

SECTION 27 41 00

AUDIOVISUAL SYSTEMS

PART 1 - GENERAL

1.1 PROJECT DESCRIPTION

- A. Project is new Academic Building at University of California, Hastings College of the Law, at 333 Golden Gate Rd. in San Francisco, CA, Levels 1-6.
- B. Video and audio will be encoded to digital IP streams and routed to the appropriate decoders for network-based mixing, switching, and distribution via network switches.

1.2 DEFINITIONS

- A. Refer to Division 00 and 01 Specification Sections for project definitions.
- B. "AV" - Audiovisual
- C. "AV Contractor" - Company contracted to provide scope of work as described in this specification section
- D. "Consultant" - Charles M. Salter Associates, Inc.
- E. "Owner" – University of California, Hastings College of the Law
- F. "Architect" – SOM
- G. "AV Drawings" – "AV" Series Drawings
- H. "OFE" - Owner-Furnished Equipment.
 - 1. Equipment furnished by Owner and installed by the AV Contractor as described in this specification section
- I. "GUI" - Graphical User Interface
- J. "GC" – General Contractor, Clark Construction

1.3 SCOPE OF WORK

- A. This specification section and associated AV Drawings provide a full description of AV Contractor scope of work.
- B. Refer to general conditions and drawings by others for related work. AV Drawings include infrastructure that may be provided by other divisions; verify AV Contractor scope of work with General Contractor prior to bidding.
 - 1. Refer to "AV" Series drawings for infrastructure to support AV systems that will be provided by GC.

- C. Refer to Divisions 00, 01, general conditions, and the following specification sections and drawing series for related work:
1. Architectural
 2. Interiors
 3. Telecommunications
 4. Security
 5. Electrical
- D. The following spaces require audiovisual installation under this scope of work:
1. IDFs (1T1, 2T1, 3T1, 4T1, 5T1)
 2. Small Classrooms (103, 104, 303, 409, 503, 504)
 3. Divisible Large Classrooms (101, 102)
 4. Large Classrooms (301, 302)
 5. Extra Small Breakout Rooms 203, 204, 205)
 6. Extra Large Lecture Room (201)
 7. Small Meeting Rooms (305, 306, 309, 404, 405, 407, 411, 406, 419, 506, 507)
 8. Small Classroom w/ Distance Learning (304)
 9. Large Meeting Rooms (408, 415, 505)
 10. Colloquium Room (601)

1.4 SYSTEM DESCRIPTIONS

- A. IDFs (1T1, 2T1, 3T1, 4T1, 5T1)
1. IDFs will house AV headend equipment in new AV racks, including:
 - a. AV Network Switch
 - b. Video Encoders and Decoders for rack equipment
 - c. Rack-mounted OFE Computers
 - d. Wireless AV Hubs
 - e. Assistive Listening Transmitters
 - f. Audio DSP Devices
 - g. Audio Amplifiers
 - h. Other equipment per AV Drawing functional diagrams
 2. IDFs 3T1 and 4T1 require additional AV equipment to be mounted in telecommunications cabinet(s); AV Contractor to coordinate placement, cabling installation, and clearances with Owner.
- B. Small Classrooms (103, 104, 303, 409, 503, 504)
1. Small Classroom will be used for local instruction with rich-media lecture capture and distance learning (video conferencing) capabilities.
 2. A locked wall box will contain a video encoder for laptop connection, and a USB transmitter for keyboard and thumbdrive connection
 3. A second locked wall box will house an iPad for wireless AV hub interface, a wireless keyboard, and PoE-to-USB converters for charging iPad and keyboard.
 4. A wireless AV hub will allow instructors or students to wirelessly display content on displays and/or to far-end classroom(s) from a variety of mobile and wireless devices.
 5. Single 98" flat panel displays will be at the front of the room for video content display.
 6. Camera at back of room will capture instructor for far-end viewers.

7. One OFE “ADA Capture” computer will capture classroom content for recording all classroom activities.
8. One OFE computer will be for “ad hoc” recording as well as instructor content.
9. One OFE computer will be dedicated for Zoom Rooms video conferencing software.
10. Beam-forming ceiling microphone will allow both instructor and students to speak to far-end classroom(s) and be captured by recording device(s).
11. Two wall-mounted loudspeakers for program audio and speech from far-end classroom(s).
12. An assistive listening system will allow hearing-impaired students to hear program audio and far-end classroom speech.

a. **Two receivers required per ADA**

13. Control touch screen on wall will allow control of AV system, as well as VoIP phone calls via Owner-provided SIP-compatible IP phone system.
14. A scheduling touch screen outside of the classroom will display classroom events from a centralized Owner database (Ad Astra).

C. Divisible Large Classrooms (101, 102)

1. Divisible Large Classrooms will be used as a large public meeting space, as well as for local instruction with the capability for lecture capture and distance learning, and will be a divisible space with additional projectors on the South wall for when rooms are combined.
 - a. Room partition sensors mounted in each room division shall tell control system room partition status to switch routing between “combined” and “divided” modes, routing audio and video to associated projectors and loudspeakers.
2. A locked wall box in each room will contain a video encoder for laptop connection, and a USB transmitter for keyboard and thumbdrive connection.
 - a. A second lock wall box in 102 will be provided for laptop connection at front of room when 101 & 102 are combined
3. A second locked wall box will house an iPad for wireless AV hub interface, a wireless keyboard, and PoE-to-USB converters for charging iPad and keyboard.
4. A wireless AV hub will allow instructors or students to wirelessly display content on displays and lecture capture system.
5. Two fixed-frame projection screens and ceiling-mounted laser projectors, and additional third video projector and screens when rooms are combined.
6. Camera at front of room will capture students for far-end viewers.
 - a. Additional camera at the front of each room division for student-capture when 101 & 102 are combined
7. Camera at back of room will capture instructor for lecture capture and distance learning.
8. One OFE “ADA Capture” computer will capture classroom content for recording all classroom activities.
9. One OFE computer will be for lecture capture as well as instructor content.
10. One OFE computer will be dedicated for Zoom video conferencing software.

11. Beam-forming ceiling microphones will allow both instructor and students to speak to far-end classroom(s) and be captured by recording device(s).
12. Wireless microphone will supplement beam-forming microphones for instructor speech to lecture capture computer and video conferencing computer, as well as speech reinforcement in the room.
 - a. System will accommodate up to eight microphones total in each room (sixteen total when combined); one lavalier with belt-pack to be stored in charging station in drawer at Instructor's desk in each room. Additional microphones and chargers to be stored in Owner's office.
13. Two wall-mounted loudspeakers flanking each projection screen, and ceiling loudspeakers for program audio and speech.
14. An assistive listening system will allow hearing-impaired students to hear program audio.
 - a. **Four receivers required in each space per ADA**
15. Control touch screen on wall will allow control of AV system, as well as VoIP phone calls via Owner-provided SIP-compatible IP phone system.
16. A scheduling touch screen outside of the classroom will display classroom events from a centralized Owner database (Ad Astra).

D. Large Classrooms (301, 302)

1. Large Classrooms will be used for local instruction with the capability for lecture capture and distance learning.
2. OFE Instructor's desk will house:
 - a. Document camera
 - b. Control touch screen
 - c. Computer touch screen/confidence monitor
 - d. OFE keyboard and mouse
 - e. Table box with HDMI for instructor laptop
 - f. Encoder, decoder, USB extender and PoE injector (under table surface)
 - g. Wireless microphone charging station
3. A wireless AV hub will allow instructors or students to wirelessly display content on displays and lecture capture system.
4. Two fixed-frame projection screens and ceiling-mounted laser projectors
5. Camera at front of room will capture students for far-end viewers.
6. Camera at back of room will capture instructor for lecture capture and distance learning.
7. One OFE "ADA Capture" computer will capture classroom content for recording all classroom activities.
8. One OFE computer will be for lecture capture as well as instructor content.
9. One OFE computer will be dedicated for Zoom video conferencing software.
10. Beam-forming ceiling microphones will allow both instructor and students to speak to far-end classroom(s) and be captured by recording device(s).
11. Wireless microphone will supplement beam-forming microphones for instructor speech to lecture capture computer and video conferencing computer, as well as speech reinforcement in the room.
 - a. System will accommodate up to eight microphones total; one lavalier with belt-pack to be stored in charging station in drawer at Instructor's

desk. Additional microphones and chargers to be stored in Owner's office.

12. Two wall-mounted loudspeakers flanking each projection screen, and ceiling loudspeakers for program audio and speech.
13. An assistive listening system will allow hearing-impaired students to hear program audio.

a. **Four receivers required per ADA**

14. Control touch screen at instructor desk will allow control of AV system, as well as VoIP phone calls via Owner-provided SIP-compatible IP phone system.
15. A scheduling touch screen outside of the classroom will display classroom events from a centralized Owner database (Ad Astra).

E. Extra Small Breakout Rooms (203, 204, 205)

1. Extra Small Breakout Rooms will be used for student or staff meetings ~~and video conferencing.~~
2. Table will include a control touch screen and table box with HDMI for user laptop connection.
3. A wireless AV hub will allow users to wirelessly display content on displays and/or to far-end viewers
4. A single 75" flat panel display at the front of the room
5. ~~Camera at front of room will capture users for far end video conferencing participants.~~
6. ~~One OFE computer will be for content with OFE wireless keyboard and mouse.~~
7. ~~One OFE computer will be dedicated for Zoom video conferencing software.~~
8. ~~Multi element ceiling microphone array will allow users to speak to far end video conferencing participants.~~
9. Program audio and speech from far end video conferencing participants via Dante ceiling loudspeakers.
10. An audio jack at the table will allow Owner to connect a portable assistive listening system will allow hearing-impaired users to hear program audio and far-end participant speech.
11. Add Alternate: A scheduling touch screen outside of the classroom will display classroom events from a centralized Owner database (Ad Astra).

