



# **AUDIOVISUAL SYSTEM SPECIFICATIONS**

**US District Court, EDNY**

**Brooklyn 14<sup>th</sup> Floor Judges Conference Room**

**AV System Integration**

**225 Cadman Plaza East, Brooklyn, NY 11201**

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## Part 1 General

### 1.1 Scope of Specification

- 1.1.1 This specification covers the audiovisual (AV) systems described herein for the US District Court, Eastern District of New York which will be upgrading their space at 225 Cadman Plaza East in Brooklyn, NY. This location includes 14 floors and includes the related rooms as indicated below.
- 1.1.2 The AV related spaces are as follows:
  - 1.1.2.1 14<sup>th</sup> Floor Judge's Conference Room
- 1.1.3 All AV and Electrical drawings related to this specification shall be considered as a part of this specification.
- 1.1.4 Drawings and specifications are the property of the Owner and are not to be used on any other project or work.

### 1.2 Definition of Terms

- 1.2.1 The term "Client" refers to US District Courts, Eastern District of New York
- 1.2.2 The term "Architect" refers to the project architect
- 1.2.3 The term "Consultant" or "Designer" refers to Audio Visual Resources, Inc.
- 1.2.4 The term "Bidder" is the AV Integration firm submitting a bid response to this specification.
- 1.2.5 The term "AV Contractor" is the firm that has been awarded the contract for this specification and has responsibility for the performance specified herein pertaining to the AV Systems.
- 1.2.6 The term "General Contractor" refers to the General Contractor.
- 1.2.7 The term "Subcontractor" is any firm or individual hired by the AV Contractor to perform any of the work detailed in this specification.
- 1.2.8 The term "Equipment" refers to any and all items, off-the-shelf or custom, used to assemble the system.
- 1.2.9 The term "System" refer to singularly and/or collectively, the complete, integrated assemblage of equipment as specified and intended herein.
- 1.2.10 The term "Not In Contract" (NIC) refers to material and/or labor related to, or that functions as part of, the AV System which is not within the scope of work for this specification, but that is to be furnished or installed by other Contractors.
- 1.2.11 The term "Owner Furnished Equipment" (OFE) refers to equipment provided by the Owner. The AV Contractor shall be responsible for installing and integrating this equipment into the system.
- 1.2.12 Equipment designated as "FUTURE" shall have wiring and connector provided, ready for integration of the equipment itself, as indicated on the AV Flow drawings.
- 1.2.13 The term "Provide" means furnish and install, unless otherwise indicated.
- 1.2.14 The term "Shall" is a mandatory directive.
- 1.2.15 The term "Will" is informative.
- 1.2.16 The term "Should" is advisory.

### 1.3 Contractor Responsibility

- 1.3.1 The Contractor shall furnish all equipment and material required to ensure a complete and operating system with zero defects. (Note: The NIC and OFE equipment and materials are specifically exempted from this requirement.)
- 1.3.2 It is the responsibility of the Contractor to ensure that the work described in this document shall be complete to provide a properly functioning system in compliance with all requirements of this specification.
- 1.3.3 The Contractor shall generate all AV drawings, materials, and technical information for the complete installation and wiring of the system. The Contractor shall provide the on-site installation and wiring, and shall provide on-going supervision and coordination during the implementation phase of the project.
- 1.3.4 The Contractor shall be responsible for the initial adjustment of the systems as described in this document, and shall provide all test equipment for the system checkout and acceptance tests. The Contractor shall provide on-site training in operation and maintenance of the systems for personnel designated by the Owner.

### 1.4 Contract Documents

- 1.4.1 The following specification defines the AV system and equipment to be installed in the facilities of US District Court, EDNY located at 225 Cadman Plaza East, Brooklyn, NY 11201.
- 1.4.2 The AV Contract Documents include this specification and all the AV Contract drawings, along with any addenda, clarifications, or supplemental instructions issued prior to completion of the AV Contract.
- 1.4.3 The AV Contract drawings, the equipment list, and this specification are intended to be complimentary. Any work shown on the drawings and not mentioned in the bill of material or specification, or vice versa, is included in the AV Contract as if mentioned in both places.
- 1.4.4 Referenced dimensions shown on drawings shall be followed in preference to scaled measurements. Large scale drawings and full-size details shall be followed in preference to small scale drawings.
- 1.4.5 Nothing contained in this specification or any other AV Contract documents shall create any contractual relationship between the AV Contractor and the AV Consultant or the Architect.

### 1.5 Related Documents

- 1.5.1 All aspects of the General Construction Specification issued by the Architect apply to this specification. Bidders should examine all general construction drawings and read all divisions of the General Construction Specification to avoid omissions of duplications and to ensure a complete job. Discrepancies between drawings and specifications or obvious omissions shall be referred to the Architect and the Owner immediately.
- 1.5.2 Discrepancies between AV drawings and specifications or obvious omissions shall be brought to the attention of the Owner and the AV Consultant. Bidders shall bring all discrepancies to the attention of the Owner and the AV Consultant at least five (5) business days prior to the date of the bid closing. Failure by any bidder to do so will assume that the bidder has a clear understanding of the entire project, and assumes the responsibility to ensure a complete and working system.

## 1.6 Regulatory Requirements for the Contractor

- 1.6.1 Conform to all applicable Federal, State, and municipal codes, or the Authority Having Jurisdiction (AHJ) if they are not in agreement.
- 1.6.2 Conform to the National Electric Code and all local electrical codes.
- 1.6.3 Provide site labor compatible with on-site trades people.
- 1.6.4 Adhere to the industry standards and best practices published by the following:
  - Underwriters Laboratories
  - National Electric Code
  - Federal Communications Commission
  - Audio Engineering Society
  - Society of Motion Picture Engineers
  - IEEE/ANSI
  - InfoComm International
  - Association for Quality in AV Technology (AQAV)
- 1.6.5 It is the contractor's responsibility to obtain any permit or certificate required for completing this project, as well as associated costs.
- 1.6.6 The contractor shall show that all work follows OSHA requirements and guidelines.

