SECTION 274116

INTEGRATED AUDIOVISUAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Audiovisual systems – presentation systems, conference systems, distributed audio systems distributed video systems, control systems, and interface with other systems. Refer to article 1.4 “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. 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.
3. 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.
4. 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.
5. Provide audio transformers, whether or not explicitly shown on the drawings, with appropriate impedance ratios and power handling capacities as required for the intended function of the System.
6. Provide networks and pads, whether or not explicitly shown on the drawings, as required to achieve proper impedance matching and levels. Provide networks and pads that are balanced and constructed from 0.5 watt, 5% resistors, soldered to fixed connection points at each end.

7. 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
8. 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, 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"
5. Section 271513, "Communications Horizontal Cabling"
6. Section 270811, "Communications Twisted Pair Testing"
7. Section 270821, "Communications Fiber Optic Testing"

D. Products Installed but not Furnished Under this Section
1. Owner-furnished equipment
2. Network patch cords

E. Products Furnished and Installed Under Another Section
   1. Rough-in (device boxes, conduits, and related accessories)
   2. Electrical service (e.g., 120 VAC); refer to division 26
   3. Telecommunication cabling; refer to section 271513
   4. Telecommunication pathways; refer to section 270528.
   5. Network switches, with Power over Ethernet (PoE)

1.2 REFERENCES

A. Comply with the References requirements of section 270000.

B. In additional to the references listed in section 270000, perform work in accordance with applicable requirements of governing codes, rules and regulations including the following minimum standards, whether statutory or not:
   1. 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”
   2. 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”
   3. AVIXA
      a. A102.01, “Audio Coverage Uniformity in Listener Areas”
      b. ANSI/AVIXA D401.01:201X “Standard Guide for AV Systems Design and Coordination Processes”
      c. V201.01:2018, “Projected Image System Contrast Ratio”
      d. F501 01, “Cable Labeling for Audiovisual Systems”
   4. “Sound Systems Engineering”, 3rd Ed., Davis and Davis
   5. Electronic Components Industry Association (ECIA)
      a. EIA/ECA-310, “Cabinets, Racks, Panels, and Associated Equipment”

1.3 DEFINITIONS

A. Refer to section 270000 for definitions. The definitions of section 270000 apply to this section.

B. In addition to those definitions of section 270000 and Division 01, the following terms used in this specification are defined as follows:
   1. “ACEG”: alternating current equipment ground (an example of this is a ground bus within an electrical panel)
   2. “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).
   3. “A/R”: Indicates that the quantity of an item is as required to meet the design criteria indicated in the audiovisual drawings and specifications.
   4. “A/S”: Indicates that the quantity of an item is as shown on the drawings.
   5. “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.

6. “Custom” indicates systems or components the Contractor fabricates based on these specifications and drawings
7. “EDID”: Extended display identification data
8. “HDCP”: High-bandwidth digital content protection
9. “HDMI”: High-definition multimedia interface
10. “OFE”: Owner Furnished Equipment
11. “Or equal” indicates an item that is equal in function and performance to the specified device or system
12. “RU”: rack unit, as defined in EIA/ECA-310
13. “Shall” denotes a mandatory requirement
14. “Should” denotes an advisory statement
15. “SPL”: sound pressure level
16. “THD”: total harmonic distortion
17. “Will” denotes an informative statement
18. “Project”: The scope of work defined by this specification and its related drawings
19. “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
20. “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
21. “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
22. “System”: The audiovisual components, cabling, and programming incorporated in the descriptions and equipment lists herein

1.4 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. Display of closed captioning content
2. Accessible control systems
3. Assistive listening systems

C. Audio System Performance Criteria
1. Provide echo cancellation for microphones in audio and video conferencing systems.
2. Frequency Response:
   a. Program audio system: 100 Hz to 12,000 Hz. 3 dB per octave roll off below 100Hz and above 12 kHz.
   b. Distributed audio system: 125 Hz to 10,000 Hz. 3 dB per octave roll-off below 125 Hz and above 10 kHz.
3. Total Acoustical Harmonic Distortion:
   a. Program audio system: less than 2% at 90 dBC (1 kHz reference) at four feet (1,220 mm) above finished floor in the middle of the room.
   b. Distributed audio system: 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. System component minimum resolution: capability of 1920 X 1080.
2. Supported resolutions: 1,280 x 720, 1,920 x 1,080, 1,920 x 1,200, 3840 X 2160, and 4096 x 2160.

E. 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.

F. Control Systems
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 the 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.

G. 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

1.5 ROOM TYPES

A. General
1. The audiovisual systems design and documentation in this set of contract documents 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 for the quantities of each type of room and for specific audiovisual interface information per room.

B. Group Study Rooms
1. Group Study rooms include three sizes: small, medium, and large. These spaces will be used by student and faculty members for meetings and working sessions.
2. Provide a wall-mounted display for users to share content from personal devices. Refer to the overall floor plan drawings for the required display size for each room.
3. Provide hardwired, HDMI laptop connection to the display via 2.5” diameter brushed stainless grommet in the table.
4. Provide a soundbar in the small and medium rooms for program audio. Provide ceiling-mounted loudspeakers in the large room for program audio.
5. Provide an Assistive Listening System to meet Code requirements.
6. Provide a wall-mounted button panel for system control including on/off, volume up/down, and source selection.

C. Meeting Rooms
1. Meeting rooms are available for faculty member meetings and include software-based video conferencing system. These spaces will support audiovisual presentations and collaboration. Provide a scaled input to the display.
2. Provide a wall-mounted display for users to share content from personal devices.
3. Provide hardwired, HDMI laptop connection to the display via 2.5” diameter brushed stainless grommet in the table.
4. Provide wall-mounted camera/microphone for software-based video conferencing hosted on laptop.
5. Provide ceiling-mounted loudspeakers for program audio.
6. Provide a shared- portable RF Assistive Listening System to meet Code requirements.
7. Provide a wall-mounted control panel for system control including on/off, volume up/down, and source selection.

D. Office of IT Director
1. The Office of the IT Director is a private office with a basic AV system.
2. Provide a wall-mounted, annotative display for users to share content from personal devices.
3. Provide hardwired, HDMI laptop and USB connections to the display.