F. Extra Large Lecture Room (201)

1. Extra Large Lecture Room will be used for local instruction with the capability for lecture capture and distance learning.
2. OFE Instructor's desk will house:
 - a. Document camera
 - b. Control touch screen
 - c. Computer touch screen/confidence monitor
 - d. OFE keyboard and mouse
 - e. Table box with HDMI for instructor laptop
 - f. Encoder, decoder, USB extender and PoE injector (under table surface)
 - g. Wireless microphone charging station
3. A wireless AV hub will allow instructors or students to wirelessly display content on displays and lecture capture system.
4. Two fixed-frame projection screens and ceiling-mounted laser projectors

5. Two cameras at front of room will capture students for far-end viewers.
 6. Cameras at back of and side of room will capture instructor for lecture capture.
 7. One OFE "ADA Capture" computer will capture classroom content for recording all classroom activities.
 8. One OFE computer will be for lecture capture as well as instructor content.
 9. One OFE computer will be dedicated for Zoom video conferencing software.
 10. Beam-forming ceiling microphones will allow both instructor and students to speak to far-end classroom(s) and be captured by recording device(s).
 11. Wireless microphone will supplement beam-forming microphones for instructor speech to lecture capture computer and video conferencing computer, as well as speech reinforcement in the room.
 - a. System will accommodate up to eight microphones total; two lavaliers with belt packs to be stored in charging station in drawer at Instructor's desk. Additional microphones and chargers to be stored in Owner's office.
 12. Two wall-mounted loudspeakers flanking each projection screen and ceiling loudspeakers for program audio and speech.
 13. An assistive listening system will allow hearing-impaired students to hear program audio.
 - a. **Six receivers required per ADA**
 14. Control touch screen at instructor desk will allow control of AV system, as well as VoIP phone calls via Owner-provided SIP-compatible IP phone system.
 15. A scheduling touch screen outside of the classroom will display classroom events from a centralized Owner database (Ad Astra).
- G. Small Meeting Rooms (305, 306, 309, 404, 405, 407, 411, 406, 419, 506, 507)
1. Small Meeting Rooms will be used for staff meetings and video conferencing.
 2. Table will include a control touch screen and table box with HDMI for instructor laptop.
 3. A wireless AV hub will allow users to wirelessly display content on displays and/or to far-end viewers
 4. A single 75" flat panel display at the front of the room
 5. **USB Soundbar/Camera** at front of room will capture users for far-end video conferencing participants.
 6. One OFE computer will be for content **and Zoom software for video conferencing** with OFE wireless keyboard and mouse.
 7. ~~One OFE computer will be dedicated for Zoom video conferencing software.~~
 8. ~~Multi-element ceiling microphone array will allow users to speak to far-end video conferencing participants.~~
 9. Program audio and speech from far-end video conferencing participants via Dante ceiling loudspeakers.
 10. An audio jack at the table will allow Owner to connect a portable assistive listening system will allow hearing-impaired users to hear program audio and far-end participant speech.
 11. Add Alternate: A scheduling touch screen outside of the classroom will display classroom events from a centralized Owner database (Ad Astra).
- H. Small Classroom w/ Distance Learning (304)

1. Small Classroom w/ Distance Learning will be used for distance learning as well as local instruction.
 2. OFE Instructor's desk will house:
 - a. Document camera
 - b. Control touch screen
 - c. Computer touch screen/confidence monitor
 - d. OFE keyboard and mouse
 - e. Table box with HDMI for instructor laptop
 - f. Encoder, decoder, USB extender and PoE injector (under table surface)
 3. A wireless AV hub will allow instructors or students to wirelessly display content on displays and/or to far-end classroom(s) from a variety of mobile and wireless devices
 4. Two 98" flat panel displays will be at the front of the room for video content display.
 5. ~~A single 75" flat panel display will be at the back of the room for far-end classroom camera views.~~
 6. Camera at front of room will capture students for far-end viewers.
 7. Camera at back of room will capture instructor for far-end viewers.
 8. One OFE "ADA Capture" computer will capture classroom content for recording all classroom activities.
 9. One OFE computer will be for distance learning as well as instructor content.
 10. One OFE computer will be dedicated for Zoom video conferencing software.
 11. Beam-forming ceiling microphones will allow both instructor and students to speak to far-end classroom(s) and be captured by recording device(s).
 12. Two wall-mounted loudspeakers for program audio and speech from far-end classroom(s), mounted to left of left display, and right of right display.
 13. An assistive listening system will allow hearing-impaired students to hear program audio and far-end classroom speech.
 14. Control touch screen at instructor desk will allow control of AV system, as well as VoIP phone calls via Owner-provided SIP-compatible IP phone system.
 15. A scheduling touch screen outside of the classroom will display classroom events from a centralized Owner database (Ad Astra).
- I. Large Meeting Rooms (408, 415, 505)
1. Large Meeting Rooms will be used for staff meetings and video conferencing.
 2. Table will include a control touch screen and table box with HDMI for instructor laptop.
 3. A wireless AV hub will allow users to wirelessly display content on displays and/or to far-end viewers
 4. A single 86" flat panel display at the front of the room
 5. **Fixed USB** Camera at front of room will capture users for far-end video conferencing participants.
 6. **One OFE "ADA Capture" computer will capture meeting content for recording all Meeting Room activities.**
 7. One OFE computer will be for content with OFE wireless keyboard and mouse.
 8. One OFE computer will be dedicated for Zoom video conferencing software.
 9. Beam-forming ceiling microphones will allow both presenter and audience to speak to far-end classroom(s) and be captured by recording device(s).
 10. Program audio and speech from far-end video conferencing participants via Dante ceiling loudspeakers.
 11. An assistive listening system will allow hearing-impaired users to hear program audio and far-end participant speech.

12. A scheduling touch screen outside of the classroom will display classroom events from a centralized Owner database (Ad Astra).

J. Colloquium Room (601)

1. Colloquium Room will be used for special events, staff meetings and presentations, with the capability for video conferencing and lecture capture.
2. A wireless AV hub will allow staff to wirelessly display content on displays and lecture capture system.
3. Single fixed-frame projection screen and ceiling-mounted laser projector
4. ~~Two~~ **Single** cameras at front of room will capture staff for far-end viewers.
5. Camera at back of and side of room will capture presenter.
6. **One OFE "ADA Capture" computer will capture classroom content for recording all classroom activities.**
7. One OFE computer will be dedicated for Zoom video conferencing software.
8. Beam-forming ceiling microphones will allow both presenter and audience to speak to far-end classroom(s) and be captured by recording device(s).
9. Wireless microphone will supplement beam-forming microphones for presenter speech to video conferencing computer, as well as speech reinforcement in the room.
 - a. System will accommodate up to sixteen microphones total, with sixteen handheld microphones with charging station, and four lavalier with belt-pack and charging station stored in the room. Additional microphones and chargers to be stored in Owner's office.
10. Two wall-mounted loudspeakers flanking projection screen and ceiling loudspeakers for program audio and speech.
11. **Additional loudspeakers in roof garden area**
12. An assistive listening system will allow hearing-impaired participants to hear program audio.
 - a. **Four receivers required per ADA**
13. Control touch screen at front wall will allow control of AV system, as well as VoIP phone calls via Owner-provided SIP-compatible IP phone system.
14. A scheduling touch screen will display room events from a centralized Owner database (Ad Astra).

1.5 AV CONTRACTOR RESPONSIBILITY

- A. Furnish and install a complete and functioning audiovisual system including cabling, receptacle plates, loudspeakers, and electronic devices. Provide and install all components including the necessary equipment, interconnections, transducers, labor, and services required to meet specifications herein and as indicated on the drawings. Any item listed in the specification or shown on the drawings is to be included as part of this scope of work. Items specifically indicated on the drawings as "Not in Contract" are not to be provided.
- B. By bidding on this scope of work, the AV Contractor confirms that the system functionality described herein can be achieved with the equipment and conditions described. Additional labor, materials, or connections required are the responsibility of the AV Contractor. AV Contractor shall notify the Owner if it is believed the described system functionality cannot be achieved with the equipment or conditions identified in this scope of work.

- C. IT Coordination: Coordination as required with the Owner's IT representative where network related system configuration is required.
- D. Verify site conditions including dimensions, clearances, conduit sizes, and routing. Coordinate the exact location of the equipment with the architectural drawings. Report any conflicts that may interfere with systems installation.
- E. Verify that 120-volt AC power has been supplied near each equipment rack location, or any other location requiring AC power. Provide connection in flex-conduit from nearby AC power to equipment racks, where AC power receptacles are not located within the equipment rack enclosure. Provide and install all AC power receptacles within the equipment racks. Provide low-voltage turn-on controllers and switched outlets to activate and distribute AC power within the equipment racks.
- F. Notify the Owner's Representative in writing prior to AV installation of any penetrations at walls, ceilings and floors required for the installation of audiovisual equipment and cabling.
- G. Verify that the systems have been engineered prior to installation of suspended devices including, but not limited to, loudspeakers, microphones, flat panel monitors, video projectors, etc. Verify any attachment points and methods with licensed structural engineer prior to installation.
- H. Provide ventilation as required for equipment housed in millwork so that manufacturer-recommended temperatures are maintained during normal operating conditions.
- I. Conduct preliminary testing and adjustment. Submit documentation required by this specification. Participate in approval testing for acceptance. Perform final adjustments as required to meet specifications.
- J. Transfer all warranties and equipment guarantees and provide a written description of system operation to the Owner at the time of acceptance of the work by the Owner.
- K. Provide system operation training as described in this specification section.
- L. Provide "as-built" drawings of all systems, including modifications to the as-built infrastructure if any, on full sized sheets. Revisions are to be made to the actual CAD computer files (red pen revision markups on paper drawing sheets are not acceptable) prior to print out. Provide CAD files on USB flash drive or storage format preferred by the Owner. Provide touch panel and control system source code, DSP system configuration files, and all systems initial configuration preset files to Owner. Store files on site in the system documentation binders in disk sleeves.
- M. Owner Furnished Equipment: The AV Contractor shall be responsible for integrating owner-furnished equipment into the audiovisual systems as shown on the AV drawings.
- N. Perform all operations necessary to complete the installation.
- O. The audiovisual systems and components described in this specification section shall be free of any manufacturing, engineering, installation, or operational defects.
- P. AV Contractor shall provide installation that meets or exceeds applicable building codes.
- Q. System Programming and Graphical Interface Design

1. The AV Contractor shall work with the Owner and/or Consultant to provide an agreed-upon GUI for all AV system touch screen interfaces. Note, existing programming and GUI code may be available at time of programming/installation. AV Contractor may be required to use/augment existing code for uniformity across Owner systems.
2. Provide all touch panel, control system, audio DSP, and audiovisual processing equipment source code created for the project to the Owner upon system acceptance.
3. Millwork
 - a. Coordinate audiovisual system components in millwork and furniture. Contractor shall perform all cutting, patching and painting as required, and shall repair any damage done as a result.