## 1.7 Scope of Work

- 1.7.1 The work shall include all labor, material, equipment, and services necessary to provide a complete and working system as conceptually defined in the contract documents. Claims for additional equipment or labor needed to achieve a complete and working system shall not be considered, regardless of whether said equipment or labor is shown or described specifically in the contract documents.
- 1.7.2 The contract documents are conceptual in nature. It is the responsibility of the AV Contractor to create all signal flow fabrication, installation, and riser diagrams needed to achieve the design concept.
- 1.7.3 Any quantities given in the AV Contract drawings or specification are provided for the bidder's reference only. Where stated quantities do not agree with each other, or do not agree with the quantities needed to provide complete and working systems, the larger quantity shall be part of the AV Contract.
- 1.7.4 All fabrication and installation shall be done from contractor-created shop drawings that have been approved by the Owner and AV Consultant.
- 1.7.5 All portable equipment specified herein shall be unpacked, fully assembled, tested, and fully exercised with the interfacing system(s) as part of the work.

## 1.8 Related Work By Others

- 1.8.1 The work of this contract shall include coordination of all related work by other trades, including but not limited to the work described herein.
- 1.8.2 Work by the General Contractor**

- 1.8.2.1 The GC shall cut holes into ceiling tiles or dry wall ceilings for ceiling loudspeakers, unless otherwise specified.
- 1.8.2.2 The GC shall provide both rough openings and finished trim for all wall-mounted displays.
- 1.8.2.3 The GC shall provide and install any additional HVAC equipment required to properly ventilate and cool AV equipment racks.
- 1.8.2.4 The GC shall provide and install all acoustical treatments on walls or ceilings.

### **1.8.3 Work by the Electrical Contractor**

- 1.8.3.1 The EC shall provide and install all conduit, wire ways, junction boxes, and floor boxes required for the low voltage AV signal cable.
- 1.8.3.2 The EC shall provide and install all the power outlets and circuits required for the low voltage AV signal cable.

### **1.8.4 Work by the Structured Cabling Contractor (or Electrical Contractor)**

- 1.8.4.1 The Structure Cabling Contractor shall provide and install all the DATA, TV Feed, and TELCO connections required for the AV Systems.

### **1.8.5 Work by Others**

- 1.8.5.1 All credenzas and table that must receive AV Equipment shall be provided and installed by others, unless otherwise specified.
- 1.8.5.2 The furniture contractors shall provide any access or mounting holes, as well as any ventilation openings required to successfully accommodate the AV equipment, unless otherwise specified.
- 1.8.5.3 All motorized blackout and/or solar shades shall be provided and installed by others.
- 1.8.5.4 All lighting systems shall be provided and installed by others.

## **1.9 Bid Submittal Information**

- 1.9.1 All bids shall be submitted for equipment, material, and labor as specified herein.
- 1.9.2 Bidders shall read all sections of this specification and examine all related drawings in order to avoid omissions, duplications, and to ensure a complete job. Bid submittal prices shall be valid for a minimum of sixty (60) days.
- 1.9.3 All bids are to be submitted as described in the covering documentation.
- 1.9.4 No extensions will be granted for any reason.

### **1.9.5 Bidder Qualifications**

- 1.9.5.1 Any AV firm bidding on this contract shall have a minimum of five (5) years of experience in the successful completion of similar projects to that is described herein.
- 1.9.5.2 Upon award, the successful Bidder shall submit a listing of the key engineering, project management, and installation personnel who will be assigned to this project, along with a brief job description and resume of their career-related backgrounds and experience. The key personnel must be InfoComm International and/or AQAV certified as appropriate for their roles, and must provide corresponding and valid certificates. These key personnel must remain directly involved in all aspects of the project until its completion.
- 1.9.5.3 The successful Bidder must be able to devote appropriate manpower resources necessary to meet the construction schedule.

- 1.9.5.4 The successful Bidder shall provide to the Owner, prior to beginning any work, proof of Workman's Compensation Insurance and Contractor's Liability Insurance, as required by the Owner.
- 1.9.5.5 Each Bidder shall own, as a minimum requirement, the following test equipment, and be familiar in their operation, application and use

<b>Test Instruments</b>
Sensitive AC voltmeter, -80 dBu sensitivity or more, 20Hz-30 kHz response, able to measure signal to noise ratio, THD, electrical audio levels within the system. Note that some systems require measurements up to 100 volts and may require an external pad.
Sound Pressure Level Meter, ANSI Type II, with A and C weighting filters, fast or time-averaged.
Audio Signal generator, 20-30 kHz, sine wave, pink noise, and continuous sine wave sweep
Amplified loudspeaker 100 mm producing 60 dBA at one meter, and 70 dBA at one meter, pink noise, sine wave, speech files.
200MHz oscilloscope, with TV sync (analog video only).
Analog Video Signal Generator NTSC/PAL, plus computer patterns at all required resolutions and refresh rates required for the systems under test. For systems with composite video, include PLUGE pattern. (analog video only)
Digital Video Signal Generator for computer patterns for all resolutions and refresh rates required for the systems under test, HDMI/DVI, with and without HDCP.
The ability to measure STI-PA (source and analyzer).
Colorimeter/luminance meter, 10% accuracy.
Infrared Thermometer.

**1.9.6 Pre-Bid Inspection**

- 1.9.6.1 Every Bidder shall schedule a pre-bid inspection of the job site with the GC, the Owner, and the AV Consultant when required. Each bidder shall become acquainted with all aspects of the project, including storage and delivering of equipment. It is the bidder's responsibility to examine the site; failure to do so will not relieve the bidder from furnishing any and all items required in order to complete the project.
- 1.9.6.2 Every bidder shall field verify all dimensions, location, and clearances during the pre-bid inspection. Any questions, inconsistencies, or omissions noted during the pre-bid inspection must be reported with the bid. Any questions, inconsistencies, or omissions reported after the bid shall be the full responsibility of the bidder.
- 1.9.6.3 When pre-bid inspection is required, any bids submitted by a firm that has not conducted a site survey shall be rejected.