E. Classroom Type 1
1. This classroom will be used for lecture style sessions.
2. Provide projection system with short-throw projector and wall-mounted projection screen.
3. Provide a wall mounted equipment enclosure near wall-mounted projector

4. Provide technology connection points at the instructor lectern containing:
    a. Connection for laptop, including HDMI with multiple adaptors for DisplayPort, and Mini DisplayPort for legacy support including audio via 2.5” diameter brushed stainless grommet in the furniture.
    b. Document camera
    c. Owner-furnished, all-in-one computer
5. Provide wireless sharing device
6. Provide supporting AV presentation system, including switching and amplification functions
7. Provide ceiling-mounted, pendant loudspeakers
8. Provide wireless instructor microphone
9. Provide a control system, self-contained, with push-button style panel, to control all functions of the AV systems
10. Provide a shared portable Assistive Listening System as required by Code

F. Classroom Type 2
1. This classroom type is flexible in configuration.
2. Provide two flat panel displays. Both displays will show content from the instructor input location.
3. Provide a plenum-rated ceiling equipment enclosure the display in the accessible ceiling
4. Provide two technology connection points at the wall for an instructor:
    a. Connection for laptop, including HDMI with multiple adaptors for DisplayPort, and Mini DisplayPort for legacy support including audio
    b. Document camera
    c. Owner-furnished, all-in-one computer
5. Provide wireless sharing device
6. Provide supporting AV presentation system, including switching and amplification functions
7. Provide ceiling-mounted loudspeakers
8. Provide wireless instructor microphone
9. Provide a control system, self-contained, with push-button style panel, to control all functions of the AV systems
10. Provide a shared portable Assistive Listening System as required by Code

G. Classroom -Type 3
1. This classroom will be used for lecture style sessions
2. Provide short throw projection system with projector and ***wall-mounted (Addendum 03)*** projection screen.
3. Provide a wall mounted equipment enclosure near wall-mounted projector
4. Provide two technology connection points at the front of the room for an instructor lectern containing:
    a. Connection for laptop, including HDMI with multiple adaptors for DisplayPort, and Mini DisplayPort for legacy support including audio via 2.5” diameter brushed stainless grommet in the furniture
    b. Document camera
    c. Owner-furnished, all-in-one computer
5. Provide wireless sharing device
6. Provide supporting AV presentation system, including switching and amplification functions
7. Provide ceiling-mounted loudspeakers
8. Provide wireless instructor microphone
9. Provide a control system, self-contained, with push-button style panel, to control all functions of the AV systems
10. Provide a shared portable Assistive Listening System as required by Code

H. Classroom -Type 4
   1. This classroom will be used for lecture style sessions
   2. Provide projection system with projector and projection screen.
   3. Provide a ceiling mounted equipment enclosure at projector
   4. Provide two technology connection points at the front of the room for an instructor lectern containing:
      a. Connection for laptop, including HDMI with multiple adaptors for DisplayPort, and Mini DisplayPort for legacy support including audio via 2.5” diameter brushed stainless grommet in the furniture
      b. Document camera
      c. Owner-furnished, all-in-one computer
   5. Provide wireless sharing device
   6. Provide supporting AV presentation system, including switching and amplification functions
   7. Provide ceiling-mounted loudspeakers
   8. Provide wireless instructor microphone
   9. Provide a control system, self-contained, with push-button style panel, to control all functions of the AV systems
   10. Provide a shared portable Assistive Listening System as required by Code

I. Tutoring Lab
   1. This classroom type is flexible in configuration
   2. Provide two flat panel displays and connection points for OFE mobile display carts at four floor locations. All displays will show the instructor’s content.
   3. Provide terminated HDMI extension RJ45 connectors at four floor locations for mobile cart connections.
   4. Locate AV equipment in lectern
   5. Provide two technology connection points at the front of the room for an instructor lectern containing:
      a. Connection for laptop, including HDMI with multiple adaptors for DisplayPort, and Mini DisplayPort for legacy support including audio via 2.5” diameter brushed stainless grommet in the furniture
      b. Document camera
      c. Owner-furnished, all-in-one computer
   6. Provide wireless sharing device
   7. Provide supporting AV presentation system, including switching and amplification functions
   8. Provide ceiling-mounted loudspeakers
   9. Provide wireless instructor microphone
   10. Provide a control system, self-contained, with push-button style panel, to control all functions of the AV systems
   11. Provide a shared portable Assistive Listening System as required by Code

J. Instructional Lab
   1. This classroom type is flexible in configuration
   2. Provide dual flat panels systems
   3. Provide a ceiling, plenum-rated equipment enclosure near displays in accessible ceiling
   4. Provide two technology connection points at the wall for:
      a. Connection for laptop, including HDMI with multiple adaptors for DisplayPort, and Mini DisplayPort for legacy support including audio
      b. Document camera
      c. Owner-furnished, all-in-one computer
   5. Provide wireless sharing device
   6. Provide supporting AV presentation system, including switching and amplification functions

7. Provide ceiling-mounted loudspeakers
8. Provide wireless instructor microphone
9. Provide a control system, self-contained, with push-button style panel, to control all functions of the AV systems
10. Provide a shared portable Assistive Listening System as required by Code

K. Writing Center lab
1. None

L. Library Reading Open Area
1. Library Reading area is flexible space with a single projection system (projector and projection screen).
2. Provide projector and projection screen
3. Provide a ceiling mounted equipment enclosure near ceiling-mounted projector
4. Provide a technology connection point at the wall for:
   a. Connection for laptop, including HDMI with multiple adaptors for DisplayPort, and Mini DisplayPort for legacy support including audio
   b. Document camera
   c. Owner-furnished, all-in-one computer
5. Provide wireless sharing device
6. Provide supporting AV presentation system, including switching and amplification functions
7. Provide ceiling-mounted loudspeakers
8. Provide wireless instructor microphone
9. Provide a control system, self-contained, with push-button style panel, to control all functions of the AV systems
10. Provide a shared portable Assistive Listening System as required by Code

M. Design Suite
1. Provide infrastructure to support owner-furnished systems

N. Room scheduling
1. Provide room scheduling device outside all AV-enabled rooms to display room reservation information and the room's occupancy status.
2. Each room scheduler will require a single network/data drop.
3. Integrate with Laney's calendaring system.

