2. The use of electrical tape for bonding, splicing, joining, or any other purpose is prohibited.
3. Provide cable runs between termination points that are continuous, with sheath continuity. Splices are not permitted anywhere.
4. Place cables within designated pathways, such as cable tray, cable hangers, etc. Do not fasten cables to other building infrastructure (such as ducts, pipes, etc.), other systems (such as ceiling support wires, wall studs, etc.), or to the outside of conduits, cable trays, or other non-approved pathway systems.
5. Protect cables from physical interference and damage during installation and termination. Install cables with no kinks or twists.
6. Install HDBaseT cables within manufacturers' length recommendations.
7. Comply with manufacturers' limits for pulling tension.
8. Do not use cable-pulling compounds for indoor installations.
9. Install cables within manufacturers' bend radius limits. If no minimum bend radius is given, then maintain a minimum bend radius of six times the cable diameter during and after installation.
10. Route cables under building infrastructure (such as ducts, pipes, conduits, etc.); do not route cables over building infrastructure. Install cables to provide accessibility for future service.
11. Place cables 6", minimum, away from power sources to reduce interference from EMI.
12. Connectors: Use the following connectors:

Category	**Subcategory**	**Type**	**Acceptable Manufacturers**				**Comments**
Audio	Low-level	RCA / S/PDIF	Switchcraft	Pomona			
Audio	Low-level	3.5mm TRS	Switchcraft	Neutrik	Amphenol		
Audio	Low-level	1/4" TS/TRS	Switchcraft	Neutrik	Amphenol		
Audio	Low-level	XLR	Switchcraft	Neutrik	ITT Cannon		
Audio	Low-level	Combo XLR/TRS	Neutrik				No substitutions
Audio	Low-level	TA-series (mini XLR)	Switchcraft				No substitutions
Audio	Low-level	Microdot	Lemo				
Audio	Microphone, no mute control	XLR-3	Switchcraft	Neutrik	ITT Cannon		
Audio	Microphone, with mute control	XLR-5	Switchcraft	Neutrik	ITT Cannon		
Audio	Microphone under table or desktop, no mute	R3F	Switchcraft	Neutrik	ITT Cannon		

Category	Subcategory	Type	Acceptable Manufacturers				Comments
Audio	Microphone under table or desktop, with mute	R5F	Microphone under table or desktop, no mute				
Audio	Low or high-level	Phoenix	Phoenix Contact				
Audio	High-level	Banana	Pomona	GC Electronics			
Audio	High-level	Speakon	Neutrik	Switchcraft			
Video	50-ohm	BNC	Kings	AMP - TE Connectivity	Trompeter	Amphenol	
Video		Triax	Trompeter				
Video		HDMI bulkhead barrel	Switchcraft	Cliff	Neutrik	Harting	
Video		HDMI cable	Extron	Crestron			
Video		DisplayPort cable	Extron	Crestron			
Video		Mini DisplayPort/ Thunderbolt cable	Extron	Crestron	Apple		
Video	D-sub	HD-15 ("VGA") cable	Extron	Crestron	Cables to Go		
RF	75-ohm	BNC	Kings	AMP - TE Connectivity	Trompeter	Amphenol	
RF		F-type	Belden	Amphenol	Liberty	Digicon	
RF		UHF	Amphenol				
Control	D-sub	DB-9, DB-25	Amphenol	TE Connectivity			
Control	Phoenix		Phoenix Contact				Or as provided with equipment
Control	Modular	4p4c plug	Cinch Connectivity	Molex	TE Connectivity	Hirose	
Control	Modular	8-contact	Ortronics	Panduit	Belden	Molex	
Control	USB cable	A, B, C types	Extron	Crestron	Hosa	Belkin	
Control	Crimp	Fork lug	TE Connectivity	Molex	Phoenix Contact		
Control		XLR	Switchcraft	Neutrik	ITT Cannon		
Control		DIN	CUI	Hirose			
Control	etherCON	RJ45	Neutrik				
Fiber		FC	Molex	TE Connectivity	3M		
Fiber	opticalCON	Click-on duplex	Neutrik				
Fiber		LC	Molex	TE Connectivity	3M		