**1.9.7 Bid Response Contents**

- 1.9.7.1 All bids shall include individual, itemized, equipment line item pricing, subtotals and labor pricing, based on the equipment lists provided with this specification. These equipment and labor pricing sheets will be based on the equipment list provided with this specification.
- 1.9.7.2 Each system's equipment pricing sheet shall include an allowance for all wire, cable, connectors, and miscellaneous items not specifically mentioned.
- 1.9.7.3 Each system's equipment pricing sheet shall include any other expenses required to complete the project in a timely manner.
- 1.9.7.4 The bid response must include the following information:
- Bidder's company letterhead and/or has logo on proposal.
  - Site location listed with complete address
  - Scope of work in description of the proposal
  - Sales tax information included (i.e. applicable sales tax included)
  - Clearly define the total requested dollar amount on the proposal
  - Signature of a representative of the Bidder (non-electronic)

### **1.9.8 Bid Schedule**

- 1.9.8.1 Day 0: AV contract documents are issued to Bidders
- 1.9.8.2 Day 3: Pre-bid conference call, if required
- 1.9.8.3 Day 5: Bidders to submit RFI's in writing to Owner and AV Consultant
- 1.9.8.4 Day 7: Response to RFI's are provided to Bidders
- 1.9.8.5 Day 10: Bids are due by End of Day
- 1.9.8.6 Day 15: Contract awarded
- 1.9.8.7 (These days are counted in business days, unless otherwise noted.)

### **1.9.9 Rejection of Proposals**

- 1.9.9.1 The Owner reserves the right to reject any bids or proposals received.

### **1.9.10 Changes and Substitutions**

- 1.9.10.1 Substitute equipment may be proposed, but shall be in addition to the "as specified" contract documents and separately proposed. It will be identified as "alternates" with equipment costs shown separately and apart from the costs of the equipment "as specified".
- 1.9.10.2 Equivalency in quality, performance, construction, and function shall be demonstrated by submitting, as applicable or required by the AV Consultant, the following:
- Technical data sheets and specifications
  - Technical information and equipment test data
  - List of advantages to the Owner
  - Cost and substantive difference between the alternate and specified equipment in the contract documents.
- 1.9.10.3 The contract documents are based on specific equipment, functions, and arrangements. Additions or revisions to equipment, material, and labor may be necessary for the proper fit and function of any proposed substitute items to the purpose, arrangement and intent originally indicated. It is the responsibility of the Bidder to determine such additions and/or revisions and identify them in the bid submittal.

- 1.9.10.4 Costs for any additional labor and additions or revisions to wiring, space requirements, equipment or other materials, required for the use of substitute equipment shall be included by the Bidder without claim for subsequent additional payment.
- 1.9.10.5 Consideration in the bidding for a proposed substitute will be given on if, in the opinion of the AV Consultant, the substitute is equal to and/or offers significant advantage to the Owner over the specified item.
- 1.9.10.6 No changes shall be made to the work of the AV Contract, nor will invoices for changes, alterations, modifications, deviations, or substitutions be paid, except upon written order of the Owner.

## 1.10 Submittals

### 1.10.1 Equipment Submittals

- 1.10.1.1 Within one (1) week of acceptance of a bid, the successful Bidder shall provide a comprehensive package including specifications and literature for all material, devices, components, and equipment included in the scope of work.
- 1.10.1.2 These documents shall be in alphabetical order by manufacturer then by model. A table of contents with hyperlinks shall be included for easy navigation.
- 1.10.1.3 With the equipment submittal, the successful bidder shall identify any long lead time items. Failure to identify said long lead time items shall make the cost of expediting shipment the full responsibility of the bidder to meet the project schedule.
- 1.10.1.4 Under no circumstances shall the AV Contractor order any equipment without written approval of the Owner and the AV Consultant.

### 1.10.2 Shop Drawings

- 1.10.2.1 Within four (4) weeks of acceptance of the bid, the AV Contractor shall provide a set of fabrication and installation shop drawings, unless otherwise specified by the project schedule.
- 1.10.2.2 All shop drawings shall be delivered in both Adobe PDF and AutoCAD DWF viewing formats.
- 1.10.2.3 All shop drawings shall use the same symbols and nomenclature.
- 1.10.2.4 Shop drawings shall include complete, comprehensive schematic drawings, showing all equipment, devices, connectors, terminations, and wires for each system.
- 1.10.2.5 Schematic drawings shall show all rack wiring, field wiring, cable numbers, color codes, pin-outs, terminal block number, connector type, and signal levels, as well as any custom electronic modification to any device.
- 1.10.2.6 Schematic drawings shall indicate manufacturer, model number, and description/unique identifier for all equipment.
- 1.10.2.7 Schematic drawings shall be engineered and drawn by the Contractor. Copies of the contract drawings shall not be provided in any electronic format. Schematics that appear to be copies of the contract drawings shall be rejected.
- 1.10.2.8 Shop drawings shall include complete scale rack elevations for every equipment rack, including full-size details of any custom punched or engraved rack panels, including all labels and lettering.
- 1.10.2.9 Shop drawings shall include complete, full-size details of any custom wall plates, floor box plates, or panels, including all labels or lettering.

- 1.10.2.10 Shop drawing shall include complete, scaled, details of mounting arrangements for all loudspeakers, projectors, displays, and cameras, including positioning devices, framework supports, and interfaces with adjacent architecture.
- 1.10.2.11 Shop drawings shall include complete wire-pull schedules and conduit risers, with field cable numbers that match the schematic drawings.
- 1.10.2.12 Shop drawings shall include a power outlet schedule, with every device assembled in a rack assigned to a specific outlet in the power distribution within the rack.

### **1.10.3 Control System Submittals**

- 1.10.3.1 Submit all user interface layouts before starting any programming. Submissions should be made in PDF or HTML format, with hyperlinks between pages, simulating proposed operation of the touch panels. Submit a written button-by-button operation command list with the user interface layouts.
- 1.10.3.2 Programming of the control system shall only start after approval of the user interface layouts by the Owner and AV Consultant.
- 1.10.3.3 The control system programming is typically a major bottleneck in the project flow. It shall be complete, loaded, and tested in the system prior to shipping the system to the site.