O. Digital Signage
1. The digital signage software system and hardware are owner-furnished.

P. Overhead networked audio paging system
1. Furnish an overhead audio paging system consisting of headend, network enabled equipment, ceiling loudspeakers and supporting equipment.
2. Paging will be performed via Laney's IP phone system and 3rd floor reception paging microphone.
   a. Physically secure paging microphones from tampering
3. Provide ceiling mounted loudspeakers to provide uniform audio distribution coverage throughout the building.
4. Zone the system to include the following:
   a. Entire building
   b. Library only
   c. LRC only
   d. Each floor individually
   e. Confirm zoning requirements with Laney during wiring and programming
5. Provide end of line modules at the end of each loudspeaker chain.

6. Connect the audio paging system to the fire/life safety system and security system.

1.6 SUBMITTALS

A. Comply with the Submittal requirements of section 270000.

B. Bid Submittal: Submit bids in accordance with the 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 General Contractor. 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 Extron Certified Professionals.
      d. 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: Refer to section 270000 for alternate and substitution requirements. 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.

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.

C. 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. Substitutions [refer to section 270000 for substitution requirements]: 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.
3. Shop Drawings [refer to section 270000 for additional shop drawing requirements]: Submit shop drawings prior to installation and in accordance with the Conditions of Contract and Division 1, including the following.
    a. 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”).
    b. 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

c. Equipment rack elevations and patch panel assignments – clearly and consistently label rack elevations, patch panels, and on equipment controls.
d. Provide pushbutton and handheld remote control panel layouts –tag each button with function and ID matching installed labels
e. Factory and custom panels, plates, and designation strips, showing material, finish, color and engraving (exact lettering)
f. Custom designed consoles, tables, carts, support bases, and shelves
g. Equipment modifications (if any), including details of modifications that change or void manufacturers' warranties.
h. 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
i. Wattage tap setting per loudspeaker.

4. User Interface Menu Submittal:
   a. Provide a PDF per system containing a page for each menu, submenu, and popup in that system's user interfaces. 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.
5. 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
6. Samples: Submit sample panels, plates, and designation strips, including details relating to terminology, engraving, finish and color.
7. 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.

D. 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 Microphone Frequencies: Submit a list of wireless microphone frequencies and associated channels used for each microphone and system.

E. 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 [refer to section 270000 for additional as-built drawing requirements]: Submit as-built drawings in accordance with the Conditions of Contract and Division 1, including the following.
    a. System functional line drawings 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").
    b. 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
    c. 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
    d. Equipment rack elevations and patch panel assignment drawings. Clearly label the rack elevations, patch panels, and equipment controls.
    e. 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
    f. Pushbutton and handheld remote-control panel layouts, including tagging each button with function and ID that matches installed labels
    g. Factory and custom panels, plates, and designation strips, showing material, finish, color and engraving (exact lettering)
    h. Wattage tap setting per loudspeaker.
3. 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 manufacturer's operation and maintenance manuals for each piece of equipment.
4. Programming/Software:
    a. Submit the project's control system programming and audio processor configuration files – refer to "Software License" below.

1.7 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.

1.8 PROJECT MANAGEMENT AND COORDINATION

A. Comply with the Project Management requirements of section 270000.

B. 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.

C. Report to the Engineer any conditions that would prevent the correct installation of the system as designed.

D. This project requires an programming contractor. Definitions of the equipment programming responsibilities of each are defined below.
   1. Programming Contractor
      a. Touch panel layout and user experience, coordinated with the Owner's representative and TEECOM.
      b. Standard control and user interface development specific to the functionality of the audiovisual control systems and communication with controlled devices in the systems.
      c. Installation and validation of the systems and UI code on-site.
      d. Optimize and integrate Building Management System License with corresponding systems – room scheduling displays, HVAC, occupancy sensors, etc.
   2. Audiovisual Systems Contractor
      a. Audio processor programming including signal routing, system optimization, and integration of control triggers.
      b. Wireless microphone frequency coordination.
      c. Video matrix configuration including routing, scaling, and EDID optimization.
   3. Coordination Requirements
      a. Audiovisual contractor: provide a device table to the independent programming contractor including an IP address table, source input connections in matrices and output connections in matrices and corresponding end points.
      b. Audiovisual contractor and independent programming contractor: conduct coordination meetings every two weeks and supply meeting notes to TEECOM and the Owner.
      c. Audiovisual contractor and independent programming contractor: conduct collaborative on-site troubleshooting and system tuning sessions for the Project.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Comply with Delivery, Storage, and Handling requirements of section 270000.

1.10 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.

1.11 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 an 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

2.1 GENERAL

A. Comply with the Products requirements in section 270000.

B. 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.

C. Only where denoted “or equal”, equal products will be considered. The manufacturers, product numbers, and types listed at those instances establish minimum performance.

D. 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.

2.2 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. If the quantity is different than shown on the drawings, the drawings govern quantity and the specifications govern quality.

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. Provide AV signal extension as required.

D. Provide plenum-rated equipment, enclosures, and cables where required.

E. Provide secure mounting/tamper-proof attachments for all accessible AV devices to prevent theft.

F. **Group Study Rooms – Typical Small**

Description	**Make**	**Model**	**Qty.**	**Notes**
Category: Audio				
Soundbar	Extron Or Equal	60-1737-11	1	No camera, provide wall bracket
Audio extractor	Extron Or Equal	60-1681-01	1	Mount behind display
Volume control module	Extron Or Equal	60-1090-01	1	Mount behind display
Category: Video				
Video display	NEC Or Equal	C432	1	
Display mount	Chief Or Equal	MTM1U	1	
Category: Control				
Control panel	Extron Or Equal	MLC62 RS D	1	
Category: Accessories				
Interface plate	Custom		1	
Misc. cables				

G. Group Study Rooms – Typical Medium

Description	**Make**	**Model**	**Qty.**	**Notes**
Category: Audio				
Soundbar	Extron Or Equal	60-1737-11	1	provide wall bracket.
Video conference camera	Logitech Or Equal	C920	1	Provide in two video conference enabled rooms (typical of 200 and 289A)
Audio extractor	Extron Or Equal	60-1681-01		Mount behind display
Volume control module	Extron Or Equal	60-1090-01	1	Mount behind display
Category: Video				
Video display	NEC Or Equal	C551	1	
Display mount	Chief Or Equal	LTM1U	1	
Category: Control				
Control panel	Extron Or Equal	MLC62 RS D	1	