Category	Subcategory	Type	Acceptable Manufacturers				Comments
Fiber		LC Duplex	Molex	TE Connectivity	Conec		
Fiber		SC	Molex	TE Connectivity	3M		
Fiber		SC Duplex	Molex	TE Connectivity	3M		
Fiber		SMA	Industrial Fiberoptics	TE Connectivity	Phoenix Contact		
Fiber		ST	Molex	TE Connectivity	3M		
Fiber		TOSLINK	Tripp Lite				

J. Terminations and Cords at Floor Boxes

1. Provide strain relief for cables. Use appropriate cable management products (such as hook and loop straps for UTP and STP cabling, and nylon cable ties for other cables) to group similar cable types.
2. Provide permanent labels on cables within 6" of terminations.
3. Provide permanent labels on receptacles within floor boxes to clearly identify terminations and services.
4. Encase umbilicals connecting moveable racks, cabinets, etc., to floor boxes in braided sleeving. Where racks and cabinets are installed in view of non-technical people, coordinate sleeving colors with the Architect.

K. Blank panels: Provide blank trim plates in floor, wall and furniture-mounted boxes at unused termination positions. Fill each module opening filled, either with a receptacle, a receptacle plate, or a module of the type the opening is intended to house.

L. Patch panels

1. Assignments: Wire patch panels so that signal sources appear on the upper row of a row pair; and destinations appear on the lower row of a row pair. Submit variations from this approach per the requirements in Submittals.
2. Designation strips: Utilize alphanumeric identifications and descriptive information on audio and video patch panel designation strips. Number the jack positions in each row sequentially from left to right. Letter the jack rows sequentially from top to bottom. Include the alphanumeric identification of each jack on the functional block drawings. Mount reproductions of these drawings in an appropriate location near the patch bays.

3.04 EDID MANAGEMENT

A. For each system, determine the maximum pixel resolution, frame rate, and color depth supported by all content displays, and designate this as the target resolution for the system. Omit digital signage displays from this process.

1. Scalers: Configure video scalers as follows:
   a. Input: Emulate the EDID configuration of the native resolution of the connected display or projector for both analog and digital inputs.
   b. Output: Configure to match the native resolution of the display system and at the highest supported scan rate.

B. Determine the system’s maximum audio parameters – output channel count, LFE capabilities, etc.

C. Configure the system's EDID management to ensure that these audio and video parameters are sent to source devices.

3.05 HDCP MANAGEMENT

A. Include HDCP support in all equipment that incorporates copy protection for the transport of copyrighted media.

1. Installation requirements
    a. Equipment capable of passing HDCP included in this project must support the same HDCP version (i.e. HDCP 1.4 or HDCP 2.2).
2. Exceptions
    a. HDCP may be defeated for educational institution projects per 'fair use' copyright terms.

3.06 NETWORK SECURITY

A. Leave no network-connected device operating with its factory-default password.

B. Obtain Owner defined password changes for all network-connected devices. Program these passwords into the devices.

C. Where available, enable two-factor authentication.

3.07 PROGRAMMING AND EQUIPMENT CONFIGURATION

A. General Programming

1. Install the most current version of manufacturers' firmware on devices.

B. Audio Processor Programming

1. The following instructions apply to all systems including programmable audio processors and microphones.
2. Make equalization and other room tuning adjustments to obtain the flattest, and least colored result the system is capable of.
3. After tuning the system, perform other adjustments, such as dynamics, AEC, etc.