## **1.11 Warranty, Service, and Maintenance**

### **1.11.1 Warranty**

- 1.11.1.1 All provided systems shall be guaranteed against defects in material and workmanship for a period of one (1) year after final acceptance by the Owner and AV Consultant. During that warranty period, equipment or system issues will be repaired or replaced by the AV Contractor at no cost to the Owner.
- 1.11.1.2 In cases where the manufacturer's warranty period is greater than one (1) year, the AV Contractor shall honor that warranty for the full extent of the manufacturer's warranty period. This shall exclude any labor costs incurred by the AV Contractor for removing and reinstalling the defective item(s).
- 1.11.1.3 The AV Contractor shall maintain telephone remote support with qualified personnel, with duplicate sets of system documentation, to assist the Owner's personnel in operational emergencies. Telephone response time shall be within two (2) hours of notification by the Owner. If telephone troubleshooting does not resolve the problem, on-site response time will be scheduled within 24 hours of notification by the Owner.

### **1.11.2 Preventive Maintenance**

- 1.11.2.1 The AV Contractor shall provide preventive maintenance on a semi-annual basis during the warranty period. The AV Contractor will schedule these maintenance visits at the convenience of the Owner in order not to interfere with the use of the rooms.
- 1.11.2.2 During these PM visits, the users will be interviewed to confirm that all functions are operational and that the room is meeting their needs.
- 1.11.2.3 During these PM visits, all system functions will be checked for operational status and adjustments will be made as required for all systems to meet original specifications.

1.11.2.4 During these PM visits, all lenses, filters, display screens, touch panel screens, and operator surfaces will be cleaned per the original manufacturer's instructions.

**1.11.3 Extended Service Contract**

1.11.3.1 As part of the bid, the AV Contractor shall provide the Owner with an annual price for extending the warranty service from the second to fifth years.

1.11.3.2 The extended warranty shall include services from the warranty period, at least two preventive maintenance visits per year, as well as software maintenance revisions on system devices.

## Part 2 Products

### 2.1 System Functional Narratives

The awarded AV Contractor will provide a business-class conference room for the users of the 14<sup>th</sup> Floor Judges Conference Room. Features of the AV system will include video conferencing, as well as web-based video conferencing, wired and wireless presentation systems, audio conferencing, and a custom user interface, allowing users to easily and intuitively interact with the system.

The focus of the room will be a large screen LCD display mounted on the front wall. The display will provide a large enough image, so people seated within 18' of the displays will be able to read spreadsheets and documents.

The system will include several presentation sources. These will include a wired laptop connection at the table, providing users with both VGA+Audio and HDMI connectivity from the table (as well as a USB-C to HDMI adapter). The laptop connectivity will be located in one of the existing table pop-ups, which must allow for one (1) HDMI input and one (1) VGA+Audio input, as well as a USB connection, at the laptop connection point. The existing pop-ups have custom plates, so an Extron MAAP interface plate has been included for the laptop connections. This will be cut and drilled into an existing plastic plate to allow for easy and connectivity by the AV contractor.

Users will also have access to a wireless presentation gateway integrated into the presentation switcher, so they can wirelessly present from their portable devices or laptops. The wireless presentation gateway can also support up to four (4) sources on the screen at the same time.

The system will also support an **owner-furnished**, HDMI TV Tuner which will reside in the equipment rack.

The system will include a business-class hardware-based video conferencing codec. The codec will drive the system with one output so the users will be able to view the far end camera when the call connects, and users will use a picture-in-picture layout during presentations (presentation will be the larger window). The codec will also have a video input so users will be able to share unprotected (non-HDCP) source material with the far end.

The system will also include a high-definition Pan-Tilt-Zoom (PTZ) camera to be used for video conferencing. The camera will be able to capture the entire room, but will also support different preset shots, providing a more intimate experience when there are less people in the space. The camera will be a source to the system, so it can be available to be shown on the lounge display, used for video conferencing, or used as a camera for web-based conferencing.

The system includes a MediaPort which will allow access to the room's PTZ Camera. The camera will be loop through the MediaPort, converted to USB, and then transmitted to the table laptop connection so the laptops can use the room camera as a webcam. In addition to the camera, system audio

(microphones and loudspeakers) will be made available to and from the laptops for web-based conferences.

The AV Contractor will re-purpose the existing Clock Audio microphones that are currently installed in the table. The microphones are current models and are appropriately located on the table to provide crystal clear audio to the far end of both video and audio conferences. They will be tested and integrated into the system upgrade.

All the audio in the system will be managed by a TesiraForte DSP-based matrix mixer, similar to other conference rooms currently deployed. The mixer also provides an analog and digital telephone hybrid. This will allow the room to have a native VoIP extension and be integrated with the courthouse phone system (using a VoIP to Analog phone converter if the VoIP provider does not support non-phone endpoints). The mixer will also provide a USB audio connection for computer-based video conferencing.

Audio will be distributed in the room the internal loudspeakers of the display as well as distributed ceiling loudspeakers. The internal display loudspeakers will provide some localization for audio that corresponds with video sources (presentation and video conferences). Additionally, conference audio (and a mix of program audio) will be distributed from ceiling loudspeakers to provide even audio coverage for the entire space.

The AV Contractor will also provide and integrate a commercial-grade control system with custom graphical user interface. Users will be provided with a 10.1" touch screen at the table, as well as a secondary panel wall-mounted in the lounge area, to provide intuitive system controls, including:

- System power on/off
- Presentation source selection
- TV Tuner controls (Ch+/- and keypad)
- Audio conference dialing
- Video conference dialing
- Camera pan, tilt, and zoom controls
- Camera preset store and recall
- Volume controls with mute and privacy buttons
- System status for automated features (like Auto On when a laptop is connected)

The control system will be able to grow and change with the needs of the users. A similar system is installed in the 10<sup>th</sup> Floor Judges Conference Room in Central Islip. The look and flow of the touch panel menus should match those used in Central Islip to maintain a consistent user interface experience between the rooms.

All equipment will be housed in a lectern-sized equipment rack on casters in the network/equipment closet across the hall where the existing DSP mixers are located.

The system will be integrated according to industry best practices, wherever possible. The system will be staged prior to shipping in the AV Contractor's shop to keep on-site and installation time to a minimum. After the installation is complete, the system will be rigorously tested according to the AV9000 Quality Management Standard for the AV industry to assure zero defects.

