SECTION 27 41 16
INTEGRATED AUDIOVISUAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Related Divisions and Sections: Coordinate the work of this section, including, but not limited to, the following other divisions, sections, and trades:

1. None

1.2 SUMMARY

A. General: Provide integrated audiovisual systems, including equipment and materials, whether specifically mentioned herein or not, to ensure complete and correctly operating systems in accordance with requirements of the Contract Documents.

B. The requirements described in this section include the following:

1. References
2. Definitions
3. System Descriptions
4. Submittals
5. Quality Assurance
6. Coordination
7. Project Management and Coordination
8. Delivery, Storage, and Handling
9. Scheduling
10. Warranty
11. Maintenance
12. Project Closeout and Record Documents

C. Refer to Bidding Requirements, Contract Forms, and the Conditions of Contract. Provisions listed or specified therein apply to work under this section.

D. Alternates: None

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

1.3 REFERENCES

A. General

1. Codes, standards, and industry manuals/guidelines listed by reference, including revisions by issuing authority, form a part of this specification section to the extent indicated. Consider such codes and/or standards a part of this specification as though fully repeated herein.

2. Standards listed are identified by issuing authority, authority abbreviation, designation number, title, or other designation established by the issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation.

3. Reference to codes, standards, specifications, and recommendations of technical societies, trade organizations, and governmental agencies shall mean that the latest edition of such publication is adopted and published prior to the submittal of the bid unless otherwise specifically stated.

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

1. California Code of Regulations (CCR):

a. Title 8, “Industrial Relations”

1) Chapter 3.22, “California Occupational Safety and Health Regulations (CAL/OSHA)”

b. Title 24, “California Building Standards Code”

1) Part 1, “California Building Standards Administrative Code”

2) Part 2, “California Building Code” (CBC)

3) Part 3, “California Electrical Code” (CEC)

4) Part 11, “California Green Building Standards Code” (CALGreen)”

2. National Fire Protection Agency (NFPA)

a. NFPA 75, “Protection of Information Technology Equipment”

b. NFPA 262, “Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces”

3. Code of Federal Regulations (CFR) Title 47 “Telecommunication”, Chapter I “Federal Communications Commission (FCC)”:

a. Part 15, “Radio Frequency Devices and Radiation Limits”

b. Part 27, “Miscellaneous Wireless Communications Services”

4. International Code Council (ICC):

    a. “International Building Code” (IBC)

    b. “International Fire Code” (IFC)

    c. “ICC Performance Code”

5. Other applicable national, state, and local binding building and fire codes

C. Perform work in accordance with applicable requirements of governing codes, rules and regulations including the following minimum standards, whether statutory or not:

1. FCC Federal Communications Commission

2. City, and other local codes and requirements

3. UL Underwriters Laboratories

4. ASTM American Society for Testing Materials

5. NEMA National Electrical Manufacturers Association

6. ANSI American National Standards Institute

7. ETL Electrical Testing Laboratories

8. SMPTE Society of Motion Picture and Television Engineers

9. EIA Electronic Industries Association

10. ISO International Standards Organization

11. Sound Systems Engineering, 2nd Ed., Davis and Davis, Howard W. Sams Co., 1987

D. Provide products and systems compliant with the following standards:

1. ANSI/AVIXA 1M-2011: Audio Coverage Uniformity in Enclosed Listener Areas

2. ANSI/AVIXA 3M-2011: Projected Image System Contrast Ratio

3. NFPA 262: Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces

4. UL 813: Commercial Audio Equipment

5. UL 1419: Professional Use Video and Audio Equipment

6. UL 1480: Speakers for Fire Alarm, Emergency, and Commercial and Professional Use

7. UL 1492: Audio-Video Products and Accessories

8. UL 60065-1: Audio, Video and Similar Electronic Apparatus

1.4 DEFINITIONS

A. The following list of definitions as used in this specification are defined as follows:

1. AFF: Above Finished Floor

2. AHJ: Authority Having Jurisdiction

3. Cabling: Installed media ready for electronic or optical signal circuit use; a complete media connection comprised of cables, termination apparatus (patch panels, blocks, connectors), outlets, connecting media (path cord, cross connects), labeling

4. CBC: California Building Code (CCR Title 24 Part 2)

5. CCR: California Code of Regulations

6. CEC: California Electrical Code (CCR Title 24 Part 3)

7. Connect: To install patch cords, equipment cords, cross connect wire, etc. to complete an electronic or optical signal circuit

8. Cord: A length of cordage having connectors at each end. The term “Cord” is synonymous with the term “Jumper” and “Lead”

9. Engineer: BrookTrout Designs

10. First-in-Place: A single unit of work for the Owner’s and Engineer’s review and written approval prior to proceeding with the work of the entire project

11. Furnish: To purchase, procure, acquire, and deliver complete with related accessories

12. GC: General contractor

13. Identifier: A unique code assigned to an element of the telecommunications infrastructure that links it to its corresponding record

14. Install: To set in place, join, unite, fasten, link, attach, set up or otherwise connect together and test before turning over to the Owner, parts, items, or equipment supplied by contractor or others. Make installation complete and ready for regular operation.

15. IOR: Inspector of Record

16. LED: Light Emitting Diode

17. MSDS: Material Safety Data Sheets

18. NEC: National Electrical Code (NFPA 70)

19. NEMA: National Electrical Manufacturers Association

20. NFPA: National Fire Protection Agency

21. NIC: Not in Contract (work or equipment)

22. OFCI: Owner-furnished contractor-installed; coordinate the integration of components furnished by the Owner; provide mounting hardware, cable, connectors, etc. to ensure proper integration of OFCI equipment

23. OFE: Owner-Furnished Equipment

24. Owner: The entity for whom the project is being built

25. PDF: A file saved in the Adobe Portable Document Format

26. Pigtail: A length of cordage having connectors at one end

27. Provide: To furnish, transport, install, erect, connect, test, and turn over to the Owner, complete and ready for regular operation

28. UL: Underwriters Laboratories

B. In addition to those definitions of paragraph 1.4.A, 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 these audiovisual contract documents.

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. BYOD: “Bring your own device”: a laptop, tablet, or smart phone a system user intends to use with an audiovisual system.

7. Custom: Systems or components the Contractor fabricates based on this audiovisual contract document package

8. EDID: Extended display identification data

9. HDCP: High-bandwidth digital content protection

10. HDMI: High-definition multimedia interface

11. Or equal: An item that is equal in function and performance to the specified device or system

12. RU: A 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 audiovisual contract document package.

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 software created for the control or operation of the audiovisual systems in this Project.

21. Control System Development Software: Use Aurora ReAX™ Core Studio AI software to create user interfaces and control logic for this project. Note: Manufacturer to do off-site programming and testing of system as part of Project Master Quotation - S2404-00541 (attached).

22. 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.

23. System: A package of audiovisual components, cabling, programming, installation and configuring efforts resulting in a package that functions in an integrated system.

1.5 SYSTEMS DESCRIPTIONS

A. General

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

B. Rooms and Spaces (overview)

1. The following provides a list of rooms and spaces included in the project and an overview of requirements for them. Detailed requirements follow.

a. **Board Chambers**. A formal meeting space used for scheduled government agency meetings. The Council Chambers encompasses the upper and lower dais, audience seating and presentation podium.

During meetings, the System will operate in a conventional formal board room manner. In addition to audio/video presentation and sound reinforcement, the System will also create an internet Live Stream, and host remote participants via Zoom.

Control of the system will be from the Clerk's touch panel and the Technician's touch panel. Members will also be able to control their individual microphone mutes and cast votes from individual touch panels on their multi-function controllers.

b. **System Tech Room**. This room encompasses both the system racks and technical equipment and the system operator(s). The system racks include all of the audio/video/control head-end equipment.

The operators will work with the NewTek Tricaster to manage the Live Stream and camera content to the Council Chambers and ancillary room displays. Operators will also have a duplicate touch panel for controlling the presentation system. A display allows the Tricaster operator to monitor the cameras and Zoom system.

c. **External Hallway**. There are two displays in the Hallway for video overflow of Board meetings. Show the Live Stream on the displays

2. Rooms and Spaces (detail)

a. Board Chambers

1) Audio.

a) Provide multifunction touch panel/microphone/loudspeakers for microphones and personal speakers at the upper and lower Dais. Each device will have microphone on and mute buttons. The loudspeaker incorporated into the housing will function as part of the mix-minus system for local dais sound reinforcement.

b) Provide a multifunction touch panel/microphone/loudspeaker for the presentation lectern for microphone and personal speaker, as well as an audible and visible presentation timer. Connect it to local and Zoom audio via Dante.

c) Provide desk microphone for the Secretary station on the upper dais. Wire for external control for mute function with a 5-pin XLR connection. Provide 3.5mm input for line level music source.

d) Retain existing ceiling speakers. Incorporate into new system. Tune for optimum performance.