C. Control System and Touch Panels

1. Owner's requirements
    a. Meet with the Owner and document their functional and user interface requirements (backgrounds, color scheme, screens, menus, functions, etc.).
    b. Develop programming and user interfaces based on the user requirements.
    c. Submit touch panel layouts and menu flow documentation to the Owner and Engineer per submittal schedule.
    d. Meet with the Owner and Engineer and present the control system programming and user interfaces. Obtain the Owner's approval on these items.
2. Programming guidelines
    a. Create initial screens (splash screens) that use a version of the Owner's logo, generated without visible scaling artifacts.
    b. Only use red for alarm indicators and other screen elements of special significance.
    c. Avoid use of technical terms, rather, use clear, everyday language. For example, instead of "System On", use "Turn System On"; instead of "Power Down", use "Turn Power Off", etc.

d. Ensure soft buttons are sized consistently and spaced evenly.
e. Ensure spelling, punctuation, and grammar are 100% correct.
f. Provide menus on both touch panels and control system web pages that appear and function consistently throughout the project.
g. Ensure items with similar functions appear consistently in all menus.
h. Provide soft button presses that display visual feedback, and if required by the Owner, audible feedback.

3. Tech menu: Provide a "tech" menu for each touch panel. Include in tech menus:
   a. Volume control for button audible feedback
   b. Screen brightness
   c. A means to change the tech screen password; obtain from the Owner's Representative a default password for all touch panel tech menus
   d. Other technician-specific functions required for each system
4. Make IP control system devices (touch panels, controllers, processors, etc.) accessible and controllable via the network and via web access. For example, users and/or technicians shall be able to operate touch and pushbutton panel functions remotely Coordinate with the Owner's Representative to ensure a successful implementation of this requirement.
5. In AV-equipped rooms with an operable partition, program the AV system to use signals from the rooms' partition sensors to automate audiovisual system combine/divide functions.

D. Power control and sequencing

1. Whether explicitly listed in this specification or not, provide power control interfaces, e.g., remotely controllable PDUs, for equipment and devices that are not equipped with integrated power control. Provide power control interfaces that are fully compatible with the specified control system. Follow this directive for devices, such as audio power amplifiers, which would not be adversely affected by external power controls. Omit such power controls for devices, such as transmitters and receivers, that should not be externally power controlled.
2. Configure non-controlling items to power off or go into a standby/low power-consumption mode when systems are powered off. At minimum, program the AV system to power off the following types of devices when not in use.
   a. Audio processors
   b. Audio amplifiers
   c. Displays
   d. Projectors
3. Configure devices that detect connection to user devices to stay in standby/low power-consumption mode when audiovisual systems are turned off.
   a. Video switchers and processors
4. When turning systems on, use the following sequence for audio components.
   a. Turn on source devices.
   b. Turn on processing and routing devices.
   c. Turn on amplifiers.
5. When turning systems off, use the following sequence for audio components.
   a. Turn off amplifiers.
   b. Turn off processing and routing devices.
   c. Turn off source devices.

E. Network connection

1. Connect all network-connectable equipment and devices to the network. Program them to electronically issue notifications for preventative maintenance (e.g., replace a projector lamp).

2. Coordinate with the Owner's Representative which devices are to provide notification (e.g., email notification) immediately at the time of a fault and which devices will provide notifications on a daily or weekly report.

3. Coordinate with the Owner's Representative to obtain the default notification means (e.g., the email address for maintenance messages).

4. Ensure the Owner's Representative can revise the maintenance email address via a simple method – using a single address for all networked AV devices. Document this procedure in the Operations Manual.

F. Equipment configuration:

1. Blu-ray disk players: Set color space to RGB.

2. Computer interfaces, signal extenders and transmitters with integral input switching: Program each device and related system components involved so that the analog audio input is active regardless of which video input is selected.

3.08 LABELING

A. Provide labeling identifiers that match closeout documentation (e.g., as-built drawings, O&M Manual, etc.).

B. Clean and degrease surfaces receiving nameplates and labels prior to affixing labels.

C. When creating labels for user-facing equipment and cables, use colored labels where possible. Example uses are floor boxes, table boxes, cameras, displays, and user-facing cables. Use color coding to relate labels to related components, i.e., match the text and color on each user-facing cable, its corresponding button on the button panel, and its corresponding input on the display. Example: HDMI 2 cable has a yellow label printed with "HDMI 2", the button panel at the table box has a yellow "HDMI 2" label and the input on the display has a yellow label printed with "HDMI 2".