1.6 QUALITY ASSURANCE

- A. All materials must be newly manufactured current production models and must conform to all applicable codes and the relevant standards listed below:
 1. American National Standards Institute (ANSI)
 2. Electronic Industries Association (EIA)
 3. Institute of Electrical and Electronic Engineers (IEEE)
 4. Underwriters Laboratories (UL)
 5. "B" stock and/or refurbished items are not acceptable.
- B. Contractor Qualifications
 1. Experience: The AV Contractor will specialize in the installation of audiovisual systems in professional/commercial environments. Installers and engineers must individually have a minimum of five years of documented experience in the field of audiovisual system installation.
 2. Dealership: AV Contractor shall be an authorized dealer for all products listed, and shall perform any manufacturer training, certification, or other specialized requirements recommended by the manufacturer prior to installation. AV Contractor shall offer full factory warranty on all products provided.
 3. Certification: Bidder must have at least (1) employee staffed on the project in a supervisory role with either CTS-D or CTS-I certification from InfoComm International.
 4. Contractor shall be Crestron A+ Partner and shall honor Crestron A+ pricing structure.
- C. Supervision
 1. The AV Contractor will designate a single supervisor to oversee the installation work for the duration of the project to ensure that the system is installed in accordance with the specification and drawings.
 2. The supervisor will maintain adequate staff and be responsible for installing and testing the system on schedule.
 3. The supervisor will have at least five years of documented, recent, and similar project experience.
- D. The Owner reserves the right to make use of the system prior to the completion of the punch list. Temporary use of the equipment will not constitute an acceptance of the system or any part. The Owner will not pay additional cost to the AV Contractor and the commencement of the warranty period will not begin for the system or any device prior to the completion of the punch list and final acceptance of the system by the Owner.

- E. Codes: AV Contractor will comply with all applicable laws, regulations and codes.

1.7 SUBMITTALS

- A. Comply with submittal requirements Division 01 General Requirements.

- B. Bid Submittals: Submit the following qualification documents:

1. Firm description.
2. Submit a list of authorized dealerships. The AV Contractor must be a dealer for any devices installed in this project to assure the installers are trained and that the dealer has a path for warranty repair as needed.
3. List of related projects: Related project list to include project name and location, description of project, contract amount, reference name and telephone number. One of the related projects must have been completed within the last 12 months.
4. Resumes of project supervisor documenting related experience. Project supervisor must have completed at least one installation in the past 12 months.
5. Names and scope of work for any subcontractors whose work would be part of this contract.
6. Clearly list and describe any deviations from and exceptions to the specifications or drawings.
7. As part of the AV Contractor's bid, a fully itemized list shall be provided showing the manufacturer's cost basis for each piece of equipment by room or system. This cost basis may be used by Owner to substitute in comparably priced up-to-date equipment that is brought to market after the construction submittal period.
8. Provide an optional price for maintenance contract extensions on an annual basis beyond the initial one-year warranty period.

- C. Construction Submittals:

1. Submit complete equipment list by manufacturer, model number, and type. Include all accessories, options and functional components, and quantity to be supplied.
2. Equipment Substitutions
 - a. All submitted equipment must meet the minimum performance requirements shown in Part 2 of this specification.
 - b. Post-Submittal Equipment Update Substitutions: As there is a time gap between construction submittals and equipment installation, the Owner reserves the right to request substitutions of outdated equipment for updated equipment of a comparative class and cost basis. This arrangement is required of video projectors and flat panel displays. For video projectors, the contractor should attempt to provide substitutions to limit the number of different equipment manufacturer's for ease-of-maintenance considerations. Specified projector and flat panel mounting hardware will need to be re-evaluated to meet the requirements of the final projector selection.
3. Submit shop drawings for each building space included in this specification with the following drawings (as required by specific system):
 - a. Point-to-point functional wiring diagrams for all audio, video, control, and related signal system wiring diagrams. Must be connector pin-specific. Re-used Audiovisual Consultant design drawings with wire run numbers added are not acceptable for field construction use. Engineered

- drawings are not to have devices nor connections noted "typical". Show pin-specific wiring connections with wired numbers noted.
- b. All receptacle plates and panels, including rack-mount panels labeling shown for engraving.
 - c. Equipment rack elevations.
4. Submit shop drawings of any proposed design changes for approval prior to fabrication. Shop drawings are submitted for review and approval prior to fabrication and installation. Make submittals at least fifteen (15) working days prior to scheduled fabrication. Note on the submittal the dates of scheduled fabrication.
 5. Submit samples of engraved labels, cable marking system, and receptacle plate/panel etching.
 6. Acceptance Test Submittals: Prior to requesting the completion of the acceptance tests, submit Preliminary Test Report including all information required in Part 3. The AV Contractor is to provide a letter on company letterhead verifying that all devices and signal inputs have tested and are operable. This letter is to be signed by the project manager and sent to the consultant before acceptance testing can proceed.

1.8 PERMITS AND INSURANCE

- A. Permits: Obtain any necessary permits for the execution of this work in conformance with applicable union regulations, local, State and Federal codes and regulations.
- B. Insurance: Provide evidence of insurance for the full value of equipment and material located on site. Insurance will cover all losses until the work is formally accepted. Maintain additional liability insurance to protect the supplier and/or Owner against damage claims for personal injury, including death, which may arise during the performance of this work.

1.9 GUARANTEES AND WARRANTIES

- A. Transfer all manufacturer warranties to the Owner at the time of acceptance.
- B. Guaranty all installation work to be free of faulty workmanship. Guarantee all components and workmanship to be free from defects for a period of one year from the final date of acceptance, including solid-state devices.
 1. Provide an optional price for maintenance contract extensions on an annual basis beyond the initial one-year warranty period.
- C. Guaranty the replacement of faulty materials and workmanship within 48 hours of notification at no cost to the Owner if failure occurs during warranty period.

PART 2 - PRODUCTS

1. GENERAL REQUIREMENTS FOR AUDIOVISUAL PRODUCTS

- A. Materials listed herein represent specific minimum levels of performance and function. These levels of performance and function are as published by the listed manufacturers. All material submitted shall be as listed or shall be substitutions that meet or improve upon the performance and functional characteristics of the listed material.

- B. If conflicts exist within the specification or between the specification and the drawings, contact the Consultant for clarification. Where listed quantities differ from that shown on drawings, assume the greater quantity and contact AV consultant for clarification.
- C. Equipment shall be procured from the original equipment manufacturer, or a manufacturer-approved dealer. If procured from a manufacturer-approved dealer, product(s) shall be supported at the same level as if procured from manufacturer.
- D. Repair or replace any equipment damaged during installation.

2.10 EQUIPMENT

- A. IDFs (1T1, 2T1, 3T1, 4T1, 5T1)
 - 1. Hardware Devices
 - a. Horizontal Power Distribution, Conditioning, and Surge Protection: Furman P-8 PRO C
 - b. Vertical Power Distribution: Middle Atlantic PDT-2015C-NS
 - c. Equipment Rack: Middle Atlantic VMRK-54
 - 1) Front Door: VFD-54
 - 2) Seismic Brackets: MRK-Z4
 - d. Mounting Shelves: Middle Atlantic VSA-2744
 - 2. Audio Devices
 - a. Audio DSP: QSC Q-Sys
 - 1) Core Processor: Core510iCTO
 - 2) Input/output Expander: I/O-8 Flex
 - 3) Dante Card: CDN64
 - 4) Four-channel Input Card: CIML4
 - 5) Four-channel Output Card: COL4
 - b. Power Amplifier 1 (2 Channel, 100W/Channel, 70V or Low-impedance): Lab Gruppen E 2:2
 - c. Power Amplifier 2 (4 Channel, 125W/Channel, 70V or Low-impedance): Lab Gruppen E 5:4
 - d. Power Amplifier 3 (8 Channel, 125W/Channel, Low-impedance): Lab Gruppen C 10:8
 - 3. Video Devices
 - a. Card Chassis for Video Encoders and Decoders: Crestron DMF-CI-8
 - 4. Control Devices
 - a. Control Processor: Crestron CPN3
 - b. 48-Port PoE+ Network Managed Gigabit Switch: Cisco 300 Series, or approved equal

B. Typical Equipment

1. Hardware Devices

- a. Ceiling Storage Box (for a single encoder/decoder): Chief CMS491
- b. Ceiling Storage Box (for two encoder/decoders in a single box): Chief CMS492
- c. HDMI Cable for Ceiling Storage Box to devices: FSR HDMI 2.0 Digital Ribbon Cables
- d. **POE-to-USB Power: FSR IT-CHRG**

2. Audio Devices

- a. Wall-mount Loudspeakers: QSC AD-S802T
- b. Ceiling Loudspeakers: Crestron Saros IC6T-W-T-EACH
- c. Beam-forming Ceiling Microphone: Shure MXA910
- d. Ceiling Dante Loudspeakers: SoundTube IPD-CM52-BGM
- e. Dante Ceiling Microphone Array: ClearOne

- 1) Microphone: 910-6200-101
- 2) Interface Box: 910-6200-105-D
- 3) Backbox: 910-6200-104

f. Assistive Listening System (ALS): Listen Technologies

- 1) RF Transmitter: LT-800-072-01
- 2) Antenna Kit: LA-122
- 3) Rack Mounting Kit: LA-122
- 4) RF Receiver: LR-5200-072
- 5) Universal Ear Speaker: LA-401
- 6) Neck Loop: LA-430

3. Video Devices

- a. 22" Touch Screen (Lectern Confidence Monitor): PXL2230MW
- b. Video Encoder (in-room): Crestron DM-NVX-350
- c. Video Decoder (in-room) Crestron DM-NVX-350
- d. Video Encoder Card (in IDF rack): Crestron NVX-350C
- e. Video Decoder Card (in IDF rack): Crestron NVX-350C
- f. Pan-Tilt-Zoom (PTZ) Camera: Panasonic AW-HN38H
- g. Document Camera (Doc Cam): Wolfvision vSolution Camera
- h. USB Transmitter/Receiver Pair: Crestron USB-EXT-2
- i. AV-to-USB Bridge: Vaddio AV Bridge Mini
- j. USB Capture (for Zoom Computer only): Magewell #32060
- k. Wireless AV Hub: Wolfvision Cynap **Pure**
- l. HDMI Distribution Amplifier (DA): Crestron HD-DA2-4KZ-ES