2) Video.

a) Retain four existing displays for presentation and display of remote participants via Zoom. Distribute video content to displays via networked video transmitters.

b) Retain existing display at Presentation Lectern for existing PC.

c) Provide three PTZ video cameras in existing camera positions.

d) Provide presentation inputs at the Secretary PC at upper dais, the existing PC and BYOD HDMI input at the Presentation Lectern.

3) Control.

a) Utilize previously mentioned touchpanel/microphone/loudspeaker devices for upper and lower dais

b) Specialized Lighting. Provide a spotlight for the Solano CCD logo behind the upper dais.

b. Tech Room

1) Audio.

a) Provide two channels of wireless microphones for audience use.

b) Provide assisted listening transmitter with six receivers and four neck loops.

c) Provide an assisted listening system antenna.

2) Video.

a) Provide a video presentation transmitter for sources in the Tech Room.

b) Provide video presentation system for production of Live Stream and in-room presentation, as well as remote participants via Zoom.

3) Control.

a) Provide PoE+ network switch for primary distribution of control signals, Dante audio distribution, and NDI video distribution.

b) Provide PTZ NDI camera controller.

c) Provide logic control of the Secretary's microphone.

d) Provide relay control of IoT Relay Power Oulet

e) Coordinate with the control system manufacturer for the integration of the control system software included in Master Quotation - S2404-00541.

f) Provide commissioning of the control system.

c. External Hallway

1) Audio.

a) Utilize existing ceiling speakers as discrete zones for audio reinforcement of Zoom meeting presentation on existing monitors.

2) Video.

a) Provide digital video receivers (for two existing wall-mounted displays.

3) Control.

a) Use RS232 to control existing displays from digital video receivers

1.6 SUBMITTALS

A. Bid Submittal

1. Document and certify the following general qualifications:

a. Firm has been in business providing similar service required by this section for not less than five years.

b. Firm can outline the general scope of past projects, normal staffing levels, and union status of shop and field installation personnel.

c. Firm can list a minimum of three projects of similar scope successfully completed in the past 24 months, indicating the location, type of system installed, total contract amount, date completed, and include persons and telephone number to contact.

d. Firm can submit confirmation of current state or local contracting licenses, as required to perform the work under this section.

e. Firm shall be an authorized supplier and installer for all equipment. Note: Aurora Multimedia authorized supplier certification is not necessary for bid. It is necessary to purchase equipment.

2. Subcontract:

a. No subcontract will be permitted unless specifically identified in the bid submission.

b. The contractor assigned this Section shall have sole responsibility for the satisfactory implementation of the work in this section, regardless of any subcontract arrangement.

3. Provide bid submittals in accordance with project Bidding Requirements, in addition to any additional requirements dictated in this section.

4. Schedule of Values: Provide a Schedule of Values for equipment to be supplied. Price each piece of equipment individually. Include required modifications and accessories in equipment costs.

5. Controlled Pricing:

a. Utilize Aurora Multimedia Master Quotation - S2404-00541 for all equipment and services listed on Master Quotation.

b. Master Quotation - S2404-00541 includes programming services for all Aurora Multimedia devices.

c. Ship equipment that requires network interconnection to Aurora Multimedia for configuration during off-site programming provided as part of the Master Quotation.

d. Master Quotation - S2404-00541 contact information:

1) Kyle Rosenbloom

Krosenbloom@auroramm.com

732-591-5800

205 Commercial Court, Morganville, NJ 07751

6. Non-Equipment Costs: Furnish separately a list of non-equipment costs for each area, by the following categories:

7. Engineering: Include costs for required design, drawings, run sheets, instruction manuals, etc.

8. Pre-Installation: Include fabrication, modification, assembly, rack wiring, etc., performed on the Contractor's premises.

9. Installation: Include on-site installation and wiring, coordination and supervision, testing, checkout, Owner training, etc., performed on the Owner's premises.

10. General and Administrative: Include General and Administrative expenses, shipping, insurance, and guarantees.

11. Fees: Include e-Waste disposal fees.

12. Service Contract: Submit service and maintenance costs as with the bid submittal.

13. System Enhancements: Submit recommendations which will enhance the performance of the system, or reduce costs without loss of performance, in the bid submission. Suggestions that are of value to the Owner will be taken into consideration in the evaluation of the bid returns. Make such proposals as "alternates", with the appropriate cost modifications shown separately and apart from the costs of the system "as specified".

14. Required Components: Systems must be complete and fully functional. Whether these components are explicitly enumerated in this Section, audio conferencing systems must include acoustical echo cancellers per microphone unless otherwise indicated, for example. Equipment racks must include all cable management, electrical power distribution, blank and vent panels, etc.

15. Subcontract Information:

    a. Identify subcontractors and their responsibilities and qualifications in the bid submission.

    b. Because of the complexity of the systems, the supervision of such subcontracted work cannot be intermittent. Provide virtually continuous supervision of subcontractors during the installation.

16. Provide exceptions to these specifications and related drawings with the bid submission. In the absence of exceptions, these specifications and related drawings are binding in letter and intent. It will further be assumed that the bidder has examined the design and specifications in detail and will assume full responsibility for the performance of the complete installation as designed and specified.

17. Key Personnel:

    a. Provide certification information for the Project Manager, Field Engineer/Technician, Field Installation Supervisor, and other key personnel who will be assigned to the project .

    b. Indicate educational, factory, and industry certifications for involved personnel and provide certificates for each.

    c. Include a list of staff that will be dedicated to the project and either their resumes or a listing of technical qualifications.

d. Designate a CTS-I (Certified Technology Specialist - Installation) certified employee to actively manage this project. Provide their current CTS-I certificate. CTS credentials will be validated at the AVIXA website.

18. Utilize the Audiovisual System Software Developer (ReAX™ Core Studio AI) defined in Part 1, Definitions, to perform audiovisual system commissioning,

19. Provide a list of any company-held certifications or designations appropriate for this project.

20. ReAX™ Core Studio AI Certification is required by Designated Staff Programmer for system commissioning.

21. Schedule of Implementation: Obtain projected dates when the relevant areas will be available for the on-site installation.

22. Investigate potential contract, union, and scheduling questions, and guarantee compliance with requirements and regulations in effect on the job site.

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

B. 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: Submit requests for substitution based on the specified equipment. Submit these requests with associated equipment costs, separate from the costs of the equipment as specified.

a. Where products are noted as "or equal", a product of equivalent design, manufacture, and performance will be considered. Submit product data (product information, catalog cuts, pertinent test data, etc.) to substantiate that the product is in fact equivalent to that specified. The burden of proof that the substituted product is

equivalent to the specified product rests with the Contractor. Whenever material, process or equipment is specified in accordance with an industry specification (ANSI, TIA, etc.), UL rating, or other association standard, present an affidavit from the manufacturer certifying that the product complies with the particular standard specification. When requested by the Engineer, submit supporting test data to substantiate compliance.

b. Proposals for alternate equipment will be considered if the differences between the specified and alternate/substituted equipment do not depart from the overall intent of the system's design and operation and are in the Owner's best interests.

c. Include in requests for substitution, full technical information and cut sheets for the proposed equipment.

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

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

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

3. Shop drawings: Electronically submit the shop drawings submittal via a cloud-based project management application (such as Proliance) or as a file transfer (such as Dropbox). Submit shop drawings prior to installation, including the following.

a. Cover Letter: Accompany each shop drawing submittal with a cover letter stating that the shop drawings have been thoroughly reviewed by the Contractor and are in full compliance with the requirements of the contract documents. Have the person who prepared the submittal sign (and stamp, if applicable) the cover letter and include a drawing index.

b. 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”).

c. 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.

d. Equipment rack elevations and patch panel assignments – clearly and consistently label rack elevations, patch panels, and on equipment controls.

e. Provide pushbutton and handheld remote-control panel layouts – tag each button with function and ID matching installed labels.

f. Factory and custom panels, plates, and designation strips, showing material, finish, color and engraving (exact lettering)

g. Custom designed consoles, tables, carts, support bases, and shelves

h. Equipment modifications (if any), including details of modifications that change or void manufacturers' warranties.

i. Cable run lists – clearly show at each terminal point the type of connector to be used; include typical wiring details of each connector; note where shields are connected and where they will float to ensure the integrity of the shielding system; indicate cable types and, where appropriate, color codes; assign wire numbers and patch bay locations to every wire and patch point in the drawing

j. Wattage tap setting per loudspeaker.