D. Interface plate designation

1. Provide wall-mounted interface plates with clearly engraved alphanumeric identification of input type (e.g., "MIC-1", "LINE IN", "SPEAKER", "VIDEO", etc.) and corresponding patch field designation.

E. Equipment enclosures

1. Install the label on the top of the rack or cabinet, centered horizontally.

2. Example: line 1: "AV-01", line 2: "Audiovisual Devices".

F. Equipment

1. Rack-mounted equipment: Install labels in visible locations on equipment and devices on the front and back of the equipment.

2. Field equipment: Install labels in visible locations on miscellaneous field equipment and devices.

G. Wireless transmitters and receivers

1. Label wireless transmitters and receivers so users can clearly identify a given transmitter associated with its receiver.

2. Use an identifier, such as a room number, that associates each transmitter with a given room or system.
3. Example: RM.230–MIC.3–RCVR.1

H. Wire and cable

1. Comply with the Owner's labeling requirements. If the Owner does not have labeling requirements, conform with InfoComm F501.01.
2. Provide labels with machine-generated text; hand-written labels will not be accepted.
3. Provide labels with black text 1/8" high or #12 font size.
4. Generate a unique identifier for each cable and wire using the system defined in the InfoComm F501.01 standard. Include "primary level" data elements (per F501.01); "secondary level" (per F501.01) data elements are optional.
5. Install labels on both ends of cables no more than 4" from the edge of the cable. Install labels such that they are visible by a technician from a normal stance.

I. Patch panels

1. Using two-line designations, indicate groups of outputs on upper rows of top ports and inputs on lower rows of bottom ports.
2. Example: line 1, "Mixer Mic Inputs"; line 2, "In-1 | In-2 | In-3 | In-4, etc."

J. Batteries

1. Label batteries with the month and year they were installed.
2. Example: "Installed April 2017"

3.09 FIELD QUALITY CONTROL

A. Initial tests and measurements: Prior to final adjustment and scheduling acceptance testing, perform initial tests and measurements. At minimum, include the following initial tests and measurements:

1. Adjust, balance, and align equipment for optimum quality and to meet manufacturers' published specifications.
2. Perform the test procedure provided at the end of this specification and return the completed form no less than one week prior to the initial punch walk.
3. For rack-mounted equipment with user-accessible controls, install 1/8" diameter vinyl "map dots" as indicators for nominal operating positions of rotary, slider, and other accessible controls. Provide multiple dots, adequately distinguished, for controls having more than one nominal operating position.

B. Twisted-pair cable testing: Follow the following procedures to test CATEGORY-type twisted pair cabling.

1. Equipment, or equal:
   a. Fluke DSX CableAnalyzer
2. Test procedure:
   a. Configure the cabling and test set up as a permanent link.
   b. Test each cable under a TIA-568 Permanent Link test script to match the category of the installed cabling.

C. Digital video cabling: Follow the following procedure to test each provided digital video cable.

1. HDMI: Quantum Data 780, or equal

2. DVI/SDI/HD-SDI: Quantum Data 882D, or equal
3. DisplayPort: Quantum Data 882E-DP, or equal
4. Test Procedure:
    a. Test each cable.
    b. Replace all cables that fail.