The AV Contractor will also provide a criteria-based training for users, including presentation materials and hands-on exercises. During the training, users will operate every aspect of the system to assure completeness and familiarity with the system.

The AV Contractor will also provide a preventive maintenance visit six months after the installation is complete to ensure the system is in good working order and continues to meet the needs of the users.

### **Major Items of Equipment**

Please see the included spreadsheet found in file "14thFIJCR\_EquipList\_09-13-18.XLS" as well as the accompanying set of AV system drawings.

## **2.2 Systems that are Not In Contract**

- 2.2.1 Audiovisual/data electrical boxes
- 2.2.2 Lighting system and interfaces
- 2.2.3 Window treatments, including drapes and/or shades, as well as their interfaces
- 2.2.4 Telecom jacks and special outlets
- 2.2.5 TV Feeds
- 2.2.6 Office furniture, including tables, chairs, credenzas, etc., unless otherwise specified in the equipment list
- 2.2.7 Millwork

## **2.3 Wire, Cable, Connectors**

- 2.3.1 The AV Contractor shall provide all low voltage signal cable called for on the drawings, unless otherwise specified.
- 2.3.2 All field-installed cables are to be plenum rated, unless otherwise noted.
- 2.3.3 The AV Contractor shall provide all the connectors, adapters, and accessories required to achieve a complete and working system.
- 2.3.4 Use the tables included on the drawings for the required cable and connector types. Provide the exact cable specified, unless authorized in writing by the Owner.

## Part 3 Execution

### 3.1 Project Coordination

#### 3.1.1 Project Meetings

3.1.1.1 The AV Contractor shall attend on-site project meetings throughout the duration of the project, at the request of the Owner or the GC.

#### 3.1.2 Status Reports

3.1.2.1 The Contractor is responsible for providing weekly status reports to the Client/Architect outlining their progress on the project, with a copy to the AV Consultant. These reports shall include information on the work completed during the week, the work to be completed during the upcoming week, and any potential scheduling or field issues that may arise.

3.1.2.2 The following should be included in the Status Report, but is not limited to:

- Estimated and actual dates of submittal completion, including shop drawings, control system template designs, and other related documents
- Estimated and actual dates of rack fabrication completion and staging testing, prior to shipping equipment to the job site
- Estimated and actual dates of completion of control system programming, prior to shipping equipment to the job site
- Estimated and actual dates of installation completion and commissioning testing
- Estimated and actual dates of client training
- Estimated and actual dates for project completion
- A notes section to include any items requiring immediate attention from the client, including coordination/requests from other trades.

### 3.2 Field Coordination

#### 3.2.1 Field Inspection

3.2.1.1 The AV Contractor shall cooperate with all appropriate parties to achieve a well-coordinated project and satisfactory final project outcome. The AV Contractor shall watch for conflicts with the work of other contractors on the job site and execute moderate adjustments as are necessary to accommodate other equipment and to preserve symmetry or aesthetic appearance of the Owner's space.

3.2.1.2 The AV Contractor shall verify that surfaces, internal wall blocking, ceiling construction, and opening dimensions are ready to receive the AV system. Inspection must take place prior to and after wall closures in new construction projects.

3.2.1.3 The AV Contractor shall verify that any table, credenza, and/or closet that is to house AV equipment has been properly prepared to accept that equipment.

3.2.1.4 The AV Contractor shall verify that conduits for low voltage AV Signal cables are sized appropriately, completed, and ready for AV Wire pulling. Inspect prior to and after wall closures whenever possible.

3.2.1.5 If any part of the ongoing construction cannot accommodate the AV equipment called for in the contract documents, the AV Contractor shall immediately notify the Owner and AV Consultant, and shall recommend alternate solutions for that particular location.

3.2.1.6 Beginning the installation means acceptance of existing conditions to provide complete, working AV systems.

### **3.2.2 Equipment Delivery and Storage**

3.2.2.1 The AV Contractor shall store all equipment at their place of business prior to delivery.

3.2.2.2 The AV Contractor shall inform the Owner and GC seven (7) business days in advance of any deliveries to the job site.

3.2.2.3 The AV Contractor shall make all necessary arrangements with the appropriate parties on site for acceptance, handling, protection, and storage of all equipment delivered to the job site.

### **3.2.3 Environmental Conditions**

3.2.3.1 It shall be the responsibility of the AV Contractor to protect all AV equipment from damage due to the presence of dust or moisture prior to final system acceptance. Therefore, no electronic equipment shall be delivered to the site until the spaces that are to house that equipment are ready to accept the equipment (clean and dust-free).

3.2.3.2 The AV Contractor can deliver the following equipment to the site prior to the GC providing a dust-free, substantially complete environment:

- Low voltage cable and connectors
- Wall mounted equipment brackets
- Ceiling mounted hanging hardware and/or lifts
- Ceiling mounted loudspeakers
- Ceiling mounted projection screens
- Any other non-electronic equipment that will aid in delivering the project on schedule

3.2.3.3 It shall be the responsibility of the AV Contractor to ensure that the following environmental conditions are met in each space where AV equipment is to be installed, prior to the delivery of the equipment:

- All drywall is installed, taped, sanded, and painted.
- All millwork is installed, sanded, and finished.
- All carpeting is installed.
- All debris and dust is cleaned out of the space. The space must be vacuumed and/or damp mopped clean, as is appropriate for the finishes.
- Spaces that are to receive AV equipment are secure and lockable.
- The HVAC systems for spaces that are to receive AV equipment have been turned on, balanced, and commissioned.

3.2.3.4 If the ongoing construction falls behind the estimated project schedule, and does not leave enough time after substantial completion for the AV Contractor to complete the AV work on time, the AV Contractor shall notify the Owner and AV Consultant immediately, and provide an updated schedule for the completion of the work.

### **3.2.4 Clean Up and Repair**

3.2.4.1 Upon project completion, the AV Contractor shall remove all of their refuse and debris, and shall leave all work areas clean and in an operational state.

3.2.4.2 The AV Contractor shall be responsible for repairing any damage caused to the Owner's property or premise by the AV Contractor's installation activities, at no cost to the Owner.