4. Touch screen menus submittal:

a. Provide a single PDF containing a page for each menu, submenu, and popup in that system's user interface. Include menus that are manually triggered and those that automatically appear as the result of events such as the connection of a source device. Ensure that the PDF is unlocked, so that the Engineer and Owner may annotate it. *Touch panel programming will be provided as part of the manufacturer's Master Quote.* The basic outline of the touch panels is as follows:

1) There are four touch panel layouts with complementary controls:

a) Upper Dais Positions

(1) Mic on/off and voting (yes/no/abstain) on a single page. Have the LED reflect mic on/off status.

(2) Lower Dais positions (RXT-4D)

(3) Mic on/off on a single page. Have the LED reflect mic on/off status.

b) Secretary (RXT-10D-B)

(1) System on/off

(2) Video presentation matrix page (inputs to outputs)

c) Audio page:

(1) Mic on/mute

(2) Faders/mutes for audio from video and audio from Secretary VPX-TC1- LT (used for "background and masking music")

(3) All mute button

(4) Are you sure you want to power off? (yes/no buttons)

d) Tech (RXT-10D-B)

(1) All functions of Secretary touch panel

(2) all mic gain controls (Dante outputs to be POST-gain)

(3) all mic faders (control of local audio)

(4) on/off for relay control of spotlight power outlet

(5) Are you sure you want to power off? (yes/no buttons)

5. Site Matrix/Network Coordination:

a. Submit on a Google Sheet, a list of equipment that will be connected to the Owner's network, including but not limited to the following (e.g., spreadsheet column headers):

1) Item number,

2) Description,

3) Manufacturer,

4) Model/part number,

5) MAC address,

6) IP address type (DHCP or static),

7) Hostname,

8) Power-over-Ethernet (PoE) requirements (yes or no; PoE type),

9) Specific network and/or subnet configuration requirements,

10) Specific QOS requirements,

11) Anticipated network traffic,

b. Return the completed Site Matrix to the Engineer at least one week prior to installing equipment in the field.

c. Once the completed site matrix has been provided to the Engineer, obtain their approval to connect network-enabled equipment to the Owner's network prior to connecting it.

d. When programming hostnames, capture a screen shot of the verified hostname programmed into the associated equipment. Provide screen captures to the Engineer, with room numbers included, in a single pdf prior to performing final engineering, programming, and documentation.

e. Provide any unusual or non-standard network requirements for any audiovisual devices when submitting the site matrix.

6. 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 electronic documents with testing procedures to be performed during pre-functional testing and acceptance testing, including the minimum acceptable outcome for each test.

C. Prior to Acceptance Testing:

1. A minimum of 10 business days prior to the scheduled "Go Live" date, submit an Initial Testing and Tuning Report showing procedures and results for tests performed to the Engineer. Provide the names of specific automated tests performed via testing tools or installed AV equipment.

2. Provide reports generated by automated tests using both standalone testing equipment and programs running on installed AV equipment.

3. Provide a list of the test equipment used for these tests.

4. Coordinate with the Owner to obtain a sample of the laptop computers and other portable devices, including any types of tablets and smartphones used for presentation. Confirm presentation systems are compatible with these devices.

D. Project Closeout / At the Completion of the Installation:

1. Provide written notification to the Owner and Architect when initial checkout is complete, normal settings are documented, as-built and operational documentation are complete, and systems are available for final acceptance tests.

Provide a completed copy of the initial testing report included in Part 3 of this Section. Acceptance testing will follow the submission of the initial testing report.

2. Submit equipment manufacturers' operation and maintenance manuals for each piece of equipment.

3. Submit a single page quick-start guide, with relevant screen captures of each page of the touch screen user interface. Submit these to the Owner prior to the first day of business.

4. Submit "as-built" drawings for systems and items indicated as "Custom".

5. Submit a copy of control system programming, including touch screen layouts, capable of being revised and compiled.

6. System Operation and Maintenance Manual:

    a. Provide a system quick start guide for each room type.

    b. Provide a list of necessary and recommended replacement parts for a normal maintenance period of one year.

    c. Assume the reader of this manual to be technically competent, but unfamiliar with this particular facility.

7. Provide a copy of control system software created for this project on USB portable storage drives including modifiable and clearly commented code capable of being compiled.

8. Provide a copy of audio processor configuration files created for this project on a permanently labeled USB portable storage drive.

1.7 PROJECT MANAGEMENT AND COORDINATION

A. Provide a project manager for the duration of the project to coordinate this Work with other trades. Coordination services, procedures and documentation responsibility include, but are not limited to, the items listed in this section.

B. Prepare and maintain a shop drawing review log indicating the following information:

1. The shop drawing number and a brief description of the system/material

2. The date of the review

3. The name of the individual performing the review

4. An indication whether follow-up coordination is required

1.8 DRAWINGS

A. Layout: Follow the general layout shown on the AV/Technology drawings except where other Work may conflict with these drawings.

B. Accuracy: Drawings for the Work within this Division are essentially diagrammatic within the constraints of the symbology applied.

C. The Drawings do not fully represent the entire AV systems installation. Specifically, the functional/single-line drawings indicate design intent only.

D. Complete the details necessary for detailed system design and document this work in shop drawings.

1.9 PERFORMANCE STANDARDS

A. Meet the following performance standards with each system, unless restricted by the published specifications of a particular piece of equipment. Notify the Engineer of any such restrictions.

B. ADA Compliance:

1. Display systems must meet ADA requirements for the display of closed captioning content, where applicable.

2. Control systems must meet ADA requirements for accessibility.

3. Audio systems must meet ADA assistive listening system requirements.

4. Wall-mounted devices protruding from the wall must meet ADA requirements.

C. Audio System:

1. Program Audio System:

a. Frequency Response: ± 3 dB per octave band, 100 Hz to 12,000 Hz. 3dB per octave roll off below 100Hz and above 12 kHz.

b. Total Acoustical Harmonic Distortion: Less than 2% at 90 dBC (1kHz reference) at four feet (1,220mm) above finished floor in the middle of the room.

2. Distributed Audio System:

a. Frequency Response: ± 3 dB per octave band, 125 Hz to 10,000 Hz. 3dB per octave roll off below 125 Hz and above 10 kHz.

b. Total Acoustical Harmonic Distortion: Less than 2% at 85 dBC (1kHz reference) at four feet (1,220mm) above finished floor in the middle of the room.

3. Adjust the gain structure for all audio system components (mixer input to amplifier output) to achieve the highest signal-to-noise ratio, 75 dB from 50 Hz to 15 kHz minimum.

4. Ensure that the audio frequency response of the electronics system with equalizers bypassed varies less than ±1 dB from 50 Hz to 12 kHz.

5. The electronic system audio distortion shall be less than 0.5% at 1 kHz at the equipment's rated input signal level.

6. Sound Output Capability: Provide program levels of not less than 95 dB and speech reinforcement levels of not less than 85dB in the seating area without objectionable distortion, rattles, or buzzes, employing as test signals several different samples of recorded music and microphones applied at each system input.

7. Hum and Noise: Hum and noise shall be inaudible (below the background noise level of the space) under normal operation and as observed in normal seat locations.

D. Control:

1. Provide IP-controlled power control interfaces to devices not provided with these, whether power control accessories are listed in this Section or not. Verify functional operation for specified control operations.

2. Illuminated feedback of the active function via illuminated or shaded pushbutton at operator and wired remote control stations.

3. Wireless systems shall neither be the source of, nor be affected by, radio frequency interference to/from external signal devices.