D. Audio system:

1. Loudspeaker line impedance: Measure the impedance at 63 Hz, 250 Hz, and 1 kHz and the resistance of each loudspeaker line leaving the sound equipment rack with the line disconnected from its normal driving source. For lines to full range distributed loudspeaker systems, measure impedance at 1 kHz.
2. Hum and noise level:
    a. Measure the hum and noise levels of the overall system for each microphone input channel and line level input channel.
    b. Adjust gain controls for optimum signal to noise ratio so that full amplifier output is achieved with 0 dBm at a line level input.
    c. Terminate line level inputs with resistors of 150 and 600 ohms, respectively, for these measurements.
    d. Disconnect the loudspeaker lines and terminate the power amplifier outputs with power resistors for these measurements. Use load resistors within 5% of the nominal load impedance of the amplifier under test. Use resistors with power ratings equal to or greater than the power rating of the amplifiers.
3. System frequency response:
    a. Measure audio system frequency response for the AV systems described in Part 1. Adjust systems to provide specified performance.
4. Uniformity of coverage:
    a. Using a calibrated testing device, measure octave bands using a pink noise test signal played through the loudspeaker system(s).
5. System power output and signal level adjustment:
    a. Measure the electrical distortion of the overall system for each line level input channel.
    b. Adjust gain control as for the tests specified herein.
    c. Apply a 1 kHz sine wave signal from a test signal generator having less than 0.5% total harmonic distortion at the input tested, at a level required to produce full amplifier output. Note that a pad with 150-ohm output impedance is required for driving the microphone level input in accordance with the EIA standard.
    d. Use a distortion analyzer to measure the output level and total harmonic distortion of the audio equipment. In the absence of a distortion analyzer, a high input-impedance measuring device such as a DMM may be used to measure the output level.
6. Loudspeaker polarity
    a. Perform loudspeaker line polarity checks using a polarity tester or use DC source at one end of each line and a voltmeter at the other end. Confirm that loudspeaker lines are correctly polarized with respect to color coding.
    b. Confirm loudspeaker polarity using a polarity tester.
7. Freedom from parasitic oscillation and radio frequency pickup:
    a. With systems set up for each mode of operation specified in the Part 1, confirm that systems are free from spurious oscillation and radio frequency pickup, in the absence of audio input signal and when the system is driven to full output at 100 Hz.

b. Confirm these tests audibly and by using an oscilloscope having at least 5 MHZ bandwidth.

c. Apply a slow sine wave sweep from 50 Hz to 5 kHz at a level of 6 dB below rated power amplifier output to each system. Listen carefully for buzzes, rattles and objectionable distortion.

d. Correct causes of these defects unless the cause is clearly from other than the sound amplification system's equipment and installation, in which case bring the cause to the attention of the Owner and Architect.

8. Audio test signal paths: Verify operation from source inputs through system components to signal destinations.

E. Analog composite video system:

1. Signal to noise: Operate the system using an RS-170A test signal. Measure and document output noise levels using a composite video distortion analyzer.

2. Differential gain: Using an RS-170A step test signal and a waveform monitor, measure chrominance, luminance, and normal synchronizing and blanking signals. Measure variations in chroma subcarrier amplitude at 10%, 50%, and 90% luminance.

3. Differential phase: Operate the system as indicated above and measure chroma subcarrier phase variations at 10%, 50%, and 90% luminance.

F. Projection systems:

1. For each projection system, measure light intensity at the screen’s center and four corners. Take corner measurements 5% of the image area width and height in from image edges.

2. Use a properly calibrated foot-candle (or lux) meter with cosine correction for the above measurements.

G. Control systems:

1. Verify all operational functions at each fixed control interface position.

2. Verify all operational functions of provided wireless control devices.

3. Verify all operational functions of the control system and interfaced devices.

H. Radio frequency (RF) systems:

1. Connect an analog-capable TV to each system outlet. Make a subjective evaluation of picture quality and verify that no visible components of cross modulation, ghosting, or beat interference appear when the receiver is tuned to each of the desired channels.

2. Using an RF signal strength meter, record the signal levels in dBmV of modulated carriers transmitted through the system at representative outlets.

3. RF Test Signal Paths: Verify proper system operation from source inputs to the head end, including antennas, CATV feeds and modulators, through line amplifiers, splitters, and directional couplers, to system outlets.

3.10 CLEANING, PROTECTION AND REPAIR

A. Remove temporary coverings and protection of adjacent work areas. Remove unused, excess, and left over products, debris, spills, or other excess materials. Remove installation equipment.

B. Leave finished work and adjacent surfaces in neat, clean condition with no evidence of damage.

C. Repair or replace damaged installed products.

D. Legally dispose of debris.

E. Clean installed products in accordance with manufacturer's instructions prior to Owner's, or Owner's Representative's, punch walk.