### 3.3 Installation

#### 3.3.1 General

- 3.3.1.1 The AV Contractor shall provide labor compatible with on-site trades people.
- 3.3.1.2 All equipment shall be firmly secured in place unless there are requirements of portability. This includes equipment in equipment racks, behind displays, under tables, etc. There shall be no equipment hanging from cables or resting on the floor.
- 3.3.1.3 All boxes, equipment, wall plates, floor box plates, mounts, etc. shall be secured plumb and square.
- 3.3.1.4 Consideration shall be given not only to the operational efficiency of the space, but also to the overall aesthetics of the space, while installing equipment and cables during the project.

#### 3.3.2 Equipment Racks

- 3.3.2.1 All rack-mounted equipment, blank panels, and vent panels shall be securely installed in steel equipment racks.
- 3.3.2.2 Any equipment that cannot be rack-mounted shall be installed on fixed, metal rack shelves.
- 3.3.2.3 Each full-sized rack shall have a locking rear door and a place to store a physical set of as-built drawings, as well as a USB drive with system documentation on it.
- 3.3.2.4 Equipment rack layouts shall conform to any rack elevations and architectural drawings. They shall allow for proper installation and serviceability.
- 3.3.2.5 All AV cabling shall be neatly dressed, labeled, and secured, and measures to provide adequate strain relief shall be taken.

#### 3.3.3 Wiring Methods and Practices

- 3.3.3.1 All cables shall be installed into the space with respect to the manufacturer's recommendations for bend radius. No cable shall be coiled with too small a radius that may damage the cable.
- 3.3.3.2 All cables will be free from strain, and appropriate strain relief will be used so that connectors and terminations are not being pulled due to the weight or tension of the cables.
- 3.3.3.3 The Contractor shall provide ample service loops at each termination so that the termination can be redone two times without re-dressing the cable. Also, plates, panels, and equipment shall be able to be demounted for inspection and service, and drawers or slides shall be able to move freely.
- 3.3.3.4 All exposed shield drain wires shall be sheathed in properly sized clear Teflon tubing or clear/white shrink tube.
- 3.3.3.5 The Contractor shall install cables in complete runs. There shall be no splices in any cable. All cables are to have the specified slack on the drawings and schedules. Extra slack will be stored out of the way to allow serviceability in the rack.
- 3.3.3.6 Cable ties shall not be tightened to a point where the outer cable jacket shows any deformation.
- 3.3.3.7 Hook and loop cable straps, and NOT cable ties, shall be used on all category and fiber cables.
- 3.3.3.8 Any fire barriers disturbed during installation shall be replaced. Fire barrier material moved in ducts, conduits, and other penetrations shall be replaced. Fire barrier material shall be installed in all fire-rated penetrations that have cabling running through them.

### 3.4 Quality Assurance

The client expects that the system shall comply in product, performance, and practices as outlined in the document "AV 9000" given in the References below. The vendor shall certify compliance by furnishing affidavits prepared by individuals on behalf of the vendor with recognized industry qualifications, namely CQD and/or CQT (AV9000 Certified QA Designer, Technician), or CTS-D and/or CTS-I (Certified Technology Specialist – Design, Installation). Affidavits shall reflect that the system passed a Design Review, Staging, and the Commissioning battery of tests without defect before the system can be accepted.

Prospective bidders must attest that they possess, and are skilled in the use of, all the necessary test equipment for verifying that the performance of the system is in compliance with AV9000. The Bid Response must include the name of the Certified qualified individual(s) assigned to the project, so that credentials may be verified with the Association for Quality in Audio Visual Technology, Inc. (AQAV), or on InfoComm International's website. Special consideration will be given to those companies with a well-defined Quality Management System in place, such as those with a current AV9000 Compliance registration.

No final payment will be made until these certificates have been presented by the vendor for review by the client or his representative. The client retains the right to enlist the services of a third party *Testing and Verification Services Provider* to verify compliance, and may elect to do so in the event of any discrepancy in test results. Vendor's final payment may be offset by the cost of corrective actions as well as third party re-testing.

#### 3.4.1 Design Review and Submissions

The contractor shall prepare a submission for approval prior to beginning fabrication. The submission shall show evidence that a cross functional design review has been performed, including calculations to conform the performance of the system that will be installed, and including a signed affidavit from the project manager with CQD or CTS-D qualifications, in accordance with AV 9000. Approval of shop drawings does not relieve the contractor of meeting the specifications in product, performance, and practices. The submission shall be delivered in four copies and shall also include:

- Plain-language functional narrative, preferably signed by client
- A complete set of engineering drawings, prepared in CAD, including but not limited to AV flow with EDID Plan, control flow, panel/user interface layouts with button by button script and/ or "Programmers Design Kit" (control system specification), Network Deployment Plan, rack elevations, wiring details, conduit details, I/O and user interface plates, and reflected ceiling plans, AV layouts, and elevations as required to clearly show the system in an unambiguous manner such that it may be reviewed, fabricated, installed, and calibrated.
- Where applicable, suspension arrangement for the loudspeaker clusters. This drawing shall indicate hanging details and orientation of loudspeakers as required for proper coverage as specified. When deemed necessary, shop drawings shall be sealed by a Structural Engineer licensed in the state (or other jurisdiction as required).

- Control panel layouts, when not defined by the client, must conform to the industry's "Dashboard Controls" recommendations
- List of major items of equipment being provided.
- Function list (i.e., playback of DVD disc, presentation of computer video and audio, etc.).
- Calculations verifying the predicted performance.
- Certificate of review and compliance

**3.4.2 Staging**

Before delivery to the jobsite, the system shall be staged completely in the successful bidder's shop. A test of the AV system, with peripheral equipment and working control system programming shall be scheduled, and the owner may elect to inspect the staging. A written report shall be prepared and signed by qualified individual described above, using the Staging Checklist below. Not all tests may apply. The successful bidder shall provide a list of the calibrated equipment that will be used on the performance tests in the Staging and Commissioning Checklists, along with the calibration date and serial numbers for each. Refer to the generic list of instrumentation below.