4. Take ergonomics into account when designing user interfaces. Be aware that the level of technical knowledge will vary between users. Follow these guidelines:

5. Graphics:

a. Avoid abbreviations; obtain Engineer’s authorization when they are necessary.

b. Size lettering at 1/8" minimum

c. Maintain background to lettering contrast

6. Positive logic: Provide programming that omits 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.

7. Timing: Prevent two or more commands being sent simultaneously to the same piece of equipment.

8. Linking: Provide linking of functions to require the fewest number of user actions to effectively control the equipment.

9. Clearing: Ensure that each media selection clears the previous audio and visual selection (e.g. Selecting PRESENTATION clears the audio as well as video section of the previous Blu-ray disk selection.

10. Defaults: Establish default power-up conditions for the system including device audio levels, warm-up routine, power conditions, switcher status and other default conditions as required by the Owner or Owner's representative.

11. Volume Memory: Provide easy-to-use memory for volume settings associated with each source device. These settings shall be maintained between alternate selections during each use – from power on to power off.

12. Status Indication: Buttons (hard and soft) which incorporate indicator light or inverted illumination capabilities shall be addressed through the software and programming.

13. Failsafe: No operation or sequence of operations shall cause the control system to become inoperable or interfere with further processing, correct operations or execution of commands.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Delivery

1. Deliver products to the site only when protected storage space is available.

2. Coordinate materials delivery with installation schedule to minimize storage time at jobsite.

3. Deliver materials in manufacturer's original, unopened, undamaged packaging and containers with identification labels (name of the manufacturer, product name and number, type, grade, UL classification, etc.) intact.

4. Immediately replace equipment damaged during shipping at no cost to the Owner, so as not to impact the construction schedule.

B. Storage and Protection

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

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

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

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

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

C. Handling

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

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

1.11 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. Warranty shall include service as described in 3.14 "Maintenance and Extended Service".

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

C. In the case of contractor-modified equipment (where the manufacturer's warranty could be voided), assume responsibility for that equipment's warranty.

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

1.12 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.

2. ("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.

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

4. 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, and the AV Contractor agrees that such sublicense is granted with consent of the third-party at no cost to the Owner, and Owner shall be entitled to use such software under the same terms as the AV Contractor.

5. The AV Contractor and third-party suppliers are not restricted from licensing the Software or any portion thereof to other customers.

6. At acceptance testing, the AV Contractor shall 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 requirements 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. The Contractor must 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. 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, 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 issue(s) in sufficient detail to allow them to be reproduced and notify the AV Contractor. Update the software, shall provide or post updated Software files as detailed above, shall demonstrate that the error has been resolved, and shall maintain updated Software files as detailed above within 48 hours of resolution of the error.

5. The AV Contractor is responsible to 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 in writing the AV Contractor promptly and give authority, information and assistance at the AV Contractor's expense.

6. The AV Contractor at its own expense and option shall, if able, procure for the Owner the right to continue to use the Software as licensed or to replace it with a non-infringing release. This shall not include any agreement by the AV Contractor to accept liability for patent or copyright infringement for beyond the Software as licensed and furnished for the Project. This also excludes any agreement by the AV Contractor to accept liability for patent or copyright infringements for methods and processes to be carried out by using said Software except those inherent in the furnished System.

7. All contracts with Third-party software suppliers will transfer from the AV Contractor to the Owner at Project acceptance by the Owner.

8. The Owner shall apprise the AV Contractor of activities it takes with Third-party software providers during the warranty period. Included activities would include discontinuing the use of any Software component, installing updated or alternate versions of the Software, revising the configuration of affected systems.

9. The Owner can contact the AV Contractor for questions at no additional cost during the warranty period, providing:

    a. The queries are related to the audiovisual systems defined in this document.

b. The query is asked by the Owner's staff or authorized representative.

c. The inquirer has attended the AV Contractor's or the manufacturer's training in the use of the systems defined in this document.

d. The question is not intended as design consultation.

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

D. Software License Terms

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

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

PART 2 - PRODUCTS

2.1 EQUIPMENT

A. Each component shall be the latest version of the specified model or type available at the time of bidding, as long as the updated devices provide the same or better capabilities and performance required by the system design.

B. Materials and equipment shall be new and shall meet or exceed the latest published specifications of the manufacturer.

2.2 EQUIPMENT SCHEDULE

A. General:

1. Note on quantities: Determine quantities of items with an A/S (as shown) or A/R (as required) in the Qty. column by performing a take-off of these items from the audiovisual drawings, and/or an analysis of required functionality.

2. USB Cabling and Extension: Refer to the Cabling Section below for performance requirements. Provide products as required to meet distance requirements for each application.

3. Equipment Schedule:

Item	QTY	Notes
Aurora Multimedia DTX-3232D	1	Master Quotation - S2404-00541
Aurora Multimedia DTX-44D	1	Master Quotation - S2404-00541
Aurora Multimedia RXS-2-i712-1T32G	1	Master Quotation - S2404-00541
Aurora Multimedia RXT-10D-B	2	Master Quotation - S2404-00541
Aurora Multimedia RXT-4D	17	Master Quotation - S2404-00541
Aurora Multimedia VPX-TC1- LT	9	Master Quotation - S2404-00541
Aurora Multimedia VPX-TC1-Pro	1	Master Quotation - S2404-00541
Chauvet COLORdash Par H7X IP	1	
Custom 3.5MM TRS Input Plate	1	
Dell S2425HS	2	
Dell S2725DS	1	
Generic Display	7	OFE
Generic PC (Existing)	1	OFE
Generic Distributed Speakers	4	OFE
Global Connect GCRL3A	1	
IoT Relay Powered Outlet	1	
Listen Technologies LA-381-01	1	
Listen Technologies LA-401	2	
Listen Technologies LR-3200-072	2	
Listen Technologies LS-31-072	1	
Listen Technologies LT-803-072-01	1	
Lumens VC-A71P-HNW	3	
Lumens VS-KB21N	1	
Netgear M4350-44M4X4V	1	Master Quotation - S2404-00541
NewTek TriCaster 1 Pro	1	
Powersoft Mezzo 324 A	1	
Shure MX412D/C	1	
Shure ULXD2/SM58	2	
Shure ULXD4D	1	

4. Network Assignments

Port	Name	Device	
1	Zoom Pc	Aurora Multimedia RXS-2-i712-1T32G	
2	Board Secretary Input	Aurora Multimedia VPX-TC1- LT	
3	Lectern Content Input A	Aurora Multimedia VPX-TC1- LT	
4	DSP B	Aurora Multimedia DTX-3232D	Dante
5		Aurora Multimedia DTX-3232D	NET

6	DSP A	Aurora Multimedia DTX-44D	Dante
7		Aurora Multimedia DTX-44D	NET
8	Wireless Receiver	Shure ULXD4D	
9	Tech Room Content Input	Aurora Multimedia VPX-TC1- LT	
10	Board Dais Touch Panels	Aurora Multimedia RXT-4D	
11		Aurora Multimedia RXT-4D	
12		Aurora Multimedia RXT-4D	
13		Aurora Multimedia RXT-4D	
14		Aurora Multimedia RXT-4D	
15		Aurora Multimedia RXT-4D	
16		Aurora Multimedia RXT-4D	
17		Aurora Multimedia RXT-4D	
18		Aurora Multimedia RXT-4D	
19	Lower Dais Touch Panels	Aurora Multimedia RXT-4D	
20		Aurora Multimedia RXT-4D	
21		Aurora Multimedia RXT-4D	
22		Aurora Multimedia RXT-4D	
23		Aurora Multimedia RXT-4D	
24		Aurora Multimedia RXT-4D	
25		Aurora Multimedia RXT-4D	
26	Lectern Timer Touch Panel 1	Aurora Multimedia RXT-4D	
27	Board Secretary Touchpanel	Aurora Multimedia RXT-10D-B	
28	Tech Room Touchpanel	Aurora Multimedia RXT-10D-B	
29	Ndi Camera Controller	Lumens VS-KB21N	
30	Chambers Monitors	Aurora Multimedia VPX-TC1- LT	
31		Aurora Multimedia VPX-TC1- LT	
32		Aurora Multimedia VPX-TC1- LT	
33		Aurora Multimedia VPX-TC1- LT	
34	Lectern Monitor	Aurora Multimedia VPX-TC1- LT	
35	Hallway Monitors	Aurora Multimedia VPX-TC1- LT	
36		Aurora Multimedia VPX-TC1- LT	
37	Live Stream And Zoom Production	TriCaster 1 Pro	NET/Dante
38	Shure Mic Controller	GLOBAL CONNECT	
39	Network Uplink		
10GB 1	Live Stream And Zoom Production	NewTek TriCaster 1 Pro	NDI
10GB 2	Room Camera 1	Lumens VC-A71P-HNW	NDI
10GB 3	Room Camera 2	Lumens VC-A71P-HNW	NDI
10GB 4	Room Camera 3	Lumens VC-A71P-HNW	NDI

2.3 CABLING

A. Cable Selection - General:

1. Refer to functional diagrams for signal type between equipment.

2. Select an appropriate cable construction, including external jacket properties and armor, when installing cables in aerial, outdoor, underground, corrosive, riser and plenum environments.