F. During the installation and up to the date of final acceptance, protect finished and unfinished work against damage and loss. In the event of such damage or loss, replace or repair such damaged work.

3.11 SUBCONTRACTOR MANAGEMENT

A. Continuously supervise subcontractors during the installation; intermittent supervision is not acceptable.

3.12 SYSTEM ACCEPTANCE TESTS

A. Perform system acceptance tests after completion of initial system checkout and after submitting the Initial Testing and Tuning Report.

B. Prior to setting up a demonstration and/or punch walk with the Engineer, ensure that the System/Systems are complete, operational, and fully functioning, and that pre-functional and functional testing have been completed. Fees for any additional punch walks resulting from incomplete and/or non-functioning Systems may be assessed.

C. System acceptance tests consist of the following:

1. Take a physical inventory of equipment on site and compare it to equipment lists in the contract documents.
2. Demonstrate the operation of system equipment.
3. Perform both subjective and objective tests to determine compliance with the specifications. Provide test equipment specified for these tests.
4. Provide final, "as built" drawings, run sheets, manuals, and other required documents, as detailed in Part 1.
5. Provide complete testing reports generated by subsystems that provide self-testing.
6. Perform power on/off cycles to ensure these take place with no audible and only minimally visible artifacts, pops, etc.

D. Initial Testing and Tuning Report

1. Perform the following tests for each system unless otherwise noted in Part 1.
2. Use additional pages as necessary to allow complete comments.
3. Where blanks are provided in the checklist below, observe the associated value in parenthesis.

Test	Description	Result	Comment
1	Record equipment that was specified but is not present. Provide a reason why this equipment is not present.		
2	Confirm no sharp or jagged surfaces are accessible to users and technicians.		
3	Confirm that each active device's external temperature, measured using a non-contact thermometer, is within manufacturer's guidelines.		

Test	Description	Result	Comment
4	Perform and log cable inspection. Confirm each cable is labeled, dressed, included in a bundle with cables with like signals, not under stress, is serviceable, is correctly strain-relieved, is not bent beyond manufacturer's recommended bend radius, does not have tie wraps tensioned excessively or used inappropriately. Confirm labels are positioned and oriented consistently and are legible and unambiguous.		
5	Demonstrate that the full inventory is new equipment, in full compliance with the specification, or as modified by approved submission. Record test results as pass/fail, and list exceptions.		
6	Confirm rack elevation and single-line drawings, cable and other labels and engravings are an accurate model of the furnished system, and comply with latest revised specifications. Record test results as pass/fail.		
7	Confirm switcher inputs and outputs are labeled (wherever possible), so that users can easily make manual routes quickly without having to refer to the system drawings.		
8	Confirm amplifier channels are properly labeled, so technicians can make quick adjustments without having to refer to the system drawings.		
9	Confirm rack mounted equipment is labeled and that the labels match those on the drawings (equipment symbols and/or description), control system, field plates, patch panels, and any labels associated with the system.		
10	Confirm modular terminations are solid in their connectors.		
11	Confirm each coax cable respects the manufacturer’s minimum bend radius or at least 5x the cable’s diameter.		
13	Confirm power amplifiers are working within rated load. *Record the impedance (and at what frequency) of each loudspeaker line on each power amplifier at 63, 250, and 1,000 Hz.*		
14	Using appropriate test signals, have the sound system produce a nominal operating level of __(65) dB SPL for conference speech, __(60) dB SPL for program material, “A” weighted at all listeners’ ears ±__(2) dB ("Uniformity of Coverage") (or at least __(15) dB above the ambient noise, A-weighted, whichever is greater), with the control system volume control indicating "normal" or default setting. *Record results for each channel and source.*		