4. Control Devices

- a. 7" Control Touch Screen: Crestron TSW-760-B-S
 - 1) With PWE-4803RU PoE Injector
 - 2) With TSW-760/1060-MSMK Tabletop Mount
- b. 7" Scheduling Touch Screen: Crestron TSW-760-B-S
- c. USB Extender: Crestron USB-EXT-2

- C. Small Classrooms Equipment (103, 104, 303, 409, 503, 504)
 - 1. Display Devices
 - a. 98" Flat Panel Display: Planar UltraRes UR9851-ERO w/ UR9851 Mount

- D. Divisible Large Classrooms Equipment (101, 102)
 - 1. Audio Devices
 - a. Wireless Microphone System: Shure Microflex
 - b. Receiver: MXWAPT8
 - c. Belt pack Transmitter: MXW1 w/ MX183 Lavalier Mic (Qty: 3)
 - 1) One kept in Large Classroom, two in Office
 - d. Wireless Handheld Transmitter: MXW2/SM58 (Qty: 8)
 - e. Wireless Microphone Charging Station: MXWNCS2 (Classroom)
 - f. Wireless Microphone Charging Station: MXWNCS8 (Office)
 - 2. Display Devices
 - a. 12,000 Lumen WUXGA Video Projector: Panasonic PT-RZ12KU w/ Chief VCMU Mount
 - b. 160" Diagonal 16:9 Aspect Ration Ambient Light Rejecting Fixed Projection Screen: DNP XL (CHA-JF-15247)
 - 1) Distributed by RP Visuals Inc., 1275 S. Lewis St., Anaheim, CA 92805
 - 3. Hardware Devices
 - a. Room Partition Sensor: Crestron GLS-PART-CN

- E. Large Classrooms Equipment (301, 302)
 - 1. Audio Devices
 - a. Wireless Microphone System: Shure Microflex
 - b. Receiver: MXWAPT8
 - c. Belt pack Transmitter: MXW1 w/ MX184 Lavalier Mic (Qty: 3)
 - 1) One kept in Large Classroom, two in Office
 - d. Wireless Handheld Transmitter: MXW2/SM58 (Qty: 6)
 - e. Wireless Microphone Charging Station: MXWNCS2 (Classroom)
 - f. Wireless Microphone Charging Station: MXWNCS8 (Office)
 - 2. Display Devices
 - a. 12,000 Lumen WUXGA Video Projector: Panasonic PT-RZ12KU w/ Chief VCMU Mount
 - b. 160" Diagonal 16:9 Aspect Ration Ambient Light Rejecting Fixed Projection Screen: DNP XL (CHA-JF-15247)
 - 1) Distributed by RP Visuals Inc., 1275 S. Lewis St., Anaheim, CA 92805

- F. Extra Small Breakout Rooms Equipment (203, 204, 205)
 - 1. **Audio Devices**

- a. **Desktop Conference Phone: Polycom Trio 8800**
- 2. Display Devices
 - a. 75" Flat Panel Display: Planar UltraRes UR7551-MX-ERO w/ UR7551 Mount
- G. Extra Large Lecture Room Equipment (201)
 - 1. **Audio Devices**
 - b. **Wireless Microphone System: Shure Microflex**
 - c. **Receiver: MXWAPT8**
 - d. **Belt pack Transmitter: MXW1 w/ MX184 Lavalier Mic (Qty: 3)**
1) **One kept in Large Classroom, two in Office**
 - e. **Wireless Handheld Transmitter: MXW2/SM58 (Qty: 6)**
 - f. **Wireless Microphone Charging Station: MXWNCS2 (Classroom)**
 - g. **Wireless Microphone Charging Station: MXWNCS8 (Office)**
 - 2. Display Devices
 - a. 12,000 Lumen WUXGA Video Projector: Panasonic PT-RZ12KU w/ Chief VCMU Mount
 - b. 160" Diagonal 16:9 Aspect Ratio Ambient Light Rejecting Fixed Projection Screen: DNP XL (CHA-JF-15247)
 - 1) Distributed by RP Visuals Inc., 1275 S. Lewis St., Anaheim, CA 92805
- H. Small Meeting Rooms Equipment (305, 306, 309, 404, 405, 407, 411, 406, 419, 506, 507)
 - 1. **Video Devices**
 - a. **USB Soundbar/Camera: Crestron UC-SB1-CAM**
 - 2. Display Devices
 - a. 75" Flat Panel Display: Planar UltraRes UR7551-MX-ERO w/ UR7551 Mount
- I. Small Classroom w/ Distance Learning Equipment (304)
 - 1. Display Devices
 - a. ~~12,000 Lumen WUXGA Video Projector: Panasonic PT-RZ12KU w/ Chief VCMU Mount~~
 - b. ~~160" Diagonal 16:9 Aspect Ratio Ambient Light Rejecting Fixed Projection Screen: DNP XL (CHA-JF-15247)~~
 - 1) ~~Distributed by RP Visuals Inc., 1275 S. Lewis St., Anaheim, CA 92805~~
 - c. **98" Flat Panel Display: Planar UltraRes UR9851-ERO w/ UR9851 Mount**
- J. Large Meeting Rooms Equipment (408, 415, 505)
 - 1. **Video Devices**
 - a. **Fixed USB Camera: Crestron CCS-CAM-USB-F-400**

2. Display Devices
 - a. 86" Flat Panel Display: Planar UltraRes UR8651-MX-ERO w/ UR8651 Mount
- K. Colloquium Room Equipment (601)
1. Audio Devices
 - a. Wireless Microphone System: Shure Microflex
 - b. Receiver: MXWAPT8 (Qty: 2)
 - c. Tabletop Transmitter: MXW8 w/ MX410 Gooseneck Microphone (Qty: 16)
 - d. Belt pack Transmitter: MXW1 w/ MX184 Lavalier Mic (Qty: 4)
 - e. Wireless Handheld Transmitter: MXW2/SM58 (Qty: 16)
 - f. Wireless Microphone Charging Station: MXWNCS8 (Qty: 4), MXWNCS4 (Qty: 1)
 - g. **Outdoor Roof Garden Loudspeakers: OWI IC570V10**
 2. Display Devices
 - a. 12,000 Lumen WUXGA Video Projector: Panasonic PT-RZ12KU w/ Chief VCMU Mount
 - b. 160" Diagonal 16:9 Aspect Ratio Ambient Light Rejecting Fixed Projection Screen: DNP XL (CHA-JF-15247)
 - 1) Distributed by RP Visuals Inc., 1275 S. Lewis St., Anaheim, CA 92805
- L. Other Locations
1. Audio Devices
 - a. Portable Assistive Listening System (ALS)
 - 1) Transmitter: Listen Technologies LT-700-072 (Qty: 2)
 - 2) Intelligent DSP RF Receiver 6-Pack: Listen Technologies LP-40-072-01 (Qty: 1)
 2. Video Devices
 - b. Virtual Switching Appliance Hardware for set-up and management of encoder and decoder devices: Crestron DM-XIO-DIR-ENT
 - 1) This appliance hardware will be installed in Level 3 server room of another building under a separate project. Network access will be granted through Owner IT network team. Contractor shall be responsible for adding devices from this Project onto the existing hardware/software to allow for a seamless integration of existing and new systems.
 3. Control Devices
 - a. 48-Port PoE+ Network Managed Gigabit Switch: Cisco 300 Series, or approved equal
 - b. Management and monitoring services: Crestron XiO Cloud

- 1) This is a free service for the first year included with purchase of NVX devices. Contractor shall set up service for Owner and provide Owner with direct contact to extend services past initial first year of service.

2.11 MISCELLANEOUS HARDWARE

- A. Terminal cabinets and boxes: terminal cabinets, mud-rings, and junction boxes housing audio cabling shall be metallic. Terminal cabinets shall be verified for size by AV Contractor prior to beginning job-site work. Size cabinets for required base-bid wiring fill. Allow forty percent (40%) additional capacity for future system growth.
- B. Provide matching manufacturer vents and blanks as required.
- C. Rack Connections: AC power cables to the power strips shall be run in steel conduit. All in-going and out-going signal cabling shall be run in conduit or cabling pathways independent of AC power cabling.
- D. Connectors: Provide compatible plugs as indicated on the receptacle plate drawing sheets; all cable connectors shall have black anodized finish where available unless otherwise noted. Connector parts subject to any possible structural loading or stress shall be metal.
- E. Conduit: Provide removable seals at penetrations for acoustic isolation.
- F. Audiovisual System Faceplates: Silk-screened and coated lettering shall identify individual plate mounted receptacles. Connector identification shall denote function and unique input/output number. Lettering shall be centered above appropriate connector. Connector mounting will allow sufficient finger clearance for connector insertion and removal without interference from adjacent connectors.
- G. Receptacle Plates:
 1. Receptacle plates shall be steel or aluminum with etched and ink filled labeling. Confirm plate color preferences and requirements with Owner prior to fabrication or ordering. Plates ordered without Owner approval may be replaced at AV Contractor's expense. Refer to AV Drawings for specific plate connector requirements.
 2. Center lettering vertically over appropriate connector. Connector mounting shall allow sufficient finger clearance for connector insertion and removal without interference from adjacent connectors.
 3. Engraved plastic labels fastened with epoxy are acceptable only where custom engraving options are not available from manufacturer, and only with approval by the Owner.
- H. Provide black Techflex cable umbilical wrap as required for cable umbilicals.
- I. Electronic component faceplate labels: Provide permanent labels on equipment to identify device, system, or control function as appropriate for operational purposes. All control knob and switch labels shall be located vertically adjacent over the appropriate control. Engraved plastic labels fastened with epoxy are acceptable. Dymo type labels are not acceptable.
- J. Rack Equipment

1. Provide placard at each AV equipment rack that states “Designed by Charles M. Salter Associates, Inc. & Installed by _____ (AV Contractor name with phone and website). For repairs call _____ (AV Contractor name with phone).” Provide as either a rackmount panel, or as a placard attached to one of the equipment racks in each major control room equipment location.