3. Select the appropriate rating and configuration of cable as required by local building code, electrical code, AHJ, and all applicable codes and regulations governing the installation.

4. Cables shall be continuous without splices

B. Manufacturers - General:

1. Crestron

2. Extron

3. Liberty

4. Belden

5. Canare

6. West Penn

7. Or approved equal

C. For systems using signal extension via STP and UTP cabling, use the extender system manufacturer's recommended cable type for the specific system and the cable run length to be used.

D. USB Cabling/Extension

1. USB 2.0 Performance

a. Meets USB 2.0 High Speed (480Mbps) Standard or greater

b. Supports mice/keyboard peripherals, controllers, cameras, mobile devices, memory hubs

c. Windows and Macintosh compatible

d. Supplies USB power from host device to receiver device

e. Active extension up to 65' distance:

1) Single-cable solution

2) No power required

3) Plenum-rated

f. Long-range extension up to 330’ distance:

1) Host and receiver unit size nominally 1” x 4” x 3”

2) Utilizes manufacturer’s recommended UTP or STP cabling type for the specific system and the cable run length to be used. At minimum, utilize a Category 6A type cable.

g. Manufacturers – Active extension up to 65’ distance:

1) Kramer CA-UAM/UAF

2) Or approved equal

h. Manufacturers – Long-range extensions up to 330’ distance:

1) Crestron USB-EXT-2

2) Or approved equal

2. USB 3.0 Performance

a. Meets USB 3.0 SuperSpeed (max 5Gbps) Standard

b. Supports touch screen peripherals, cameras, hubs

c. Supplies USB power from host device to receiver device

d. Active extension up to 50-meter distance:

1) Single-cable solution

2) No power required

e. Manufacturers - Active extension:

1) Telycam TLC-43 (30-meter)

2) Telycam TLC-45 (50-meter)

3) Or approved equal

E. The following cable manufacturers and types are listed as a reference to establish performance standards. Any of the equal manufacturers′ products can be used:

1. Audio Cable:

a. Microphone, 4-conductor star quad, low impedance: Belden #1172A

b. Microphone, single-pair cable: Belden #1800F

c. Line level, single-pair cable: Belden #9451

d. Microphone and line level, single-pair, plenum-rated cable: Belden #9451P

e. Digital audio, multi-conductor, stranded, AES/EBU cable: Belden #1350SB

f. Digital optical TOSLINK cable: TrippLite A102-Series

g. Digital coaxial, low-loss serial cable: Belden #1694A

2. Program Loudspeaker Cable:

a. Low impedance, multi-conductor cable: Belden 5000UE-Series

b. Low impedance, multi-conductor, plenum-rated cable: Belden 6000UE-Series

c. High impedance, 70V / 100V, multi-conductor, shielded, plenum-rated cable: Belden 5000FE-

d. Series

e. High impedance, 70V / 100V, multi-conductor, shielded cable: Belden 6000FE-Series

3. Digital Transport SM Fiber, MM Fiber Cables:

a. Refer to the appropriate communications spec section for fiber optic cabling requirements.

2.4 CABLE TIES AND SUPPORTS

A. Use plenum-rated cable in plenum-rated spaces. Where plenum-rated cable is used, provide plenum-rated and approved cable ties and supports.

1. Manufacturer:

a. Thomas and Betts #TYV525M

b. Or approved equal

B. Braided Sleeve

1. Manufacturer:

a. Techflex Braided Sleeving Products #PTN2.00-BK, Flexo PET 2” braided sleeve, black

b. Or equal

2.5 RECEPTACLES AND CONNECTORS

A. Manufacturers:

1. Canare
2. Switchcraft
3. Neutrik
4. Amphenol
5. Pomona
6. Extron
7. Liberty
8. Or approved equal

2.6 MODULAR CONNECTION FRAMES AND MODULES

A. A. Manufacturers/Series:

1. Extron/AAP and MAAP
2. Legrand/AVIP
3. AMX/HPX
4. Crestron/FTA-CP
5. Or approved equal

2.7 LABELS

A. Manufacturers:

1. Brady
2. Thomas and Betts
3. Or approved equal

B. Wire and Cable Labels:

1. Performance
    a. Self-laminating adhesive laser labels
    b. Machine printable with a laser printer
    c. Cable size: as required

d. Color: white label with black lettering

2. Manufacturer:

a. Brady wire marking labels WML–211-295 and WML-311-292

b. Or approved equal

C. Device Labels: Self-laminating, type-on tape, permanent adhesive labels. Use Helvetica 12-pt text

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: Examine the areas to receive the Work and the conditions under which the Work would be performed. Remedy conditions detrimental to the proper and timely completion of the Work. Do not proceed until unsatisfactory conditions have been corrected.

B. Verify that electrical requirements including junction boxes, floor boxes, ceiling loudspeaker enclosures, empty conduit and power circuits and receptacles are in place as shown on the drawings.

3.2 INSTALLATION

A. General: Include the delivery, unloading, setting in place, fastening to walls, floors, ceilings, counters, or other structures where required, interconnecting wiring of the system components, equipment alignment and adjustment, and other work, whether or not expressly required, which is necessary to result in complete operational systems.

B. Provide any accessory products required to provide a complete and functional cabling infrastructure system.

C. Manufacturer Support: Refer to manufacturer technical support for online help with basic room programming and setup.

D. Physical Installation:

1. Firmly secure equipment in place unless requirements of portability dictate otherwise.

2. Provide adequate for fastenings and supports with a safety load factor of at least four.

3. Secure plumb and square boxes, equipment, etc.

4. Install every item so that it not only functions correctly and is serviceable and replaceable but also that the result looks neat and professional.

a. Ensure any interface ports that require access have enough space to connect/disconnect cables and/or devices.

b. When possible, install devices in a way that allows service personnel to quickly view the status lights and access control buttons.

5. Furnish the manufacturer remotes for all displays and hand them to the local IT representative.

6. Set display video settings to produce clear, natural image for computer graphics or text. Confirm the display is not set to over scan.

7. For all HDMI computer signals requiring cable runs longer than 20 feet, install approved HDBaseT or DM extension systems with the required hardware and necessary faceplates.

E. Attachment of Devices to Displays and Projectors:

1. If no specific mounting hardware is indicated, attach small devices to displays and projectors using 3M™ part number TB3571/TB3572 or an approved equal only.

2. Prepare mounting surfaces per the manufacturer's instructions.

3. Where possible, mount devices inset from the sides of displays to minimize their visibility.

4. Mount devices square and plumb.

5. Mount each device such that neither the device's nor the display's cooling is impaired.

F. Equipment Configuration:

1. Scalers: Set output resolution to match that of the attached display device.

2. Projectors: Disable electronic lens shift and keystone correction.

3. EDID Strategy:

a. The system color space will be RGB.

b. Program EDID management preferences for a maximum input resolution of 3840x2160 for rooms with 4k displays, otherwise use 1920x1200 or 1080p depending on the output device.

G. Security Configuration:

1. Change default passwords; coordinate with the Owner's representative to obtain passwords for all password-protected devices and systems.

2. Install the latest security patches for all included equipment and systems.

3. Disable unused communication ports and protocols.

H. Cable Installation:

1. Mark cables, regardless of length, with permanent, non-handwritten number or letter cable markers per the instructions below in Labeling. There shall be no unmarked cables in the system.

2. Furnish screw-type terminal blocks, boards, strips, or connectors, for cables which interface with racks, cabinets, consoles, or equipment modules. Terminate wires terminating at screw-type terminals with crimp-on lugs. "Telephone-style" punch-down blocks are not acceptable for signal and data wiring.