Description	Make	Model	Qty.	Notes
Category: Accessories				
HDMI Interface plate	Custom		1	Provide HDMI and USB for video conference enabled rooms (typical of 200 and 289A)
Misc. cables				

A. **Group Study Rooms – Typical Large**

Description	Make	Model	Qty.	Notes
Category: Audio				
Ceiling loudspeakers	Extron Or Equal	60-1310-03	A/S	
Power amplifier	Extron Or Equal	60-1449-01	1	Mount behind display
Category: Video				
Video display	NEC Or Equal	C651	1	
Display mount	Chief Or Equal	LTM1U	1	
HDMI extension TX	Extron Or Equal	60-1586-52	1	Install in floor box
HDMI extension RX	Extron Or Equal	60-1631-53	1	
Category: Control				
Control panel	Extron Or Equal	MLC62 RS D	1	
Category: Accessories				
Misc. cables				

B. **Typical Meeting Rooms**

Description	Make	Model	Qty.	Notes
Category: Audio				
Ceiling loudspeakers	Extron Or Equal	60-1310-03	A/S	
Power amplifier	Extron Or Equal	60-1449-01	1	
Volume controller	Extron Or Equal	60-1090-01	1	Mount behind display
Audio plate for portable ALS	C2G Or Equal	Stereo RCA wall plate	1	
Tabletop microphone	Biamp Or Equal	Parlé TTM-XEX	A/R	Confirm color with Architect. Secure mount to table
Category: Video				
Video Display	NEC Or Equal	C751Q	1	
Wall Mount	Chief Or Equal	LWRIWUB	1	
Wide angle Camera	Logitech Or Equal	C930E	1	Provide wall mount
VC Hub	Biamp Or Equal	Devio SCR-20	1	Mount under table

Description	Make	Model	Qty.	Notes
Category: Control				
Wall mounted control panel	Extron Or Equal	MLC62 RS D	1	

C. Office of IT Director

Description	Make	Model	Qty.	Notes
Category: Video				
Annotative video Display	Sharp Or Equal	PN-L401C	1	
Wall Mount	Chief Or Equal	MTM1U	1	
Category: Accessories				
Input plate	Custom		1	

D. Classroom Type 1

Description	Make	Model	Qty.	Notes
Category: Audio				
Ceiling mounted loudspeakers	Extron Or Equal	60-1736-02	A/R	Coordinate color with Architect
Instructor microphone	Extron Or Equal	VLM 3001	1	
Power amplifier	Extron Or Equal	XPA 2001-70V	1	
Audio Distribution	RDL Or Equal	ST-DA3	1	
Category: Video				
Short-throw video Projector	Epson or Equal	V11H878520	1	
Projector wall mount and equipment enclosure	Extron Or Equal	USFM 100 and UPB 125	1	
Presentation System	Extron Or Equal	PVS407D	1	
Video Extender Set, HDMI, shielded CAT6 interconnect	Extron Or Equal	PVT HDMI	2	Coordinate lectern mounting with architect
Collaboration System, Wireless	Extron Or Equal	Sharelink500	1	Coordinate with Laney IT
Document Camera, HDMI, interactive	Elmo Or Equal	TT-12F	1	
Category: Control				
Control Keypad	Extron Or Equal	MLC Plus 200	1	
Table mount kit	Extron Or Equal	SMB113	1	Coordinate color with architect
Category: Accessories				
Projection Screen, wall mount, 16:10, 130” diagonal	Da-Lite Or Equal	Tension Contour Electrol	1	***Da-Mat surface (Addendum 03)***

Description	Make	Model	Qty.	Notes
Audio plate for portable ALS	C2G Or Equal	Stereo RCA wall plate	1	Coordinate lectern mounting with architect

E. Classroom Type 2

Description	Make	Model	Qty.	Notes
Category: Audio				
Ceiling mounted loudspeakers	Extron Or Equal	60-1736-02	A/R	Coordinate color with Architect
Instructor microphone	Extron Or Equal	VLM 3001	1	
Power amplifier	Extron Or Equal	XPA 2001-70V	1	
Category: Video				
Display	NEC or Equal	C981Q	2	
Display mount	Chief or Equal	PNRIWUB	2	
Ceiling equipment enclosure	Extron Or Equal	PVM220	1	
Presentation System	Extron Or Equal	PVS407D	1	
Video distribution w/ audio out	Crestron or Equal	HD-DA-2	1	
Video Extender Set, HDMI, shielded CAT6 interconnect	Extron Or Equal	PVT HDMI	2	
HDMI extension to displays	Extron Or Equal	DTP 2 200 series	A/R	Provide wall plate at display location
Collaboration System, Wireless	Extron Or Equal	Sharelink500	1	Coordinate with Laney IT
Document Camera, HDMI, interactive	Elmo Or Equal	TT-12F	1	
Category: Control				
Control Keypad	Extron Or Equal	MLC Plus 200	1	
Category: Accessories				
Audio plate for portable ALS	C2G Or Equal	Stereo RCA wall plate	1	

F. Classroom Type 3

Description	Make	Model	Qty.	Notes
Category: Audio				
Ceiling mounted loudspeakers	Extron Or Equal	60-1736-02	A/R	Coordinate color with Architect
Instructor microphone	Extron Or Equal	VLM 3001	1	
Power amplifier	Extron Or Equal	XPA 2001-70V	1	
Audio Distribution	RDL Or Equal	ST-DA3	1	