2.12 PRE-MANUFACTURED CABLES

- A. Pre-Manufactured Cables for Receptacle Plates (HDMI, VGA, Audio): Provide one cable with connectors for every receptacle for end-users to connect laptop computers, and other portable audiovisual source devices:
 1. Gold-Plated Connectors
 2. NEC CL2 rated non-plenum
 3. VGA Input: 1080p 1920 x 1200 verified
 4. HDMI/DVI Input: Cables must be rated for HDMI 2.0a specifications or better, capable of passing required resolutions, frame rates, and color space at distances under 10' without an active equalizer.
 5. Audio: 20 to 20Khz
 6. Recommended Equipment: Extron, various models.
- B. HDMI(F)-to-Display Port(M) Adapter: For every pre-manufactured HDMI cable provided, provide an adapter for Display Port source devices.

2.13 INSTALLATION CABLE – ALL SPACES

- A. Loudspeaker Cable (8 or 4 ohm, less than 500 watts): West Penn Wire C207 (12 AWG, unshielded pair) or equal
- B. Distributed Non-Plenum Loudspeaker Cable (70volt, less than 60 watt tap): Belden 1309A (14 AWG, unshielded pair) or equal.
- C. Distributed Plenum Rated Loudspeaker Cable (70volt, less than 60 watt tap): Belden 6100UE (14 AWG, unshielded pair) or equal.
- D. Analog Microphone/Line Level Installation Cable: Belden model# 9464 (20 AWG conductor, jacketed, shielded, twisted-pair) or equal.
- E. Analog Microphone/Line Level Installation Cable (Dining Room inputs, high noise rejection): Mogami W2534 (24AWG 4-conductor, jacketed, shielded, twisted-pair) or equal.
- F. Analog Microphone/Line Level Equipment Rack Interconnect Cable: Belden model# 8450 (22 AWG conductor, jacketed shielded, twisted-pair) or equal.
- G. Antenna Cable: Conductor is 13 AWG (RG8/U) covered by braided shield. JSC model# 3040 or equal. Provide co-axial cable whose impedance matches devices requiring 50ohm antenna connection.
- H. Pre-Terminated HDMI or DVI-D cables: Extron, Atlona, or equal. (Note, cables must be rated for HDMI 1.3a specifications or better, capable of passing 1080p or 1920x1200 resolution at distances under 10' without an active equalizer.)
- I. Control System Device Control Cables (RS232, RS422, Serial (IR), Relay or Contact Closure): Supply pre-terminated serial control cables within equipment racks. Provide

West Penn Wire 1992 (4 pair) signal cable, or equal for relay or contact closure application, as required.

- J. Network and twisted pair Cable for AV Signal Extenders: Provide project network standard Category 6 cable, or equal.
- K. All cabling shall be rated for the environment for which it is placed.
- L. Provide plenum rated cable for all cable where required by code. Any cable changes or substitutions must be submitted and approved prior to installation. Cable that has been installed without approval is replaced at the AV Contractor's expense.
- M. Portable Microphone Cable: For each microphone input receptacle at floorboxes and wall plates provide a pre-manufactured microphone cable
 - 1. Hi-Flex 25-foot (7.5 m) microphone cable with chrome XLR connectors, for low-impedance operation.
 - 2. Recommended Equipment: Shure CJ25.
- N. For HDMI runs over 25' AV Contractor shall provide HDMI over shielded CAT6 extension system.
- O. Cable installed without Owner approval may be replaced at the AV Contractor's expense.
- P. Acceptable Cable Manufacturers:
 - 1. Liberty
 - 2. Belden
 - 3. West Penn
 - 4. Canare
 - 5. Mogami
 - 6. Extron
 - 7. Crestron
 - 8. Windy City Wire

2.14 CONNECTORS

- A. Audio 1/4" panel-mount connector: Switchcraft 1/4" TS, solder back, or equal.
- B. Loudspeaker Connectors: Neutrik 4-Pole Speakon series.
- C. HD-SDI, Composite Video, Genlock (Sync), SMPTE BNC panel-mount connector: Provide a panel-mounted BNC jack with isolated ground bulkhead and compatible connector. Supply Canare BCP-C5FA male, or equal.
- D. Antenna connector: Provide receptacle plate-mounted general-purpose UHF antenna connector. Coaxial bulkhead connector will match impedances of antenna cable and match style of connector on device requiring antenna. Supply Amphenol 83-1f.
- E. RS232/Control D-Shell Panel-Mount Connector: Mouser D-sub series, or equal.
- F. VGA D-Shell Panel-Mount Connector: ORA D-sub series, or equal.

- G. Specialty RJ45 connectors (UTP Extenders, etc.): Supply Neutrik Ethercon series connectors where AV connections are to be terminated at AV receptacle plates and panels.
- H. VGA signal terminated on BNC will NOT be accepted.
- I. CAT6 8-Pin Modular Chassis Connector at Receptacle Plates
 - 1. CAT6 Compliant up to 10GBits/s
 - 2. CAT6 specifications according TIA / EIA 568B, ISO / IEC 11801, EN 50173
 - 3. Push Pull mating - secure and proven locking system
 - 4. Ground lead jumper on panel connector with selectable grounding option
 - 5. Gas-tight IDC termination without tool
 - 6. Recommended equipment: Neutrik NE8FDY-C6-B

2.15 FINISHES

- A. All enclosures, housings and fixtures supplied by the AV Contractor not having a standard factory protective finish are to be painted. Paint specifications are to be supplied by the Architect or indicated herein.
- B. Any equipment or materials supplied which are exposed to public view are to be approved by the Owner. Provide, as required by the Owner, custom color and/or finish for publicly-visible devices, if available.

PART 3 - EXECUTION

3.10 GENERAL DESCRIPTION

- A. The following is required for acceptance of the audiovisual system by the Owner:
 - 1. Install complete and functioning audiovisual system specified.
 - 2. Label equipment and cables as specified and corresponding to functional diagram.
 - 3. Conduct adjustments and preliminary testing.
 - 4. Report results of preliminary testing along with system documentation.
 - 5. Participate in acceptance test and deliver final system and documentation.
 - 6. Conduct any adjustments or re-testing that is required to adhere to the specifications.
 - 7. Provide training to individuals designated by the Owner.
- B. Installation shall meet or exceed industry standards and best practices, including, but not limited to, those described in the following publications:
 - 1. InfoComm International
 - a. "Basics of Audio and Visual Systems Design"
 - b. "AV Installation Handbook"
 - c. "AV Implementation Handbook"
 - 2. Building Industry Consulting Service International (BiCSi), "Telecommunications Distributions Methods Manual" (TDMM)
 - 3. Telecommunications Industry Association/Electronic Industries Alliance (TIA/EAI), "TIA/EIA Wiring Standards"

3.11 GENERAL REQUIREMENTS

- A. All equipment except portable equipment shall be held firmly in place. This includes racks, conduits, cables, receptacle plates and panels, and all electronic equipment. The Owner shall approve structural fastenings and supports.
- B. Submit shop drawings for custom fabrications including custom panels, receptacle plates, patch panel layouts, and rack elevations to the Owner for review and approval. Make submittals at least fifteen (15) days prior to scheduled fabrication. Note on the submittal the dates of scheduled fabrication. Submittal responses is expedited due to the compressed installation schedule.
- C. Do not commence work on any portion of the project requiring Owner 's approval prior to obtaining such approval. Work commenced and installed prior to review and approval shall be accepted at the Owner's discretion. Installation does not imply acceptance or review for acceptance.
- D. Keep at the job site an up-to-date complete record set of prints and specification. Make daily corrections and show all changes from the original contract drawings. Final as-built drawings are required at the conclusion of the project.
- E. Keep the job adequately staffed at all times. A qualified engineer approved by the Owner and employed by the AV Contractor shall exercise engineering supervision over the entire installation. Unless through illness, loss of personnel, or other circumstances beyond the control of the AV Contractor, keep the same individual in charge throughout the execution of the work.
- F. Execute, without claim for additional payment, moderate moves or changes as necessary or required by the Owner prior to installation to accommodate minor design changes, rack layout changes, or to preserve symmetry and pleasing appearance.
- G. Conduct preliminary testing and adjustment. Submit documentation required by this specification. Participate in approval testing for acceptance. Perform final adjustments as required to meet specifications.
- H. Deliver bound "as-built" system documentation. Transfer all warranties and equipment guarantees and provide a written description of system operation to the Owner at the time of acceptance of the work by the Owner. Provide system operation training as specified in Section 3.6.

3.12 INSTALLATION REQUIREMENTS

- A. General
 - 1. All equipment and cabling shall be installed in accordance with manufacturer recommendations, in a clean, neat, and organized fashion.
 - 2. Equipment requiring service or routine adjustments, such as equipment racks, shall be accessible for such services.
 - 3. All permanently installed equipment shall be plumb and square, and firmly held in place.
 - 4. Contractor shall take appropriate measures to minimize electromagnetic and/or electrostatic interference. Install all equipment and cabling with regard for minimization of induced electromagnetic and electrostatic noise.
 - 5. Cables and wiring in racks, consoles, connector boxes and on terminal strips shall be clearly marked between 2" and 4" from end of cable gasket/harness. Provide

maximum label visibility. Indicate the signal type, wire number, source and destination and jack, receptacle or socket to which connector should be mated. Use appropriate diameter clear shrink tubing over surface of label for protection and permanence. Extend shrink tubing over label by approximately 1/4" at each end.

6. Contractor shall provide appropriate protection for equipment and related wiring in locations where extreme environmental conditions may occur.
7. All audiovisual point-to-point signal cable is to be run in cabling pathways separate of AC power and network data conduit, except where identified on drawings.
8. Verify that all AC power circuits designated for audiovisual equipment, both fixed-in-place and portable, are properly wired, phased and grounded. Report any discrepancies found to the Owner.
9. Verify with Owner where secure attachments, such as Kensington locks or projector locks, are required for audiovisual equipment in public spaces due to theft or vandalism concerns. Provide such attachments where required.
10. Confirm finish color of publicly visible devices, such as loudspeakers, with Owner and/or Architect prior to ordering. Any publicly-visible devices installed without prior approval may be replaced at the AV Contractor's expense.