3. Group cables according to the signals being carried. In order to reduce signal contamination, form separate groups for the following cables:

    a. Power cables

    b. Control cables

    c. Analog video cables

    d. Digital audio and video cables

    e. Analog microphone audio cables

    f. Analog line audio cables

    g. Loudspeaker audio cables

    h. RF cables

4. Where possible, run power cables, control cables, and high level cables on the left side of an equipment rack as viewed from the rear. Run other cables on the right side of an equipment rack, as viewed from the rear. Where wiring issues preclude this orientation, it is acceptable to deviate from the directions above, as long as separation is maintained between signal and electrical power cables.

5. Provide a service loop of appropriate length within racks and at boxes or points of termination to allow each piece of equipment to be removed from the front of the rack for servicing. Provide service loops at boxes or points of termination to allow the equipment to be removed and laid flat on a surface for servicing.

6. Install no cable with a bend radius less than that recommended by the cable manufacturer.

7. Clearly identify cable terminated in a floor pocket with permanent, indelible, computer or label printer labels within 6" of the cable connector. Provide strain relief for cables. Provide a minimum of 3' of free cable coiled in the floor pocket. Use nylon cable ties to group similar cable types.

8. Install network patch cords, provided under the structured cabling work, between the AV network switch and/or serving data/voice faceplate and audiovisual equipment. Coordinate network connections to the Owner’s network with the telecom contractor. Refer to the patching matrix for information.

9. Provide cable management for all exposed cabling, and bundled cabling routed to portable or quasi-portable equipment. Protect cables with braided sleeve between feedpoint and bottom of furniture or equipment connections. Exercise caution to prevent scraping, cutting, or other damage to cable′s jacket.

I. Jacks and Connectors:

1. Panel-mounted jacks must be recessed and have isolated grounds.

2. Contacts must be silver- or gold-plated over brass.

3. Unless otherwise required in these specifications and drawings, use the following types of connectors:

a. Microphones without mute controls: XLR-3 female

b. Microphones with mute controls: XLR-5 female

c. Line level audio: Combination XLR-3 or ¼" TRS

d. Loudspeaker: Neutrik Speakon or Switchcraft equivalent

e.

f. RF: F

g. Wired Remote Control (multiplex signal): XLR-5 female

h. Wired Remote Control (relay contacts): Neutrik Neutricon

J. Interface Plate Designation: Clearly engrave wall-mounted interface plates with alphanumeric identification of input type (i.e., mic, line, speaker, video, etc.) and corresponding patch field designation.

K. Blank Panels:

1. Provide and install trim and blank plates in all floor, wall and furniture-mounted boxes that incorporate audiovisual connectivity within the assembly, including but not limited to:

a. Blank standard ganged plates

b. Blank Decora-style plates

c. Blank modular (e.g., AAP and MAP) plates and inserts

d. Blank vendor-specific plates and inserts

L. Grounding Procedures: To minimize problems resulting from improper grounding, and to achieve maximum signal-to-noise ratios, adhere to the following grounding procedures:

1. General: Because of the great number of possible variations in grounding systems, follow good engineering practice, as outlined above, and deviate from these

practices only when necessary to minimize crosstalk and to maximize signal-to-noise ratios in the audio, video, and control systems.

2. System Grounds: Establish a single primary "system ground" for the systems in each particular area. Connect grounding conductors in that area to this primary system ground. Provide the system ground in the audio equipment rack for the area. The ground shall consist of a copper bar of sufficient size to accommodate secondary ground conductors.

3. Rack Ground:

    a. Connect the No.6 insulated copper wire connected to the earth ground to the primary system ground busbar in the Equipment Rack.

    b. Bond a No.12 TW stranded wire from the Equipment Rack frame to the primary system ground bus bar.

4. Equipment Grounds: Grounding methods used will be dependent upon individual equipment interconnection of chassis ground, circuit common, and power supply common within the units.

5. Provide ground method for equipment types as follows:

    a. Equipment having a three-wire power cord with green wire of the power cord connected to chassis (Signal common is not internally connected to chassis): Make no connection from chassis ground to primary systems ground bus bar in Equipment Rack.

    b. Equipment having a three-wire power cord with green wire of the power cord connected to chassis: Make no connection from chassis ground to primary system bus bar, but do make connection with 14AWG insulated wire from circuit common to primary system ground busbar in Equipment Rack. Separate circuit common from chassis ground.

    c. Equipment having a two-wire power cord, no green wire, neutral is not tied to chassis, and circuit common is tied to chassis: Make connection from chassis to primary system ground bus bar using 14 gauge insulated wire.

    d. Audio Cable Shields: Ground audio cable shields at one point only. There are no exceptions.

    e. For inter- and intra-rack wiring connect the shield at one end only. For ungrounded portable equipment, such as microphones, connect the shield at both ends.

M. Recognition: Provide a single-rack-unit blank panel for each rack with the BrookTrout Designs logo, the Contractor’s logo and the following text:

1. Designed by: BrookTrout Designs, www.BrookTroutDesigns.com

2. Installed by: [Contractor Name]. [Contractor telephone number].

3. Obtain the BrookTrout Designs logo by requesting it from the Engineer. Do not scale a bitmapped graphic obtained from the internet.

3.3 NETWORK

A. General

1. Coordinate audiovisual device connectivity to the Owner’s network with the Owner’s representative.

B. AV Port Matrix: For network-enabled devices, complete and return an AV Port Matrix which will be issued to the construction team after network labeling plans are issued.

1. Refer to the Site Matrix Submittal information provided in Part 1 for additional requirements.

C. Laptop Connectivity

1. Provide network interface card/module MAC address information for any laptops that will be directly connected to the Owner’s network during the setup and programming of the audiovisual system.

2. Furnish this information to the Owner’s project representative at least 3 weeks prior to the start of the system’s configuration.

3. Utilize temporary network access on the Owner’s network to verify network connected devices are visible and accessible for setup.

4. Notify the Owner after completing configurations on the audiovisual equipment connected to the Owner network.

3.4 PROGRAMMING

A. Devices with frequent need for the replacement of consumables, and the ability to send notifications based on equipment error, shall use the computer network for preventative maintenance.

1. Coordinate with the Owner’s Representative to obtain the default email address for maintenance messages.

2. Ensure Owner’s Representative can revise the maintenance email address via a simple method – using a single address for all networked AV devices. Contractor shall document this procedure in the Operations Manual.

B. Power Control and Sequencing

1. Provide power control interfaces for devices not provided with these, whether these accessories are listed in this Section or not. Specify accessories compatible with the specified control products.

2. Ensure that all non-essential items are turned off or placed in a low power consumption operation mode when system is turned off. At minimum, program the AV system to turn off the following types of devices when it is not in use.

a. Audio amplifiers

b. Displays

c. Cameras and respective controllers

3. Sequence power on and power off cycles to ensure these take place with no audible and only minimally visible artifacts, pops, etc. When turning systems on, use the following sequence.

a. Turn on source devices.

b. Turn on processing and routing devices.

c. Turn on amplifiers, displays and projectors.

4. When turning systems off, use the following sequence.

a. Turn off amplifiers, displays and projectors.

b. Turn off processing and routing devices.

c. Turn off source devices.

C. Touch Panel / Control System

1. Only use the color red for alarm indicators and other buttons and indicators of special significance.

2. Unless the Owner indicates otherwise, avoid the use of technical terms; use clear, everyday language. Instead of “System On”, for example, use “Turn System On”; instead of “Power Down”, use “Turn Power Off”, etc.

3. Ensure items with similar functions appear consistently in all menus.

4. Ensure all buttons are sized similarly and spaced evenly.

5. Ensure spelling is 100% correct.

6. Menus throughout the project should appear and function consistently, across touch panels and control system web pages.

7. Video Conferencing Cameras

a. Coordinate with the Owner’s representative for camera PTZ presets. Train staff on setting camera presets and manual camera control with the PTZ control device.

8. Audio – General

a. Include a Privacy button that is accessible from every screen in control system menus. Its function shall be to mute all outgoing audio.

b. Program the system to mute all outgoing audio upon system shut-down.

c. Provide independent volume control and mute functions for the following source types (as applicable per room type):

1) Zoom

2) Program Audio (Laptop HDMI inputs)

3) Microphones

9. Touch Panel Guidance

a. Touch Panel information is provided in Submittal section 1.6-B-4 above.

D. Audio Systems

1. Provide appropriate mixing, equalization, delay, feedback suppression, filtering, gating, limiting, number of open microphones (NOM), etc. to accommodate both room properties and system functional requirements.