Description	Make	Model	Qty.	Notes
Category: Video				
Short-throw video Projector	Epson or Equal	V11H878520	1	
Projector wall mount and equipment enclosure	Extron Or Equal	USFM 100 and UPB 125	1	
Presentation System	Extron Or Equal	PVS407D	1	
Video Extender Set, HDMI, shielded CAT6 interconnect	Extron Or Equal	PVT HDMI	A/R	Coordinate lectern mounting with architect
Collaboration System, Wireless	Extron Or Equal	Sharelink500	1	Coordinate with Laney IT
Document Camera, HDMI, interactive	Elmo Or Equal	TT-12F	1	
Category: Control				
Control Keypad	Extron Or Equal	MLC Plus 200	1	
Table top kit	Extron of Equal	SMB 113		Coordinate color with architect
Category: Accessories				
Projection Screen, wall mount, 16:10, 130” diagonal	Da-Lite Or Equal	Tension Contour Electrol	1	***Da-Mat surface (Addendum 03)***
Audio plate for portable ALS	C2G Or Equal	Stereo RCA wall plate	1	Coordinate lectern mounting with architect

G. Classroom Type 4

Description	Make	Model	Qty.	Notes
Category: Audio				
Ceiling mounted loudspeakers	Extron Or Equal	60-1310-03	A/R	
Instructor microphone	Extron Or Equal	VLM 3001	1	
Power amplifier	Extron Or Equal	XPA 2001-70V	1	
Audio Distribution	RDL Or Equal	ST-DA3	1	
Category: Video				
Video Projector	Panasonic Or Equal	***PT-FRZ50 (Addendum 03)***	1	
Projector ceiling mount and equipment enclosure	Extron Or Equal	Pole Vault Digital	1	
Presentation System	Extron Or Equal	PVS407D	1	
Video Extender Set, HDMI, shielded CAT6 interconnect	Extron Or Equal	PVT HDMI	1	Coordinate lectern mounting with architect

Description	Make	Model	Qty.	Notes
Collaboration System, Wireless	Extron Or Equal	Sharelink500	1	Coordinate with Laney IT
Document Camera, HDMI, interactive	Elmo Or Equal	TT-12F	1	
Category: Control				
Control Keypad	Extron Or Equal	MLC Plus 200	1	
Tabletop kit	Extron Or Equal	SMB 113	1	Coordinate color with architect
Category: Accessories				
Projection Screen, ceiling mount, 16:10, 130" diagonal	Da-Lite Or Equal	Tension Contour Electrol	1	***Da-Mat surface (Addendum 03)***
Audio plate for portable ALS	C2G Or Equal	Stereo RCA wall plate	1	Coordinate lectern mounting with architect

H. **Tutoring Lab**

Description	Make	Model	Qty.	Notes
Category: Audio				
Ceiling mounted loudspeakers	Extron Or Equal	60-1736-02	A/R	Coordinate color with Architect
Instructor microphone	Extron Or Equal	VLME 3001	1	
Category: Video				
Display	NEC or Equal	C981Q	2	
Display mount	Chief or Equal	PNRIWUB	2	
Presentation System with amplifier	Extron Or Equal	60-1382-23	1	
Video Extender Set, HDMI, shielded CAT6 interconnect	Extron Or Equal	DTP 330 series	A/R	Provide wall plate behind display
Collaboration System, Wireless	Extron Or Equal	Sharelink500	1	Coordinate with Laney IT
Document Camera, HDMI, interactive	Elmo Or Equal	TT-12F	1	
Category: Control				
Control panel	Extron Or Equal	TLP Pro 725T NC	1	Coordinate color with architect
Category: Accessories				
Audio plate for portable ALS	C2G Or Equal	Stereo RCA wall plate	1	
Poe injector	Extron or Equal		1	

I. **Instructional Lab**

Description	Make	Model	Qty.	Notes
Category: Audio				
Ceiling mounted loudspeakers	Extron Or Equal	60-1310-03	A/R	
Instructor microphone	Extron Or Equal	VLM 3001	1	
Power amplifier	Extron Or Equal	XPA 2001-70V	1	
Audio Distribution	RDL Or Equal	ST-DA3	1	
Category: Video				
Display	NEC or Equal	C981Q	2	
Display mount	Chief or Equal	PNRIWUB	2	
Ceiling equipment enclosure	Extron	PVM220	1	
Presentation System	Extron Or Equal	PVS407D	1	
Video distribution w/ audio out	Crestron or Equal	HD-DA-2	1	
Video Extender Set, HDMI, shielded CAT6 interconnect	Extron Or Equal	PVT HDMI	A/R	
HDMI extension to displays	Extron Or Equal	DTP 2 200 series	A/R	Provide wall plate at display location
Collaboration System, Wireless	Extron Or Equal	Sharelink500	1	Coordinate with Laney IT
Document Camera, HDMI, interactive	Elmo Or Equal	TT-12F	1	
Category: Control				
Control Keypad	Extron Or Equal	MLC Plus 200	1	
Category: Accessories				
Audio plate for portable ALS	C2G Or equal	Stereo RCA wall plate	1	

J. **Library Open Reading Area**

Description	Make	Model	Qty.	Notes
Category: Audio				
Ceiling mounted loudspeakers	Extron Or Equal	60-1310-03	A/R	
Instructor microphone	Extron Or Equal	VLM 3001	1	
Power amplifier	Extron Or Equal	XPA 2001-70V	1	
Audio Distribution	RDL Or Equal	ST-DA3	1	
Category: Video				
Video Projector	Panasonic or Equal	***PT-FRZ50 (Addendum 03)***	1	

Description	Make	Model	Qty.	Notes
Projector ceiling mount and equipment enclosure	Extron	Pole Vault Digital	1	
Presentation System	Extron Or Equal	PVS407D	1	
Video Extender Set, HDMI, shielded CAT6 interconnect	Extron Or Equal	PVT HDMI	1	
Collaboration System, Wireless	Extron Or Equal	Sharelink500	1	Coordinate with Laney IT
Category: Control				
Control Keypad	Extron Or Equal	MLC Plus 200	1	
Category: Accessories				
Projection Screen, ceiling mount, 16:10, 130" diagonal	Da-Lite Or Equal	Tension Contour Electrol	1	***Da-Mat surface (Addendum 03)***
Audio plate for portable ALS	C2G Or Equal	Stereo RCA wall plate	1	

K. Room Scheduling

Description	Make	Model	Qty.	Notes
Category: Video				
Room scheduling display	Extron Or Equal	60-1563-10x	A/R	Confirm finish with architect
Display mount	Extron Or Equal	SMK 2	A/R	