B. Mounting

1. All permanently mounted equipment shall be attached to the structure and held firmly in place. Provide brackets, braces and supports as required. Verify mounting with structural engineer prior to installation.
2. Provide for \pm (5) degrees of adjustability for any angular orientation shown in drawings.
3. Verify structural mounting, backing, and reinforcement points prior to installation.
4. Provide trim/escutcheon hardware for hardware penetrating finished ceilings. Verify finishes of trim components with Architect prior to ordering.

C. Cabling

1. General

- a. All cabling shall be continuous and without splices.
- b. Maintain proper positive/negative phase between all points in the system.
- c. Use care in wiring to avoid damage to cables. Where required, use temporary guides, sheaves, rollers, or other necessary devices to protect cables from excess tension, abrasion, bending, or any other damage during pulling. Provide wire pulling lubricants in accordance with wire and cable manufacturer's recommendations.
- d. Spacing between cable ties or is to be no less than six (6) inches.
- e. Provide rubber or nylon grommets over edges of cable pass through holes in chassis, racks, boxes, plates, etc.
- f. Provide ample service loops at cable endpoints so that plates, panels, and equipment can be demounted for inspection. Where no rear access to cable termination points on equipment exists, provide sufficient length of cabling so that equipment may be easily removed independent of other equipment.
- g. No length of cable over 18", with the exception of service loops, shall be unsupported by wire-way, raceway, conduit, or other approved cable support.
- h. Equipment that is to be moved during normal operation, such as slide-out shelves, shall be provided with adequate cable lengths to

- accommodate the full range of travel in each direction, and shall be dressed to avoid pinching or wedging in moving parts.
- i. Install cabling so that there is at least 6" of separation between circuits carrying AC power.
 - j. Where cabling of different signal types must cross, they are to do so perpendicularly as to minimize interference from one another.
 - k. Bending radii shall be minimum of (10) times the outer diameter of the cable jacket
 - l. Conduit fill ratios are not to exceed 40% of internal conduit area.
2. Termination
- a. All connections to jacks and connectors shall employ rosin-core solder, with no cold joints or splatter.
 - b. Except for the case of screw terminals, all bare wire conductors are to be tinned with resin flux.
 - c. Screw-terminated conductors shall be wrapped in the same direction as screw rotation when tightening.
 - d. Provide clear shrink tubing sleeve over each individual wire termination and solder lug. All exposed shield drain wire shall be sheathed in properly sized clear shrink tubing sleeves and protected against shorting to other conductors or connector shells.
3. Labeling/Identification
- a. All cabling shall be permanently labeled with unique numbers using wire makers printed via computer software program. Maintain consistent labeling practices across all cabling, including numbering, signal type identification, and text direction. Provide "run sheets" listing all cables by number, signal type, and termination type on both ends. Labeling information is to include the following:
 - b. Cabling for audiovisual systems shall be of a different jacket color than other low-voltage cabling where pathways are shared between divisions or other systems.
4. Audio
- a. Audio system shall be free of audible hum, noise, buzz, and distortion.
 - b. Balanced audio connectors shall be terminated in accordance with the international (IEC) standard: Pin 1: shield, Pin 2: audio positive, and Pin 3: audio negative.
 - c. All audio signal conductors connected between active devices shall be electronically balanced or transformer balanced with respect to the audio signal ground. Unbalanced audio circuits, where possible, shall utilize level matching interfaces with active balanced circuitry or isolation transformers.
 - d. When connecting unbalanced and balanced line-level signals, refer to RaneNote 110: "Sound System Interconnection" for proper wiring techniques.
 - e. Where there are unused conductors in a cable assembly, fold unused cables along outer jacket and cover completely with heat-shrinkable tubing.
 - f. Microphone and line level signal cabling shall be installed at least 3" from other low-voltage cabling

- g. Bridle rings suspended from ceiling or shared cable tray shall be provided in conditions where audio cabling is to share cable tray or pathways with other low-voltage cabling.

D. Equipment Racks

1. Cabling within equipment racks shall be neatly bundled and laced. AV Contractor shall, at no additional cost, re-bundle and lace cabling if directed by Owner and/or Consultant. Utilize cable tie-bars as necessary. Harnessed cables are to be combed straight.
2. Placement of equipment in equipment racks, as shown in the drawings, is for operator convenience, ventilation and/or circuit flow. Verify any changes in placement of the equipment with the Consultant prior to assembly.
3. Provide ventilation adequate to keep temperatures within equipment racks below 90 degrees F. Provide approved passive and/or active ventilation as required.
4. Racks shall be installed plumb and square within the room, and without twists in the frames or variations in level between adjacent racks.
5. Custom panels shall be manufactured in order to prevent panel deformation during normal plugging and switching operations.
6. Equipment requiring user interface shall be mounted between 18" and 48" AFF.
7. The front and rear of each rack-mounted device shall be labeled with lamicoïd labels (i.e. "Video Switcher #"); as well as all occupied slots in card frame devices.
8. Mount equipment using equipment rack manufacturer-approved black machine screws with nylon washers.
9. Heavy and/or deep equipment shall be provided with additional mounting hardware to support rear of equipment.
10. Unless otherwise shown on AV Drawings, heavy equipment, such as amplifiers, shall be mounted towards the bottom of the rack.
11. Provide code-required seismic restraints as necessary.
12. Electrical Requirements:
 - a. Where power sequencing devices are required, the following On/Off sequencing shall be provided:
 - 1) Control system components shall remain powered up and functional to accept control system commands.
 - 2) Audio amplifiers and/or powered loudspeakers are to power up last and power down first to prevent loudspeaker damage.
 - 3) Sequence the turn-on of devices so that AC power in-rush current is minimized.

E. Loudspeakers

1. Provide structural support for wall and ceiling-suspended loudspeakers.
2. Adjust distributed loudspeaker transformer taps, audio DSP, and amplifier levels for uniform consistency in sound pressure level throughout serviced area(s).
3. Orient loudspeakers for optimal coverage of intended listening area. Perform adjustments as required to optimize coverage uniformity.
4. Provide rigid support members to prevent loudspeaker from moving during operation after final adjustments have been made.

F. Video Projectors and Monitors

1. AV Contractor shall review and assess field conditions and select video projector lens(es) with appropriate focal lengths prior to ordering. The image is to completely fill the screen. The AV Contractor shall adjust video projector(s) and

lens(es) for optimal picture quality, including lens focus, lens shift, and keystone adjustments.

2. Refer to AV Drawings for video projection screen sizes and locations.
3. Provide full video projector and monitor calibration, configuration, and adjustments for all used inputs. Adjust aspect ratio configuration so that all installed sources fill the projection screen completely, without unnecessary scaling or stretching.
4. Configure EDID settings for all analog and digital video sources as required for proper compatibility between video sources. Video scaling is to be minimized as much as possible, so that a video source is scaled no more than (1) time within the overall system.
5. Provide a query command via bi-directional protocol (serial or network) regarding projector lamp life, and provide a means to display that lamp life, either on a touch panel display at start-up, or via network settings that send notifications to appropriate maintenance staff. Coordinate with Owner regarding desired notification format.
 - a. Coordinate with Owner regarding additional information or web interface access from resource management system(s) required.
6. Video monitors shall be set to initiate "Standby" mode when no input source is detected and return to "On" state once a video source is detected.

G. Wireless AV Systems

1. Verify available wireless RF frequencies on site over a 24-hour period prior to ordering any wireless RF equipment, including wireless microphone or hearing assistance systems. Verify frequency selection with manufacturer. If available frequency spectrum does not allow for the use of specific wireless RF components, notify Owner in writing.
2. Coordinate frequencies of all wireless devices, including Owner-provided devices.
3. Locate wireless microphone receiver antennas for adequate signal reception. Provide additional antennas, amplifiers, Bias-Ts, or any other devices as required to ensure adequate signal reception in the intended area. If the intended area is unclear, verify with Consultant prior to installation.
4. Provide network coordination for digital wireless systems utilizing Dante protocol.

H. Ceiling Storage Boxes

1. Rooms with LCD displays and/or pan-tilt-zoom cameras shall utilize a Ceiling Storage Box installed in the ceiling tile grid to house associated HDMI encoder/decoders. An HDMI cable shall be run from Ceiling Storage Box to associated encoder/decoder via conduit and free-wire run above ceiling with supports as required.
 - a. No power shall be required at Ceiling Storage Boxes; encoder/decoders will be powered remotely via Power over Ethernet.
 - b. Care shall be taken in facilitating passive cooling for encoder/decoders to ensure proper ventilation is achieved, i.e. vents shall remain un-covered, cabling shall be neat and not prevent airflow, and encoder/decoders shall be mounted on component shelf with space all around to allow air to flow freely.

I. Portable Equipment

1. Where portable equipment will be routinely connected and disconnected, provide clearly labeled, color-coded connectors to correspond with correct connection points.
2. Provide Techflex cable umbilical wrap, or equivalent, where multiple cables are connected at the same plate or location. All exposed cabling is to be bundled for a neat and clean appearance.
3. Provide finish samples and shop drawings to Owner for approval prior to ordering any AV Contractor-provided furniture or millwork.

J. Millwork Coordination

1. Verify final equipment and millwork clearances prior to ordering any audiovisual equipment. Notify the Owner in writing if any conflicts are identified.
2. Coordinate and submit dimensional information of audiovisual equipment to be incorporated into furniture or millwork provided by other divisions to Owner and/or Architect for approval prior to any cutting or penetrations.
3. Provide fans, ventilation slots/holes, or other hardware in millwork as required to conform to the manufacturers' operational temperature requirements.

K. Grounding

1. Use the equipment chassis as a common point of grounding the sound system; the equipment chassis is to be grounded to earth. Cable shields shall only be used for shielding (not signal) and connected to ground at the rack. All equipment shall be checked for ground continuity.