2. Route system audio via Dante to Tricaster for Zoom and live streaming.

3.5 COMPUTER INTERFACE/EXTENDER/TRANSMITTER CONFIGURATION

A. For computer interfaces, signal extenders and transmitters with integral input switching (DisplayPort/HDMI, for example) program each device and any other system components involved so that the analog audio input (if present) is active regardless of which video input is selected.

3.6 CUSTOM FABRICATION

A. Remote Control Panels and Interface Plates. Fabricate with 1/8 inch (3mm) thick #6061-T6 aluminum material. Finish brushed with 150 grit paper. Anodized finish to be black or as approved by the Architect.

Equipment Rack: Provide power receptacle strips, with "U" ground outlets. Power receptacle strips shall be mounted on the rear interior of the rack space on the left side as viewed from the rear. Insulate power receptacle strips from the rack. Power receptacle strips shall be Middle Atlantic or approved equal. Provide UL-approved LED work lights magnetically attached on the upper left interior panel of each rack space.

B. Audio Transformers: Provide appropriate impedance ratio and power handling capacity for the function intended of audio transformers specified in the system.

C. Networks and Pads: Provide networks and pads as shown on the drawings or as required to achieve proper impedance matching and levels. Networks and pads shall be balanced. 0.5 watt, 5% composition resistors shall be soldered to fixed connection points at each end.

D. Loudspeaker Niches: Loosely fill with glass fiber to 2 lbs./cu. ft. density prior to installing loudspeakers.

E. Sound Bar Loudspeakers: Where vertical or horizontal sound bar loudspeakers are specified directly adjacent to the display, sound bar height or width is to match the dimension of the display exactly for seamless integration, as available from the specified manufacturer.

F. Labeling: Provide permanently mounted 1/32" thick by 1/4" high black engraved or anodized, brushed aluminum labels with 1/8" engraved lettering for each piece of equipment and every user-adjustable control and input on the audiovisual equipment. Provide 3/8″ to 1/2″ high permanent labels on the back of each piece of equipment. Label should be white with black lettering. Label adhesive must be permanent.

G. If the serial number of a piece of rack-mounted equipment is not visible on the rear panel, provide a visible, permanently-attached label on the equipment, duplicating the serial number.

H. Rack Shelves/Mount Adapters: Provide the appropriate factory or custom rack shelves/mount adapters for equipment installed in the audiovisual equipment rack, whether specifically itemized or not. Acceptable manufacturers for custom rack adapters: Middle Atlantic, Winsted, APC/Stantron.

I. Provide security covers or shaft locks for all level controls, as appropriate, on all equalizers, crossovers, signal delays, and other adjustable signal processors.

J. System Functional Diagrams: Provide reduced-size as-built functional diagram for the control, audio and video system. Frame with acrylic cover, or laminate drawing, and mount adjacent to equipment rack.

K. Seismic Safety: Mount and brace permanently-installed equipment to the building structure per the most stringent of applicable codes and regulations to minimize potential damage to personnel or equipment from foreseeable seismic events. Bolt audiovisual equipment racks to the floor to prevent toppling. Brace hanging audiovisual and associated equipment both to minimize sway and to prevent detachment from the overhead structure.

3.7 FIELD QUALITY CONTROL

A. Initial Tests and Measurements: Before final adjustment and acceptance tests are scheduled, perform system checkout. Furnish required test equipment and perform work necessary to determine and/or modify performance of the system to meet the requirements of this specification. Include the following:

1. Adjust, balance, and align equipment for optimum quality and to meet the manufacturers′ published specifications.

2. Perform the test procedure provided with this specification and return the completed form no less than one week prior to the initial punch walk.

3. Install 1/8" diameter vinyl "map dots" as indicators for nominal operating positions of rotary, slider, or switch controls available for operator adjustment. Provide multiple indicators, adequately distinguished, for controls having more than one nominal operating position.

B. Twisted-Pair Cabling Infrastructure: If audiovisual system includes twisted pair cabling infrastructure, test the twisted pair cabling using the following procedure.

C. Required Equipment: Fluke DTX-1800 or equal

D. Test Procedure:

1. Test each cable using the CAT6 Channel test

2. Ensure that each cable passes the test. Re-terminate or replace all cables that do not pass.

E. Digital Video Cabling: Follow the following procedure to test each provided digital video cable.

1. HDMI:

a. Required Equipment:

1) Quantum Data 780

2) Or approved testing device

b. Test Procedure:

1) Test each cable.

2) Discard all cables that fail.

F. Audio System:

1. Loudspeaker-Line Impedance: Measure the impedance at 63 Hz, 250 Hz, and 1 kHz and the resistance of each loudspeaker line leaving the sound equipment rack with the line disconnected from its normal driving source. For lines to full-range distributed loudspeaker systems, measure the magnitude of 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 will be achieved with 0 dBm at a line-level input.

c. Terminate line-level inputs with shielded resistors of 150 and 600 ohms, respectively, for these measurements.

d. Disconnect loudspeaker lines and terminate power-amplifier outputs with power resistors for these measurements. The value of the load resistor shall be within 5% of the nominal load impedance of the amplifier under test. The power rating of the resistor shall equal the power rating of the amplifier.

3. System Frequency Response:

a. Measure frequency response using the audio systems described in Part 1. Adjust gain and equalization to provide octave-band sound levels as specified.

b. Programmable Equalizers: Provide necessary controller with full audio spectrum display for the adjustment of programmable equalizers during system checkout. Do not provide equalizer programmers with the systems.

4. Uniformity of Coverage: Measure octave bands of a pink noise test signal played through the loudspeaker system.

5. Power-Output and Signal-Level Adjustment within System:

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 an oscillator 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 the total harmonic distortion of the amplification and control 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. Lack of clipping or apparent deformation of a sine-wave input signal at the power amplifier output, as seen on the oscilloscope, may serve as evidence that distortion of amplification and control equipment is within acceptable limits.

e. Make measurements with loads actually incurred in the system operation. Power-amplifier loads shall be power resistors equal to the nominal load impedance of the output terminals used in the system.

6. Loudspeaker Polarity

a. Perform polarity checks of loudspeaker lines by means of a polarity tester. Loudspeaker lines shall be identically polarized with respect to color coding: a positive signal at the input to all power amplifiers must result in a positive signal at all outputs.

b. Test loudspeaker polarity using a sine-wave test signal warbled about 500 Hz. The listener shall be located on axis of the loudspeaker. Switch the loudspeakers from nominally in polarity to nominally out of polarity with respect to the selected loudspeaker. With the loudspeakers in proper polarity, the quality and clarity of the music or speech should be greater, and the warble test signal should clearly come to the surrounding space from the loudspeaker.

7. Freedom from Parasitic Oscillation and Radio-Frequency Pickup:

    a. With systems set up for each mode of operation specified in the functional requirements, check to ensure 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. Employ an oscilloscope having at least 5 MHZ bandwidth for these checks.

    c. Apply slow sine-wave sweep from 50 Hz to 5 kHz at a level of 6 dB below rated power amplifier output voltage 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.

G. Control System:

1. Verify operational functions at each control interface position.

2. Verify operational functions of wireless control device.

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

H. Radio Frequency (RF) System:

1. Use a standard television receiver connected to each system outlet. Make a subjective evaluation of picture quality and verify that no visible components of cross modulation, ghosting, or beat interference appear when the receiver is tuned to each of the desired channels.

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

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

3.8 LABELING REQUIREMENTS

A. General Requirements

1. Label audiovisual system components. The components include, but are not limited to the following:

    a. Equipment Enclosures

b. Rack-mounted AV Devices

c. Portable AV Devices

d. Batteries

e. Wires and Cables

f. Equipment Racks

g. Terminal Blocks

h. Relays

i. Patch panels, and the termination positions within the patch panels

2. Provide labels that are consistent with the AV documentation.

3. Prior to installation, degrease and clean surfaces to receive nameplates and labels

B. Equipment Enclosures

1. Label each rack and cabinet with a designation corresponding to the system documentation.

2. Mount the label on the top of the rack or cabinet, centered horizontally.

3. Color: Black background with white lettering.

a. Example: Line 1: “AV-01” (1/2-inch high letters)

4. Audiovisual Devices

5. Label rack mounted devices associated with AV systems with a permanent, machine-generated, laminated label. Use 12-point black Helvetica text with a white background.