L. Portable Assistive Listening

Description	Make	Model	Qty.	Notes
Category: Audio				
Assistive Listening System	Listen Technologies or Equal	LT-800-072-P1	A/R	
Receivers	Listen Technologies or Equal	LR-4200-072, LA-402 LA-430	A/R	
Charging station	Listen Technologies or Equal	LA-381-01	A/R	

M. Overhead paging system

Description	Make	Model	Qty.	Notes
Category: Audio				
Ceiling loudspeaker - pendant	Atals IED Or Equal	PM4FA	A/S	In open ceiling areas. Coordinate finish with architect
Ceiling loudspeaker - can	Atals IED Or Equal	FAP62T	A/S	

Description	Make	Model	Qty.	Notes
Power amplifiers	Atals IED Or Equal	DPA804	A/R	
End-of-Line Module	Atals IED Or Equal	IED54XXEOL	A/R	Provide at the end of each speaker run
Paging microphone	Atals IED Or Equal	IPCSD-TOUCH-G	1	
Paging system controller	Atals IED Or Equal	IP108-D Globalcom.IP	A/R	
Category: Accessories				
Network switch				Coordinate model selection with owner IT

2.3 CABLES AND WIRES

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

B. For CATEGORY-type UTP cabling (cables, termination apparatus and installation requirements), refer to section 271513.

C. 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.

D. 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**, or equal	**Plenum Product**, or equal
Ethernet	Refer to section 271513	Refer to section 271513
HDBaseT	Belden 2183R West Penn 4246F Extron XTP DTP 24 Superior Essex 6H-246-xA Windy City Wire CAT6S	Belden 2183P West Penn 254246F Extron XTP DTP 24P Superior Essex 6H-246-xB Windy City Wire CAT6SP
Control cable (AMX AXLink, Crestron Cresnet)	Belden 1502R West Penn 77350, C4215 Liberty LLINX-U Windy City Wire CRESCOM	Belden 1502P West Penn D25350 Liberty LLINX-U-P Windy City Wire CRESCOMP
Microphone and line-level audio cable	Belden 9451 West Penn 454 Liberty 20-2C-SH-GRY Windy City Wire 22-1PREZ-BLK	Belden 9451P West Penn 25291B Liberty 20-2C-PSH-GRY Windy City Wire 22-1PREZP-BLK

Application	**Non-Plenum Product**, or equal	**Plenum Product**, or equal
Program loudspeaker cable	Belden 5000UE West Penn 227 Liberty 12-2C-GRY Windy City Wire 12-02-GRY	Belden 6000UE West Penn 25227B Liberty 12-2C-P-BLK Windy City Wire 12-02P-BLK
Distributed loudspeaker speaker cable	Belden 5300UE West Penn 224 Liberty 18-2C-GRY Windy City Wire 18-02-BLK	Belden 6300UE West Penn 25224B Liberty 18-2C-P-BLK Windy City Wire 18-02P-BLK
ALS emitter	See Antenna cable (wireless microphone) – 50-ohm, below	
Antenna cable (wireless microphone) – 50-Ohm	West Penn 813 Liberty RG8-CMR-BLK RG8-BLK Or equal by Belden	West Penn 2598G8 Liberty RG8-CMP-BLK RG8P-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 Windy City Wire RG59-BLK	Extron 25815 Liberty RG59-CCTV-PL-BLK Windy City Wire RG59P-BLK
Serial digital coaxial cable	West Penn 819 Liberty 20-CMR-VIDEO-BLK Windy City Wire RG59HD-BLK	West Penn 25825 Liberty 20-CMP-VID-COAX-BLK Windy City Wire RG59HDP-BLK

2.4 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).

2.5 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.

2.6 LABELS

A. General: Labels shall meet UL 969 product requirements.

B. Equipment Labels:
   1. Equipment labels shall be machine printable, shall be polyester (or similar) adhesive-back type, and shall be permanent.
   2. Face stock (print area) shall be white.
   3. Size: as needed.
   4. Manufacturer, or equal:
      a. Brady
      b. Brother
      c. DYMO XTL or Rhino

d. Panduit
1) #C150X075YJJ; component label, laser/inkjet print, white face stock 1.5"W x 0.75"H
e. Thomas and Betts

C. Cable and Wire Labels:
1. Cable and wire labels shall be machine printable, shall be permanent, and shall be either of the following types:
a. Tape – machine-printable, wrap-around, self-laminating, permanent adhesive-backed tape
b. Machine-printable, shrink-wrapped labels
2. Face stock (print area) shall be white.
3. Size: as needed per wire/cable size (approximately 1" wide).
4. Manufacturer, or equal:
a. Brady
b. Brother
c. DYMO XTL or Rhino
d. Panduit
1) #S100X075YAJ; self-laminating cable label, white face stock 1"W, for cable diameters 0.08"-0.16"C150X075YJJ
2) #S100X125YAJ; self-laminating cable label, white face stock 1"W, for cable diameters 0.12"-0.28"
3) #S100X150YAJ; self-laminating cable label, white face stock 1"W, for cable diameters 0.16"-0.32"
4) #S100X225YAJ; self-laminating cable label, white face stock 1"W, for cable diameters 0.24"-0.48"

D. Loudspeaker Labels:
1. Loudspeaker labels shall be polyester (or similar) adhesive-back type, shall be permanent, and shall be machine printable with a printer.
2. Face stock (print area) shall be white.
3. Size: as needed.
4. Manufacturer, or equal:
a. Brady
b. Brother
c. DYMO XTL or Rhino
d. Panduit
1) # C075X050YJJ; component label, laser/inkjet print, white face stock 0.75"W x 0.5"H

2.7 RACK BONDING

A. Refer to section 270526 for approved bonding products.

PART 3 - EXECUTION

3.1 GENERAL

A. Comply with the Execution requirements of section 270000.

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

C. Install products per manufacturers' instructions.

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

E. 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.

3.2 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. Verify that support infrastructure, including equipment racks, are in place prior to installation.
   5. 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.

3.3 INSTALLATION

1. Furniture connections
   a. Provide 2.5" diameter brushed stainless grommets at Av furniture locations. Coordinate AV requirements with furniture vendor.