3.13 PROGRAMMING REQUIREMENTS

A. Audio DSP

1. Coordinate with Owner to provide contact closure from fire alarm system(s) to audio DSPs, mixers, processors, and/or amplifiers to mute all audio when fire alarm system is engaged. Test functionality in all locations and systems. Coordinate with local fire safety agency for verification and sign-off.
2. Verify specified audio DSP will provide adequate processing power with manufacturer to accommodate functionality as described in this specification section prior to ordering.
3. Provide required preset configurations to accommodate all routing conditions.
4. Provide automatic microphone mixing and proper mix-minus routing systems where multiple installed microphones are utilized.
5. All video source inputs are to include audio support, unless otherwise noted. All audio associated with video is to follow video source routing. Where identified, provide audio breakaway from video programming.
6. Provide separate equalization and dynamic processing for speech and playback source inputs. Provide separate volume control(s) for speech and playback sources, including volume up/down and mute.
7. Provide limiting on all drivers.
8. Once a room has been properly equalized for a flat response, if microphone feedback issues occur during initial testing, provide dynamic feedback equalizer filters with fixed notches for microphone signals. Dynamically assigned feedback filters are to reduce filter depth and return to a flat state once feedback has been addressed.
9. Ensure all playback source output within room is within 1.5 dB of one another when source output level is identical.

10. Use available DSP processing algorithms as required to optimize audio performance in all spaces.
 11. Audio and Video Conferencing Requirements:
 - a. Provide Acoustic Echo Cancellation and Noise Reduction at individual microphones for any room utilizing audio or video conferencing system(s).
 12. Coordinate with Owner regarding audio routing to recording computers.
- B. Video Switchers, Processors, and Extenders
1. Video systems are to be configured to output the highest resolution available for the specified screen aspect ratio.
 2. EDID signals are to be managed throughout system. Where EDID management is not available, utilize EDID emulators.
 3. Where twisted-pair video transmitters and receivers are utilized, perform distance compensation adjustments as required to achieve an image that is equivalent to the original signal.
 4. Where possible, supply DC power remotely (via PoE or direct DC current) to video transmitters and receivers from equipment rack location(s) in an effort to avoid unnecessary power supplies within the room(s) served.
 5. Coordinate with Owner regarding which video source(s) shall be routed to the recording computer in each Classroom.
 6. Combination USB/HDMI cameras shall allow simultaneous HDMI and USB outputs. USB will be connected to Zoom computers via USB extenders to allow users to use Zoom software to switch between cameras. HDMI outputs will allow cameras to be routed to any input device within the system, including Zoom computers via AV Bridge devices.
 7. Video switching shall be set-up and managed via virtual switching appliance hardware device. Training shall include dashboard set-up and training for appliance to allow Owner to make adjustments and troubleshoot encoder and decoder end-devices remotely.
- C. Control Systems
1. Coordinate with the Owner and Consultant regarding specific graphical control interface requirements. This includes individual system functional requirements, touch panel graphic appearance, page hierarchy, and other control interface parameters. The control interface design should be uniform in look, feel, and functionality across all spaces and systems throughout the project, unless otherwise noted in this specification section or directed by the Owner.
 2. Coordinate with Owner regarding level of IP-based system status notification required for audiovisual system(s). This may include, but is not limited to, video projector lamp life, equipment failure notification, power failure notification, temperature level notification, after hours system use notification, room use and scheduling requirements, and digital signage display status.
 3. All control system programming is to be provided by a programmer certified by the manufacturer of the control system to be provided.
 4. Provide software necessary to operate and program audiovisual system components. The software is to be provided by the manufacturer(s) of system components.
 5. Cameras shall route to Zoom computer via USB for camera inputs to be switched via Zoom software. Content will be routed to Zoom computer via HDMI decoders to allow any source to be viewed at far end of video conference call.

6. Touch Panels:
- a. The AV Contractor is to submit touch panel pages and layouts to the Owner and Consultant in an interactive format prior to implementation. This interactive format is to emulate functionality, page hierarchy, and other interactive design parameters.
 - b. Touch panel pages and language is to be easy to understand for non-technical users. Technical terms not commonly used outside of the audiovisual industry are to be avoided whenever possible.
 - c. Coordinate with Owner about which touch panel functions shall be password protected.
 - d. Provide ample time for touch panel review in order to address Owner-requested changes without negatively impacting the installation schedule. Provide, at no additional charge, reprogramming of control system components at Owner's request for a full (30) days after system acceptance.
 - e. DSP Audio presets are to be recalled seamlessly in the background as a result of source selection and intuitive control options.
 - f. All button panels, including motorized screen controllers, are to function in parallel with touch panel user interface, and provide appropriate visual feedback at touch panel display when button panel control parameters are utilized.
 - g. Coordinate with other divisions as required to incorporate control of other room systems within the touch panel user interface, including, but not limited to:
 - 1) Mechanical/HVAC
 - 2) Lighting/Shades
 - 3) Electrical systems
 - h. At a minimum, all touch panel user interfaces are to include the following control parameters:
 - 1) Master audiovisual system On/Off control, including prompt at shutdown asking user "Are You Sure?" with "Yes" and "No" buttons to prevent accidental shut down.
 - 2) In rooms where there is more than a single display, provide On/Off control for individual displays
 - 3) For rooms with video projectors, provide a message during power-up on touch panel display indicating "The Projector is Powering Up. Please Wait..." until video projector is fully operational.
 - 4) For rooms with video projectors, provide a message during power-down on touch panel display indicating "The Projector is Powering Down. Please Wait..." until video projector is fully shut down.
 - 5) Separate speech and playback volume controls
 - 6) Audio and video conferencing dialing controls
 - 7) Source selection is to be provided for individual displays, unless otherwise noted in this specification section
 - i. **Provide lighting control for all AV-enabled spaces, and shade control where applicable. Coordinate with lighting designer for lighting panel interface type, location, and connection.**

7. Button Panels

- a. Provide and configure button panels to enable system On/Off, Volume Up/Down, and Source Selection for all systems not utilizing a touch panel control interface, unless otherwise noted in this specification section or the AV Drawings.
 - b. Where available, there are to be no unlabeled buttons on button panels. Coordinate with Consultant to assign functionality to all buttons provided.
- D. Network Data Coordination
 - 1. Coordinate with Owner regarding desired level of audiovisual network and other data network integration. If no interoperability is desired, the AV Contractor is to create an independent network for audiovisual equipment as required.
 - 2. Contractor shall set-up and deploy Crestron XiO Cloud services for remote deployment, management, and monitoring to all AV devices. This shall include, but is not limited to, AV device monitoring, equipment failure alerts, system use data, remote and scheduled power cycling, and any other function required by Owner. Coordinate with Owner for specific requirements.
 - 3. Virtual Switching Appliance will be installed in Level 3 Server Room, and remoted access will be granted by Owner IT Network manager. Contractor shall coordinate with Owner IT Network team for access and configuration.
- E. Classrooms, Lecture Room, Colloquium Room
 - 1. Default routing – Local Only Classroom
 - a. Instructor computer content view routes to display(s) at front of room and instructor's desk confidence monitor, where applicable
 - b. When laptop HDMI is plugged in, all displays switch to laptop input
 - 2. Default routing – Distance Learning Classroom
 - a. Instructor computer content view routes to display(s) at front of room
 - b. Instructor computer far-end view routes to confidence monitor at instructor's desk
 - c. When laptop HDMI is plugged in, display(s) at front of room switch to laptop input, and lectern confidence monitor switches to instructor computer content view
 - d. Ability to show different content on separate screens is disabled during distance learning mode
 - 3. Default Routing – ADA Capture Computer
 - a. Camera at back of room shall route to ADA Capture computer input
 - b. Content shown on screen shall be routed to ADA Capture Computer content input
 - 1) When different content is shown on separate screens, second content source shall route to camera input, and switch back to camera source once screens are showing same content again.
 - 4. Touch Screen Programming
 - a. When user touches touch screen, a startup page with a prompt shall ask "WHAT WOULD YOU LIKE TO DO TODAY?" with button options "LOCAL ONLY CLASSROOM" and "DISTANCE LEARNING CLASSROOM".
 - b. Refer to default routing above for default routing

- c. Main page shall consist of the following:
- 1) Main volume slider and mute button
 - 2) Under "DISPLAYS" heading:
 - (a) "FRONT DISPLAY 1" button
 - (b) "FRONT DISPLAY 2" button (where applicable)
 - (c) "DESKTOP TOUCH SCREEN" button (where applicable)
 - (d) "CONFIDENCE MONITOR" button (where applicable)
 - 3) "DISTANCE LEARNING CONTENT" button
 - 4) "CAMERA CONTROL" button
 - 5) "AUDIO CONTROL" button
 - 6) "POWER OFF" button
- d. Each of the buttons listed under "DISPLAYS" shall route to a new page with relevant video sources listed below. When a button below is selected, system shall route that source to that display.
- 1) "INSTRUCTOR COMPUTER" button
 - 2) "ZOOM ROOM COMPUTER" button
 - 3) "INSTRUCTOR HDMI" button
 - 4) "DOCUMENT CAMERA" button (where applicable)
 - 5) "WIRELESS AV HUB" button
 - 6) "CAMERA FRONT" button (where applicable)
 - (a) Note some rooms will require two "CAMERA FRONT" buttons for left and right cameras
 - 7) "CAMERA BACK" button
 - 8) "DISPLAY ON/OFF" button shall allow user to turn on/off the selected display, where applicable.
- e. When "DISTANCE LEARNING CONTENT" button is selected, touch screen will route to distance learning page to allow instructor to route classroom video sources to distance learning far end:
- 1) "INSTRUCTOR COMPUTER" button
 - 2) "INSTRUCTOR HDMI" button
 - 3) "DOCUMENT CAMERA" button (where applicable)
 - 4) "WIRELESS AV HUB" button
 - 5) "CAMERA FRONT" button (where applicable)
 - 6) "CAMERA BACK" button
 - 7) "MUTE" button shall allow instructor to mute video to far-end classroom
- f. When "CAMERA CONTROL" button is selected, touch screen shall route to a camera control page with "CAMERA FRONT" and "CAMERA BACK" options. Each camera shall have controls for pan, tilt, zoom, as well as a camera preview window to allow user to see camera view on touch screen.
- g. When "AUDIO CONTROL" button is selected, touch screen shall route to audio control page with volume sliders and mute buttons for each audio source.
- h. Microphones for far-end distance learning and recording computers shall remain active at all times and route to AV-to-USB bridges and capture devices. When microphones for far-end distance learning and/or computer recording are selected, a prompt shall appear that states "NOTE: ADJUSTMENTS TO THIS MICROPHONE'S SETTING WILL NOT BE HEARD IN THE ROOM. DO NOT MAKE ADJUSTMENTS UNLESS YOU ARE IN CONTACT WITH THE FAR-END DISTANCE LEARNING CLASSROOMS AND UNDERSTAND WHAT THE

ADJUSTMENTS BEING MADE WILL DO TO THE FAR-END CLASSROOMS.”