C. Batteries

1. Label batteries with the month and year installed.

a. Example: “April 2022”

D. Wireless Transmitters and Receivers

1. Label wireless transmitters and receivers, including, but not limited to wireless microphone systems clearly so users can identify the transmitter associated with each receiver.

2. Use an identifier that associates each transmitter with the room it is associated with, such as a room number.

a. Example: RM 230-MIC 1

E. Wire and Cable

1. Identify wire and cable clearly with permanent machine-generated labels wrapped about the full circumference within one-inch (25mm) of each connection.

2. Indicate the cable ID designated on the associated field or shop drawings and run list.

3. Assign wire or cable designations consistently throughout a given system; i.e., each wire or cable must carry the same number at both ends.

4. Position labels so they are clearly visible without the need to remove wire management devices or other obstructions.

F. Terminal Blocks

1. Label consistently with each block's designation in the AV documentation.

G. Relays and Transformers

1. Label consistently with each relay's and transformer's designation in the AV documentation.

3.9 COOLING PROVISIONS

A. Utilize thermostatically-controlled active cooling devices if necessary to keep device temperatures below manufacturer-specified maximums. Systems including devices operating above manufacturer-specified limits shall be rejected. Cooling systems utilizing fans running continuously, without thermostatic controls, will be rejected.

3.10 OWNER TRAINING

A. Provide training on the installed systems at the project site by a suitably qualified instructor, to designated personnel, to instruct them in the operation and maintenance of the systems.

B. Arrange with the equipment manufacturer for such instruction, at no additional cost, in the event qualified instructors are not available on staff for certain sophisticated equipment.

3.11 SYSTEM ACCEPTANCE TESTS

A. Perform system acceptance tests when initial system checkout has taken place and the Initial Testing and Tuning Report has been completed and submitted. System acceptance tests consist of the following:

1. Take a physical inventory of equipment on site and compare to equipment lists in the contract documents.

2. Demonstrate the operation of system equipment.

a. Provide on-site access to the Project Manager, Field Engineer, and Control and Audio System Programmers for the duration of the acceptance testing.

B. Both subjective and objective tests will be required to determine compliance with the specifications. Provide test equipment specified for these tests.

C. Coordinate with the Owner to obtain a computer specified for use as a test source. Use this computer in conjunction with a contractor-provided computer to verify audio and video signal stability at all computer input locations.

D. Provide final, "as-built" drawings, run sheets, manuals, and other required documents, as detailed in Submittals.

E. Provide complete testing reports generated by subsystems that provide self-testing.

3.12 INITIAL TESTING AND TUNING REPORT

A. Use additional pages as necessary to allow complete comments.

Test	Description	Result	Comment
1	Record all equipment that was specified but is not present. For each item, provide a reason this equipment is not present.		
2	Confirm no sharp or jagged surfaces are accessible to a user.		
3	Confirm that each active device's external temperature, measured externally 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 in a consistent manner and are legible and unambiguous.		
5	Demonstrate that the full inventory is new equipment, in full compliance with the specification, or as modified by approved submission. Record test results as pass/fail, and list exceptions.		
6	Confirm rack elevation and flow drawings, cable and other labels and engravings present an accurate model of the furnished system and comply with latest revised specifications. Record test results as pass/fail.		
7	Confirm all inputs and outputs of switchers are labeled (wherever possible), so that users can easily make manual routes quickly without having to refer to the system drawings.		
8	Confirm all channels on amplifiers are properly labeled, so technicians can make quick adjustments without having to refer to the system drawings.		
9	Confirm all 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 RJ terminations are solid in their connectors.		
11	Confirm each coax cable respects a bend radius of at least 5x the cable’s radius or as recommended by the manufacturer.		

Test	Description	Result	Comment
12	Record ambient noise, A-weighted, slow.		
13	Confirm all 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 (Sound Pressure Level) 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 system can produce 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 while source is 15 dB above nominal operating level at each “destination”, for all sources selected.		
16	Confirm system develops a noise level that is electrically 55 dB below the normal operating level for all audio sources. “Noise” refers to 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 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 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),		

Test	Description	Result	Comment
	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. *Record test results as pass/fail. 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.		
23	Confirm equalizers, whether hardware or virtual, are adjusted for best intelligibility, and in accordance with the 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 interaction between wireless systems, or RF caused artifacts.		
26	Confirm projectors are focused, centered, and evenly illuminated. *If requested, confirm using a calibrated light meter that the brightest measurement locations shall be no more than +10% above average, and the dimmest locations no less than –5% below average measurement. Also 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.*		
27	Confirm system displays with stability, with no scaling-related visual artifacts when switching between, at a minimum, 1,920 x 1,080, 1,920 x 1,200 and 4,096 x 2,160, and 3,840 x 2,160 sources, and/or all those specified in the performance criteria for this system. *Record test results.*		
28	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 an Alt Pixel test		

Test	Description	Result	Comment
	image for each resolution included in the design intent, or if not provided, by default, 1,920 x 1,080, 1,920 x 1,200, 4,096 x 2,160, and 3,840 x 2,160, each at 30 and 60 fps. Inspect each, leaving the signal on for at least 10 seconds. Fail the system if any artifacts are visible. Note: If the signal is going to a codec, HDCP should be turned off. If the signal is going to a display, HDCP should be turned on for a complete HDMI test to verify cables and display input.		
29	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.		
	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.		
30	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.		
31	Confirm all switches and receptacles are logically and permanently labeled.		
32	Confirm all nomenclature for consistency: drawings, touch screen, wall plates, floor boxes, patch panels, equipment, etc.		
33	Confirm all patch cables have cable numbers.		
34	Where cameras are included in system, confirm each operates correctly and provides correct image quality.		
35	Confirm camera presets are programmed as specified by the user. If no preset requirements have been presented, submit suggested presets.		
36	Confirm TV reception from all sources included in the design intent and that all channel presets are accurate.		
37	Confirm that all codec options specified by the customer have been installed.		

Test	Description	Result	Comment
38	Confirm and document IP addresses and configuration information provided by the client and loaded into systems, including IP addresses, subnet masks, gateways, time server, gatekeeper, etc. Confirm that all network functions specified by the customer function properly on the customer's LAN.		
39	Confirm all web-based system control and monitoring features, and other IP functionality of system (time servers, system-generated e-mail, etc.) are completely functional.		
40	Confirm that display devices have On-Screen Displays/Menus disabled. If the customer has directed otherwise, indicate from which person this direction came.		
41	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, indicate from which person this direction came.		
42	Log all test conference calls (audio and video). Log shall include time, line used, number called, success of connection, 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.		
43	Confirm no display device has lost pixels when a Full White Test signal is displayed (7 pixels maximum per quadrant, or per manufacturer's spec). Note number and location of lost pixels, if any. Provide photos.		
44	Check for excessive vibration on VC camera(s) at full telephoto position.		
45	Provide video recording of all non-conformances and anomalies.		
46	Confirm all visible devices are installed square and plumb.		
47	Confirm no dust, grease, scratches, or any other signs of handling are visible on any devices		
48	Confirm assistive listening systems work throughout intended listening areas		
49	Where closed captioning is included in the design intent, confirm it is functional on all displays		

Test	Description	Result	Comment
50	Where closed captioning is included in the design intent, confirm control system user interfaces provide a means to enable and disable display of closed captions		

1. In the event 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.

2. If the need for further adjustments becomes evident during system demonstration and testing, continue work until the installation operates properly.

3.13 CLEANUP AND REPAIR

A. Upon completion of the work, remove refuse and rubbish, and leave the relevant areas and equipment clean and in an operational state. Repair damage caused to the premises by the installation activities, at no cost to the Owner.

3.14 PROTECTION OF WORK

A. 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 work at no cost to the Owner.

3.15 MAINTENANCE AND EXTENDED SERVICE

A. Warranty and Maintenance

1. During the initial warranty period, provide on-site technical support within 24 hours to troubleshoot system defects.

2. On a quarterly basis during the warranty period, schedule with the Owner a service visit to check and adjust equipment and systems such that they maintain the original performance.

B. Pre-emptive maintenance minimum requirements:

1. Clean filters and vents, lenses and perform a general dusting of all equipment.

2. Verify projector images fill screens appropriately and images are sharply focused.

3. Test and verify that all system controls operate as labelled and that the controlled devices respond accordingly.

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

END OF SECTION