B. Displays and Mounts
   1. Wall-Mounted Displays: Install mounts using fasteners approved for the mounting substrate. For framed walls, firmly engage fasteners into backing or, if no backing is present, into framing studs.
   2. Ceiling-Mounted Displays: Install mounts to structure using fasteners and mounting accessories approved for the mount and mounting substrate. Install seismic restraints as appropriate for the installation location. Conceal cabling within mounting columns where feasible.
   3. Securely install displays onto mounts. Complete final connections (power, signal, control, etc.).

4. Install accessories onto mounts or displays using approved attachment methods that guarantee the longevity of the installation. Accessories may be attached mechanically, if allowed by the display/mount manufacturer, or by using 3M TB3571/3572 hook and loop fastener tape or an approved equal.
5. Dress cables; ensure they are maximally concealed yet serviceable.
6. Adjust each display and mount to attain a true, square, and level installed result.

C. Video Walls (arrays of individual displays assembled to create a larger composite image)
1. Position all displays physically to align in a common plane.
2. Position all displays to have equal gaps between them. Provide gaps per the display manufacturers' specifications.
3. Verify consistent gapping by displaying full-screen images with horizontal, vertical, and diagonal lines. The evidence of proper alignment will be zero line offsets between adjacent displays.
4. Adjust displays or video wall processors for proper bezel compensation.
5. Verify correct bezel compensation by displaying full-screen images with diagonal lines. The evidence of proper adjustment will be an absence of line offsets between adjacent displays.

D. 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%.

E. Ceiling Microphones
1. Review field conditions, and coordinate with the Architect or Engineer to resolve conflicts with other trades' devices conflicting with microphone locations.
2. Route analog microphone cabling away from other cabling types. Where this cabling must cross other cabling types, install it at a 90° angle.
3. Install microphone preamplifiers, conversion devices, and other back boxes using safety wires attached to the building structure.
4. Prior to acceptance testing, confirm microphones do not produce audible buzz and/or noise.

F. Table Microphones
   1. Review table drawings, and coordinate with the Architect and Engineer to resolve conflicts with other tabletop or through-table devices conflicting with microphone locations.
   2. Coordinate microphone locations and installation activities with the Architect and Engineer prior to installing through-tabletop microphones and microphone receptacles.
   3. Route analog microphone cabling separated from other cabling types to prevent signal interference. Where this cabling must cross other cabling types, cross it at a 90° angle.
   4. Install microphone preamplifiers and other microphone-related conversion devices neatly, square to the table, and as hidden from view as possible. Coordinate the locations of these devices with the Architect and Engineer.
   5. Label and dress all cables neatly and with approved cable management products.
   6. Prior to acceptance testing, confirm microphones produce no audible buzz and/or noise.

G. Wireless Microphone Systems
   1. Mount antennas external to equipment racks.
   2. For wireless microphone systems using multiple antennas, space them per manufacturers' recommendations.
   3. For VHF and UHF wireless systems, use RF coordination software (such as Shure Wireless Workbench) to scan and coordinate frequencies of all wireless microphone systems to be installed into the project.
      a. Avoid local public safety channels when assigning frequencies.
      b. Verify frequency assignments do not interfere with each other and are free from dropouts

H. Antennas
   1. Use antennas designed specifically for the frequency bands they will carry.
   2. For antennas extended from the attached equipment, use cabling appropriate for the frequency and distance.
   3. Use extender devices (preamplifiers) and distribution amplifiers per cabling lengths and manufacturers' recommendations.
   4. Install cabling per manufacturers' bend radius guidelines.
   5. Locate and orient antennas to ensure coverage throughout the room(s). Verify this by walk-testing systems.

I. 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.

J. 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.

K. 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.

L. 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.

M. Room Scheduling Displays
1. Coordinate with the general contractor and specialty contractors to conceal cabling in glazing system frame members.
2. Room Scheduling displays will be provided in the future. Provide cabling to support future system.
3. Provide service loops to allow displays to be removed prior to disconnection.

N. Digital Signage
1. Digital signage software and hardware are owner furnished
2. Make digital signage players accessible and controllable via the network and via web access.
3. Coordinate with the Owner to determine configuration and/or initialization files are required by players/receivers to be managed by the Owner's local or cloud-hosted management platform.
4. Coordinate with the Owner's Representative to ensure a successful implementation of this requirement.

O. 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 (groups of bundled cables) 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.

P. 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		

Category	Subcategory	Type	Acceptable Manufacturers				Comments
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		
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

Category	Subcategory	Type	Acceptable Manufacturers				Comments
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		
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				

Q. 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.

R. 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.

S. 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.

3.4 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.

3.5 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.

3.6 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.

3.7 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. Set input devices (wireless microphones, ceiling microphones, video device audio, etc.) to unity gain.
3. Set output devices to unity gain.
4. Set amplifiers to maximum gain.
5. Set gains from microphones on analog and Dante/AES67 input blocks in audio processors to achieve input gains on meters around -15 to -20dBFS.
6. Set gains on analog and Dante/AES67 output components in audio processors to achieve required output gain from the loudspeakers.
7. Adjust gating auto-mixer settings so that room participants can be heard clearly with minimal room noise and echo, with no noticeable delay nor cutoff words when talkers begin to speak, and with minimal breathing and other artifacts after talkers stop speaking.
8. Adjust AEC settings so that no echo can be heard by far-end callers.
9. Balance program levels between HDMI program audio and USB bridge program audio to within 3 dB.
10. Coordinate AEC among all processing devices and software in the system so that only one processor in the audio chain, whether physical, such as a hardware DSP, or virtual, such as a software processor in collaboration software, has AEC enabled.
11. Make equalization and other room tuning adjustments to obtain the flattest and least colored result the system is capable of.
12. Make additional equalization and other room tuning adjustments to eliminate feedback when the microphones are at maximum system gain. Do not use feedback suppression components.

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 Menus: Provide a "tech" (Technician-level) 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 or an alternative method for password management, such as the use of Active Directory.
      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. BMS Interfacing
1. Coordinate with the Owner's Representative regarding interfacing between AV power control and the building management system. Comply with the Owner's requirements for reporting power control and/or power usage.

F. 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.

G. Equipment Configuration:
   1. Computer Interfaces, Signal Extenders and Transmitters with Integral Input Switching: Program devices and related system components so analog audio inputs are active regardless of which video input is selected.