Test	Staging Test Description	Results & Supplementary Notes
5.1.0	<b>Physical</b>	
5.1.1	Verify that all the exceptions from previous checklists, if any, have been successfully completed.	
5.1.2	The full complete inventory is all new equipment, in full compliance with the specification, or as modified by approved submission. Record all equipment not present, and why.	
5.1.3	Racks have temporary labels indicating the building and room where they are being installed.	
5.1.4	I/O Panels are easily accessible.	
5.1.5	All equipment being installed is connected, and ALL peripheral equipment is hooked up as per flow diagram: microphones, loudspeakers, video monitors, projectors, PC's, USB switchers, etc.	
5.1.6	All mounts for all rack and field equipment (rack mounts, ceiling mounts, wall mounts, loudspeaker mounts, etc.) have been verified and tested..	
5.1.7	Racks are "clean". All blanks and vents are installed.	
5.1.8	All labeling in general is permanently fastened.	
5.1.9	All the equipment can be pulled for repairs or replaced without hindrance, and equipment without IEC removable power cords are not tie-wrapped to the cabinet. There are no obstructions to the item being pulled from the front of the rack. If there are obstructions prohibiting the disconnection of terminations on the back of the unit, there must be sufficient cabling to permit the equipment to be pulled from the front, and disconnected there. Further, terminations are such	

Test	Staging Test Description	Results & Supplementary Notes
	that it is relatively easy to find their proper terminating points when the item is re-installed.	
5.1.10	The cabling and wiring is properly dressed, and allows for signal separation (cables carrying voltages differing by 20 dB or more must be separated by 4 inches), cable stress, serviceability, and cable management. All cables are labeled in a manner consistent with the documentation, and at both ends of each cable, with machine-generated labels that are permanently fastened, and positioned and oriented in a consistent manner that is legible and unambiguous. Refer to InfoComm Document F501.01:2015 "Cable Labeling for Audiovisual Systems". Cable supports are used when unsupported lengths exceed 12 inches (depending on size and stiffness of cables), and that all terminations are free from stress due to gravity acting on the form.	
5.1.11	Terminations have sufficient service loop, allowing at least two re-terminations without having to open a form to lay in a new cable.	
5.1.12	All cables are within manufacture's recommended bend radius specification, usually given as a multiple of a cable's diameter.	
5.1.13	CatX or twisted pair cables have hook and loop fasteners, and there is no cable deformities caused by poor dress or fasteners being too tight; cables are properly identified; any color convention used by the building/integrator, or used to identify POE, proprietary video or data cabling is conforming to plan.	
5.1.14	RJ terminations are solid in their connectors. Quality of RJ connector crimps has been verified by sampled inspection: wire is fully seated in each connector, copper is visible at the end of each wire slot, no loose pins exist, and copper is in no danger of shorting to another conductor.	
5.1.15	Fiber cables have hook and loop fasteners, and have been properly identified in an unambiguous manner; unterminated spares have dust caps; they are loosely dressed, and any color convention used by the building/integrator is labeled by the patch panel.	
5.1.16	Screw terminals have spade or ring lugs on wires.	
5.1.17	All cables are of the type recommended by the manufacturer they connect to, and they are dressed in accordance with the manufactures' recommendations.	
5.1.18	Rack elevation and flow drawings, cable and other labels and engravings are an accurate paper model of the furnished system, and in compliance with latest revised specifications. All nomenclature is consistent: drawings, touch screen, wall plates, floor boxes, patch panels, equipment, etc. <i>Record test results as pass/fail.</i>	
5.1.19	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.	

Test	Staging Test Description	Results & Supplementary Notes
5.1.20	All channels on amplifiers, especially on multi-channel amplifiers are properly labeled, so users can make quick adjustments without having to refer to the system drawings.	
5.1.21	All equipment in the rack is labeled in an appropriate and reasonable manner, and 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. <i>This will allow for easy serviceability, as well as prevent confusion in systems with multiples of similar equipment.</i>	
5.1.22	A representative sampling of the wiring practices of the System Under Test is captured using digital photographs	
5.1.23	All unbalanced and balanced terminations are in agreement with the equipment manufacturer's recommendations.	
5.1.24	There is perfect agreement between the "paper model" documentation (drawings), the control system user interface (i.e., touch panel screens, push button labels, panel engravings, etc.), the device labels, any patch panels/designation strips, the physical wiring and labeling, and any label associated with the system.	
5.1.25	All connectors on input and output plates are identified in a discernible, consistent manner (i.e., there is only one "MIC 1" in the system), and in agreement with all other labels in the system.	
5.1.26	Small racks to be installed into credenzas have carpet tiles or sliders on bottom to avoid scratching credenzas.	
<b>5.2.0</b>	<b>Audio</b>	
5.2.1	All audio paths on the flow diagram have been verified (all lines marked).	
5.2.2	The thermal gradient of all the equipment in the rack has been measured and all active components to be deployed in the space (including wall plates, floor box plates, credenzas, etc.) and all equipment is operating within manufacturers' specifications. <i>Record the highest measurement and where it was found.</i>	
5.2.3	All audio channels can develop a headroom level with THD < __ (0.5)% <i>Record results for all sources.</i>	
5.2.4	All audio channels have a signal to noise (S/N) > __ (55) dB. <i>Record results for all sources.</i>	
<b>5.3.0</b>	<b>Video</b>	
5.3.1	All video paths on the flow diagram have been verified (all lines marked).	