Test	Description	Result	Comment
15	Confirm the system is capable of producing an additional __(15) dB above this level (__(80) dB SPL) for each audio source, with less than 0.5% THD (Total Harmonic Distortion) plus noise. *Measure THD plus noise when source is at __(15) dB above nominal operating level at each "destination", for all sources selected.*		
16	Confirm the system develops a noise level that is electrically __(55) dB below the normal operating level for all audio sources. "Noise" refers to the aggregate of hum, electrostatic noise, RF interference, etc. *Measure and record Signal to Noise ("signal" measured electrically at nominal operating level at each destination, for all sources selected.*		
17	Confirm program loudspeakers are connected in the same polarity, and speech reinforcement systems are polarized such that a positive acoustic pressure on a microphone results in a positive acoustic pressure at the loudspeaker ("Polarity Test").		
18	Confirm the system produces no more than a __(1) dB variance in program source levels when each program source is playing audio from a calibrated medium (CD, test signal generator, etc.)		
19	Confirm there is no audible vibration caused by improper mechanical installation. *Use a continuous sweep signal at headroom level (from an audio test signal generator or test CD.) Provide a pass/ fail result and document which device fails and the frequency of these artifacts.* ("Buzzes and Rattles Test").		
23	Confirm equalizers, whether hardware or virtual, are adjusted for best intelligibility, and in accordance with any preferred acoustic level response curves. *Record the "house curve" before equalization, as well as after the equalizers have been tuned, with and without microphone input filters. If requested by the Consultant, produce this documentation for systems without equalizers, as this test may apply to the preamp filter settings in cases where intelligibility can be improved.*		
24	If required, confirm system intelligibility, with a RSTI (Rapid Speech Transmission Index) greater than 0.85.		
28	Where several displays are visible in the same space, confirm picture tonal consistency across all of them. For composite video signals, use NTSC color bars with PLUGE signal to all. For digital video signals use a colorimeter and test color signal software to confirm consistent images		

Test	Description	Result	Comment
29	Confirm projectors are focused, centered, and evenly illuminated. *If requested, confirm using a calibrated light meter that the brightest measurement locations are no more than +10% above average, and the dimmest locations no less than –5% below average measurement. If requested, document that geometric distortion is within 2% tolerance. Take actual measurements if necessary (top, bottom, left, right dimensions of white portion of screen) and photograph if necessary.*		
30	Confirm that the system displays with stability, and with no scaling-related visual artifacts when switching between, at a minimum, the resolutions specified in 1.04 D. Record test results.		
31	Where HDMI, DVI, or DisplayPort signals are included in the system, confirm that an acceptable signal is being displayed on the monitor from each source position. Use the Alt Pixel test image (pixel-on, pixel-off) for each resolution included in the design intent: 1,920x1,200@60, 1,920x1,080@60, 1,280x720@60, as required. Inspect each, leaving the signal on for three minutes. Confirm that no artifacts are visible. For systems including 4k displays, test also at 3,840 x 2,160 and 4,096 x 2,160. Note: If the signal is going to a codec, disable HDCP. If the signal is going to a display, enable HDCP unless specified otherwise in Part 1.		
32	Using a signal generator, confirm scaler and display/projector configurations by successfully passing video at the resolutions defined in 1.04 D.		
33	Confirm HDCP is maintained from sources to destinations except as excluded above. Confirm EDID is managed correctly and that devices output at resolutions supported by the system.		
34	Confirm the control system controls all of the required equipment as specified. Confirm system performs with stability and in sync with the equipment being controlled without the need to reset any item of equipment. Confirm that user interface requirements dictated in Part 3 of the audiovisual specifications have been met.		