3.8 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 Racks and Cabinets:
   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: Label wireless transmitters and receivers so users can clearly identify a given transmitter associated with its receiver.
   1. Use an identifier, such as a room number, that associates each transmitter with a given room or system.
   2. 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 AVIXA F501.01.
   2. Provide labels with machine-generated text; hand-written labels will not be accepted.
   3. Use a numbering system with a consistent number of characters for each cable’s unique identifier.
   4. Generate a unique identifier for each cable and wire using either the Owner’s system or AVIXA F501.01. Include primary level data elements per F501.01; secondary level data elements are optional.
   5. Label Installation:
      a. Install labels on both ends of cables at least 1” (25mm) and no more than 12” (300mm) from the connector strain relief or the heat shrink tube from which individual wires exit the cable jacket.

b. Labels must be visible; they may not be concealed by strain relief elements or within bundles.
c. Install labels such that they are visible by a technician from a normal stance.
d. Install labels according to label manufacturers' guidelines.

6. Label Legibility:
   a. Text margins shall be a minimum of 1mm in the printable area.
   b. Text shall not be obscured by any part of the label.
   c. Primary text shall be all capitals, no less than 2.5mm tall. Bold is permitted; italics are not.
   d. Secondary text shall be all capitals, no less than 2.1mm tall. Neither bold nor italics are permitted.
7. Label Consistency:
   a. All primary labels shall have the same width. All secondary labels shall also be the same width, but that width may differ from that of the primary labels.
   b. All label shall be of sufficient height for the outer dimensions to meet the manufacturer's installation.
   c. In environments and applications where additional physical protection is required to preserve label integrity and legibility for the specified design life, apply additional protective materials. In such cases, apply the additional materials to all labels in the system. If a specific design life is not otherwise specified, assume 10 years will be required.
   d. Primary labels shall utilize the same font type, font size, font spacing, and margin spacing except in the case of user-accessible cable labeling. Secondary labels shall utilize the same font type, font size, font spacing, and margin spacing. The properties of the primary labels may differ from the secondary labels, but they shall be consistent within each label type.
   e. Unless defined otherwise within the labeling schema, text shall be the same color. Text color shall present high contrast to the background color of the label. Black text on a white background is preferable, but where any other color scheme is used, a contrast of no less than 3:1 shall be achieved.

3.9 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. Fiber Optic Cable Testing: Follow the following procedures to test fiber optic cabling.
   1. Equipment, or equal:
      a. MicroCare Fiber Wipes, or equal
      b. SPC FiberXP DI-200 Fiber Optic Inspection Scope, or equal
      c. Fluke DSX-5000, AFL Noyes SMLP4-4 Fiber Optic Loss Test Kit, or equal
   2. Test Procedure:
      a. Using approved materials, clean each connector end face before testing.
      b. Using the inspection scope, inspect each connector end face.
      c. Multi-mode Fibers:
         1) Set up the optical loss test set under either IEC 61280-4-1 Single Reference Cable Method or the TIA 526-14 OFSTP-14 Method B.
         2) Measure the insertion of each fiber. Record the measurements.
         3) Re-terminate or replace cables with fibers that exceed 3 dB at 850 nm and 1 dB at 1,300 nm end-to-end insertion loss.
      d. Single-mode Fibers:
         1) Set up the optical loss test set per TIA-526-7 test method A.1 “One Jumper-Cable Measurement”.
         2) Measure the insertion of each fiber. Record the measurements.
         3) Re-terminate or replace cables with fibers that exceed 1.5 dB at 1,310 nm and 1.5 dB at 1,550 nm end-to-end insertion loss.

D. 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.

E. Audio System Testing:
   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: Measure audio system frequency response for the AV systems described in Part 1. Adjust systems to provide specified performance.
   4. Uniformity of Coverage: 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 Interference:
   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.

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.

3.10 CLEANING, PROTECTION AND REPAIR

A. Comply with the cleaning requirements of section 270000.

B. 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.		
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.		

Test	Description	Result	Comment
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.		
12	Record ambient noise, A-weighted, slow.		
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.*		
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.*		

Test	Description	Result	Comment
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”).		
20	Confirm speech reinforcement systems are stable, with no ringing nor feedback.		
21	For audio conference systems, adjust microphone input gain to demonstrate that a "standard talker" (60 dB SPL at 1 m), positioned at each talker position in the room, produces a 0 dB level at the input of the mixer bus of the audio conference DSP device. If there is local voice reinforcement ("mix-minus"), AGC and ALC may need to be restricted when performing this test. *Record test results as pass/fail. Record level across analog telephone line, if one is used. Inspect DSP mixer telephone line levels, both transmit and receive, when normal speech is encountered in the room.*		
22	For conferencing mode, at the __(65) dB SPL listening level, confirm full duplex operation, with no reports of echo or “speech trails” as detected from the far end.		

Test	Description	Result	Comment
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.		
25	For wireless microphone systems, with all wireless microphones turned on, confirm that throughout the specified operating area for the transmitter, there are no dropouts, intermodulation interactions between wireless systems, nor RF-caused artifacts.		
26	If required, for composite video sources, connect a test generator at each input and confirm 1 volt peak-to-peak to each destination ± 10% (or 1dB). R*ecord results at each destination using NTSC/PAL bars, peak white, and five-step multiburst (0.5, 1.0, 2.0, 3.0, 3.58, and 4.2 MHz).*		
27	For NTSC sources, confirm optimum brightness, contrast, and color in displays using a SMPTE source with PLUGE display.		
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		
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.		

Test	Description	Result	Comment
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.		
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.		

Test	Description	Result	Comment
39	Where cameras are included in system, confirm each operates correctly and provides correct image quality.		
40	Confirm camera presets are programmed as specified by the user. In the absence of Owner direction, create and document presets that are logical for the room's layout.		
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.		
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.		

Test	Description	Result	Comment
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 16 hours 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.

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, two-year, and three-year service with quarterly pre-emptive maintenance calls and same-day issue response
   2. One year, two-year, and three-year service with quarterly pre-emptive maintenance calls and 24-hour issue response

3. One year, two-year, and three-year service with quarterly pre-emptive maintenance calls and 48-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