- i. When “POWER OFF” button is selected, a prompt shall appear that asks, “ARE YOU SURE?” with “YES” and “NO” buttons.
 - j. All touch screen pages described above, with the exception of the startup page and power off page, shall include a main volume control slider and mute button.
- F. Meeting Rooms, Extra Small Breakout Rooms
- 1. Touch Screen Programming
 - a. When user touches touch screen, a startup page with a prompt shall ask “TURN SYSTEM ON” with “YES” and “NO” buttons.
 - b. Main page shall consist of the following:
 - 1) Main volume slider and mute button
 - 2) Under “SOURCES TO DISPLAY” heading, the following source buttons
 - (a) “INSTALLED COMPUTER” (where applicable)
 - (b) “TABLETOP HDMI”
 - (c) “WIRELESS AV HUB”
 - c. “ZOOM ROOM CONTENT SEND” button
 - d. “CAMERA CONTROL” button
 - e. “AUDIO CONTROL” button
 - f. “MUTE MIROPHONE” button
 - (d) Ceiling microphone array or beam-forming microphones shall show on/off status via LED, i.e. red = off, green = on
 - g. “POWER OFF” button
 - h. When “ZOOM ROOM CONTENT SEND” button is selected, touch screen shall route to Zoom Room Content Send page, with the following source buttons:
 - 1) “INSTALLED COMPUTER (where applicable)
 - 2) “TABLETOP HDMI”
 - 3) “WIRELESS AV HUB”
 - i. When “CAMERA CONTROL” button is selected, touch screen shall route to a camera control page. camera shall have controls for pan, tilt, zoom, as well as a camera preview window to allow user to see camera view on touch screen.
 - j. When “AUDIO CONTROL” button is selected, touch screen shall route to audio control page with volume sliders and mute buttons for each audio source.
 - k. When “POWER OFF” button is selected, a prompt shall appear that asks, “ARE YOU SURE?” with “YES” and “NO” buttons.
 - l. All touch screen pages described above, with the exception of the startup page and power off page, shall include a main volume control slider and mute button.
- G. Zoom Room Computer Set-up and Programming
- 1. Cameras in Classrooms shall be routed to Zoom Room computer via USB extenders. Camera switching shall be done within Zoom software by Instructor
 - 2. Video sources shall be routed to Zoom Room computer as a “content” source via HDMI capture device downstream from video decoder.

3. Audio shall be routed in and out of Zoom Room computer via AV Bridge (Meeting Rooms, Extra Small Breakout Rooms) or USB Audio Interface from/to Audio DSP (Classrooms, Colloquium Room).

3.14 PERFORMANCE SPECIFICATIONS

- A. Unless restricted by the published specifications of a particular piece of equipment which would prevent other devices from doing so, the following performance standards shall be met or exceeded:

1. Audio Processing Equipment
 - a. Signal-to-Noise ratio (including crosstalk and hum): 75dB minimum
 - b. Total Harmonic Distortion (THD): 0.5% maximum from 20 Hz to 20 kHz
 - c. Frequency Response: Flat within 0.5 dB, 20 Hz to 20 kHz
2. Video Processing and Routing Equipment
 - a. HDMI
 - 1) HDMI 2.0
 - 2) HDCP 2.2 Compliant
 - b. Analog Video
 - 1) Signal-to-Noise Ratio (peak to RMS), unweighted DC to 4.2 MHz: 45 dB minimum
 - 2) Crosstalk, unweighted DC to 4.2 MHz: 45 dB minimum
 - 3) Frequency Response (RGBHV): +/- 0.5 dB to 300 MHz
 - 4) Line and Field Tilt: 2% maximum
 - 5) Differential Gain: 3% maximum
 - 6) Differential Phase: 2 degrees maximum

3.15 VERIFICATION

- A. Make all adjustments and modifications necessary so that the system is operational and functions as intended herein.
- B. Make all adjustment and modifications necessary for proper system gain structure as detailed herein and per equipment manufacturers' instructions and recommendations. Mark settings of all variable controls to be preset using Avery Label self-adhesive "dots" or equivalent.
- C. Upon completion of the installation (prior to Acceptance Testing), the AV Contractor is to perform verification testing of all elements of the system as follows:
 1. General Performance Verification
 - a. All cable lines are to be tested for continuity, phase, shielding, proper labeling, and unreasonable signal loss.
 - b. All equipment is to be tested for proper operation.
 2. Video Performance Verification
 - c. Signal Level, Distortion, Hum and Noise

- 1) For analog video signals, utilizing a NTSC video signal generator, vector scope, and waveform analyzer with the video signal set at 1 Volt P-P and 75% saturation, check that the video performance specifications as stated previously are met at all display devices from all source inputs.
 - 2) Utilizing a laptop PC with 1080P and WUXGA color graphics capability, check that the video performance specifications are met at the display devices from all applicable source inputs.
- d. Level Balance
- 1) Adjust all video equipment to produce the best image possible according to manufacturer's instructions. Ensure that horizontal sweep circuitry is not overdriven to the point of audible sweep frequencies are being emitted.
 - 2) Adjust all video cameras, monitors and media players to produce the best image possible according to manufacturer's instructions.
 - 3) Adjust all video distribution amplifiers for unity gain of luminance and chrominance at the end devices.
3. Audio Performance Verification
- a. Upon completion of the systems testing, the AV Contractor is to adjust, and uniformly calibrate all gain adjustments of the audio systems and related system devices.

3.16 ACCEPTANCE TESTING

- A. After completing preliminary testing, the AV Contractor shall furnish Owner with a cover letter describing system performance, and a report documenting the results of the preliminary tests, along two (2) copies of "as-built" wiring diagrams of the entire system, including the connection numbers, and their locations. The receipt of this documentation will constitute the AV Contractor's acknowledgment that the installation is complete and conforms to this specification and is ready to be reviewed and tested by the Consultant.
- B. Acceptance testing shall be performed by the Consultant with assistance from the AV Contractor after receipt of report described above. AV Contractor shall provide a capable technician familiar with the installed AV systems for (2) single eight-hour days.
 1. AV Contractor shall coordinate all site, room, millwork, and equipment cabinet access with Owner as required to fully test and verify installation.
 2. The AV Contractor shall furnish a laptop with all manufacturer supplied configuration software necessary for communicating with the Audio DSP. A review of system settings may be required for either of the programmable units at the Consultant's request, and settings may be adjusted if necessary.
 3. AV Contractor shall furnish all tools, test equipment, source equipment (including audio and video sources), and materials required to make necessary repairs, corrections, and adjustments required.
 4. Further electrical and acoustical measurements may be performed at the discretion of the Owner. Such measurements may include sound pressure levels, uniformity of coverage, distortion, or other pertinent characteristics.
 5. The Control System interface programmer shall be available during final testing to address and respond to control system interface questions, preset recall configuration assumptions etc.

- C. If further adjustments or work are required after acceptance testing, continue work until the system is made acceptable and at no additional cost to the Owner.
 - 1. If acceptance is delayed due to incomplete installation or programming, defects in or failure of equipment, or because the installation fails to meet the requirements of this specification, and additional site visits are required, AV Contractor shall retain the Consultant, at the Consultant's standard hourly rate, for any additional Consultant time and expenses required due to extension of the acceptance testing.

3.17 DOCUMENTATION

- A. Furnish all submittal documents as identified in Part 1 of this specification section.
- B. Furnish an Operations and Maintenance Manual prepared for the Owner's technical staff, in preferred Owner format(s) (i.e. USB flash drive, hard copies, etc.) containing the following sections:
 - 1. Service Reference Cover Sheet: Provide a cover sheet with AV Contractor name, address, telephone number, and website information.
 - 2. System Operation Instructions: Step-by-step operating instructions for the basic day-to-day use of the system, including power activation, connection of source devices, adjustment of volume levels, selection of sources, etc. Include illustrations and references to individual equipment manuals as necessary.
 - 3. Equipment Manuals: Include copies of individual equipment operation manuals separated by tabbed dividers. Order manuals in nominal signal path order (i.e. sources first, amplifiers/loudspeakers last), followed by control system manuals, followed by miscellaneous manuals.
 - 4. Equipment List: List all system equipment by manufacturer and model.
 - 5. As-built Drawings: Provide "as built" functional diagrams. Hard-copies, if required, shall be in reduced 11"x17" foldouts in clear plastic binder sleeves. Fold and insert drawings so that drawing title is clearly visible at the front of the sleeve.
 - 6. Provide software programmable device configuration files to the Owner for the following:
 - a. Control Systems (Source code, including any interfaces and computer-based application files).
 - b. DSP Audio System (DSP system configuration files).
 - c. Store files on site in the system documentation binders as CD-ROMs in disk sleeves. Provide the files on (2) USB flash drives.
 - 7. Maintenance: Devices requiring routine maintenance (such as video projector filters or lamps) shall be listed along with procedures and schedules for maintenance of those items. If information from the manufacturer is inadequate or item is custom, provide the information necessary for proper maintenance. Include parts lists and schematics as available from the manufacturer and for all custom items.
 - 8. Service and Warranty Information: Furnish a clear statement of the AV Contractor's guarantee for the system and contact information for on-call services. Include manufacturer's warranty statement for all equipment including actual expiration dates.
- C. Submit a draft copy of the Operations and Maintenance manual to the Consultant prior to acceptance testing.

3.18 TRAINING

- A. Training shall only occur after final acceptance by the Consultant, unless otherwise directed by the Owner. AV Contractor shall furnish a complete Operations and Maintenance Manual to each participant at the time of training.
- B. At a time designated by the Owner, furnish sixteen hours of instruction in four-hour sessions to the Owner's designated personnel in the use and operation of the system. The instructor is to be fully knowledgeable and qualified in system operation. If required by Owner, training sessions shall be video recorded in a format designated by the Owner for archiving.
- C. Furnish one (1) technician to be present and assist the Owner at the first two (2) major uses of the system as directed by the Owner.

END OF SECTION