Test	Description	Result	Comment
35	Confirm system is serviceable: all devices must be easily removable for repair by one person; all cables must be dressed neatly and be provided with adequate services looks, must be bundled in forms (refer to “Sound System Engineering”, Davis and Davis, 1987 and “Audio Systems Design and Installation”, Giddings, 1990) having no excessive pressure on cables at termination points and connectors, and each cable number must agree with the shop drawings and cabling run list.		
36	Confirm switches and receptacles are logically and permanently labeled.		
37	Confirm nomenclature for consistency: drawings, touch screen, wall plates, floor boxes, patch panels, equipment, etc.		
38	Confirm patch cables have cable numbers.		
41	Confirm TV reception from all sources (OTA, CATV, etc.) and that all channel presets are accurate.		
43	Confirm and document the IP configuration information provided by the Owner is loaded into the equipment, including IP and MAC addresses, Dante device names, subnet masks, gateways, time server, gatekeeper, etc. Confirm that all network functions specified by the customer function properly on the customer's LAN.		
44	Confirm all web-based system control and monitoring features, and other IP system functionality (time servers, system-generated e-mail, etc.) are completely functional.		
45	Confirm that display devices have On-Screen Displays/Menus disabled. If the customer has directed otherwise, document from which person this direction came.		
46	Confirm that video projectors have blue screens or other images or colors displayed in the absence of an input signal disabled. If the customer has directed otherwise, document from which person this direction came.		
47	Log test conference calls (audio and video). Include in the log start time, line used, number called, status of connection (completed/failed, etc.) who was spoken with at the far end, success of full duplex, success of auto-disconnect, dB SPL in the room. Note static, jitter/packet loss, or any other artifacts, distortion, etc. Note if auto-disconnect functions as specified.		
48	Using a full-screen white test signal, confirm no direct view display nor projector has more defective pixels than specified in Part 1. Note number and location of lost pixels, if any. Provide photos of defects. Include room numbers and any other distinguishing information in photo file names.		

Test	Description	Result	Comment
49	Check for excessive vibration on VC camera(s) at full telephoto position.		
50	Provide video recordings of all non-conformances and anomalies.		
51	Confirm all visible devices are installed square and plumb.		
52	Confirm no dust, grease, scratches, or any other signs of handling are visible on any devices		
53	Confirm assistive listening systems work throughout intended listening areas		
54	Confirm closed captioning is functional on all displays		
55	Confirm control system user interfaces provide a means to enable and disable display of closed captions		

E. If further adjustment is required, or defective equipment must be repaired or replaced, tests may be suspended or continued at the option of the Owner or Owner's representative.

1. If the need for further adjustments becomes evident during the demonstration and testing, continue work until the installation operates properly. Included in the continued work, changes to or installation of resistive pads, adjustment of loudspeaker aiming, adjustment of system processing, programming changes to the control system, convergence and/or alignment of the video projector, if these adjustments are required.

2. If acceptance of the system is delayed because of defective equipment or because the equipment does not fulfill this specification, reimburse the Owner for time and expenses for these tests during extensions of the acceptance testing period.

3.13 OWNER TRAINING

A. Provide a minimum of 8 hours per instructor group and a minimum of 4 hours per IT staff group of training on the audiovisual systems specified herein at the project site (or other location designated by the Owner) by a qualified instructor (equipment manufacturer as needed) covering operation and maintenance of the systems. Training for the IT staff should be of technical nature, while training for the instructor group should be of operational nature.

3.14 MAINTENANCE AND EXTENDED SERVICE

A. Warranty Maintenance

1. On a quarterly basis during the warranty period, execute a service visit to check and adjust equipment and systems such that they maintain the original performance. Coordinate visits directly with the Owner.

2. Pre-emptive maintenance minimum requirements:
   a. Clean filters, vents, and lenses, and dust the equipment.
   b. Verify projector images fill screens appropriately and images are focused.
   c. Test and verify that all system controls operate as labelled and that the controlled devices respond accordingly.

d. Document and photograph any conditions that may affect the continued function and long-term operation of the audiovisual system and report to owner.

e. Document and report projector lamp life to the Owner and replace lamps as directed.

B. Provide cost for additional service levels beyond the warranty period (as defined in this section) as follows:

1. One year, three-year, and five-year service with quarterly pre-emptive maintenance calls and 24-hour issue response

C. Touch Panel Programming Updates

1. At a date determined by the Owner within six months following Substantial Completion, attend a single meeting with them regarding alterations or updates to the touch panel layouts or function. At a time approved by the Owner, implement those alterations or updates.

2. Provide any training necessitated by these revisions.

3. Provide documentation of these revisions to the Engineer.

4. Provide the source code documentation according to “Software License” in this section.

END OF SECTION