Test	Staging Test Description	Results & Supplementary Notes
5.3.2	The system has been configured in accordance with the designer's EDID Plan, where applicable, and the system performs as intended (resolutions, displayed images, audio formats, etc).	
5.3.3	All displays are able to switch between different color spaces and resolutions. <i>Show a BluRay or TV (YUV) signal, then show a laptop (RGB) signal, and then switch back to the BluRay/TV (YUV) signal. The source should always display properly.</i>	
5.3.4	Automatic CEC controls do not negatively affect the displays. <i>With the displays powered on, power off each source in the system. The displays should remain on (no Power Off command sent from a source).</i>	
5.3.5	All sources can be routed to all expected destinations. <i>Disregard any routes that are not permitted by design, as described in the narrative, such as HDCP sources routed to a codec.</i>	
5.3.6	All HDCP sources can be routed to all expected destinations at the same time. <i>There are some devices with a limited capability to display on multiple displays. The system requires that each source can display on the required number of displays in the system at the same time.</i>	
5.3.7	<p>All HDMI signals have been tested using the entire cabling to be installed in the field, to the extent it is possible. <i>Using an appropriate HDMI generator, display with HDCP enabled, for the following resolutions and timings, as required in the design (check all that apply):</i></p> <p><i>_1920x1200@60 _1920x1080@60 _1600x1200@60 _1280x720@60</i></p> <p><i>_1280x768@60 _1280x800@60 _1024x768@60 _800x600@60</i></p> <p><i>_640x480@60 _1080P@60 _1080P@59.9 _1080@30</i></p> <p><i>_720@60 _720@59.8</i></p> <p><i>(base default, in case the PC has issues and boots up in default mode). Images exhibit no "sparklies" when leaving the signal on for several seconds. Appropriate HDMI Generator required.</i></p>	
5.3.8	A report is obtained when the switcher makes available a system status report with information regarding each source and destination signal integrity, EDID and CEC status information, etc. If a printed or 'pdf' report is not included, a screen print showing the status of the system (including source and destination communications with the switcher) is obtained and it is included.	
5.3.9	A BluRay movie plays. <i>Sometimes HDCP is not enabled during the menus and previews, but only during the movie.</i>	

Test	Staging Test Description	Results & Supplementary Notes
5.3.10	Typical client laptops have been successfully used with the system, inclusive of default resolution (works with switcher EDID), and any adapters, etc. <i>Client laptop(s) required.</i>	
5.3.11	Motion video has satisfactory lip sync. <i>While observing each display using a video of someone clapping their hands, confirm that there are no objectionable latency issues</i>	
5.3.12	Video levels at 'sinks' (displays) are 1 v P-P +/- 10% for composite (if any) or 700 mV for computer video for all sources.	
5.3.13	Camera(s) image quality has a focused, acceptable image.	
5.3.14	There are no lost or stuck "on" pixels when Full White Test signal is displayed (7 pixels maximum per quadrant, or follow manufacturer's spec). <i>Note number and location of lost pixels, if any.</i>	
5.3.15	AV equipment configuration and control system programming has been optimized for the least switching time when selecting different sources. In the event switching time goes beyond a reasonable time (___(5) seconds), the User receives a visual message with the estimated time to execute the command. Record the maximum switching time experienced.	
<b>5.4.0</b>	<b>Control and Network Integration</b>	
5.4.1	All control paths on the flow diagram have been tested (all lines marked - emulate closures for screens, motors, etc.)	
5.4.2	All serial controlled equipment is properly configured and communications has been established.	
5.4.3	Control system functions not obvious from the control flow diagrams (i.e., lighting presets that are activated when the control system enters a videoconferencing mode) have been verified.	
5.4.4	All IP information provided by the client is accurately loaded into the system, including IP address, network ID's, subnet masks, default gateway, timeserver, Gatekeeper, alias, hostnames, etc. <i>Confirm that these settings are listed in a report that will remain with the system.</i>	
5.4.5	All web-based system control or monitoring features, and other IP functionality of system (time servers, system-generated e-mail, etc.) has been verified.	
5.4.6	All system programming is installed (control system, DSP devices), and properly communicating with the equipment intended. <i>If a control specification is present, it has been thoroughly tested.</i>	
5.4.7	When system is powered down, system "up" sequence presents the system in a desirable state with no objectionable anomalies.	

Test	Staging Test Description	Results & Supplementary Notes
5.5.0	<b>Final Inspection</b>	
5.5.1	Non-conformances, anomalies, etc. have been video recorded and included in this report.	
5.5.2	Sanity Check: There is no reason why this system should NOT be released for installation. Everything plumb and square, clean and blemish-free.	
5.5.3	The system under test satisfies ALL of the system requirements laid out in the client-approved functional narrative/signed proposal.	
5.5.4	A document report has been completed, certifying the product, performance, and practices are in compliance, and any exceptions are noted below. <i>Distribute accordingly.</i>	

**References:**

Infocomm, 2003, *"Basics of Audio and Visual Systems Design"*

Davis and Davis, 1987 *"Sound System Engineering"*

Giddings, 1990, *"Audio Systems Design and Installation"*

ANSI/NAPM IT7.288-1997 *"Electronic Projection – Fixed Resolution Projectors"*

Maltese, 2006, *"AV 9000: Defining Quality in Engineered Audio Visual Systems"*

Infocomm, 2009, *"AV Installation Handbook 2<sup>nd</sup> Edition"*

AQAV, 2016, *"AQAV Standard AV9000:2016 Quality Management System For the Audio Visual Technology Industry" Revision 7/1/16"*

**I certify that the system being installed is completely staged, with the exceptions noted, all items on the checklist have been completed, that rack elevations are as specified, that all the equipment is new, and the system is complete and in accordance with the specification in product, practice, and performance. I further accept that if a third party testing and verification service provider is required to re-test due to reasons that are within my company's control, that the costs in doing so may be offset by the retainer.**

Signed: \_\_\_\_\_

### 3.4.3 Commissioning

Upon completion of the installation, and before acceptance, the successful contractor shall prepare a report certifying the successful outcome in the following battery of tests. Depending on the equipment being provided, not all tests may apply.

Test	Commissioning Test Description	Results & Supplementary Notes
6.1	<b>Physical</b>	
6.1.1	All exceptions from the "Staging" checklist have been successfully completed.	
6.1.2	The full complete inventory is all new equipment, in full compliance with the specification, or as modified by approved submission. Record all equipment not present, and why.	
6.1.3	Any power receptacles accessible to the user are safe, and there are no stray AC voltages on any equipment accessible to a user relative to ground.	
6.1.4	There are no sharp or jagged surfaces accessible to a user, and equipment mounting all mounting appears mechanically stable under all conditions.	
6.1.5	The thermal gradient of all equipment mounted in the rack and deployed in the room (including wall plates, floor box plates, credenzas, etc.) is operating within manufacturers' guidelines. Record the highest measurement and where it was found.	
6.1.6	The system is serviceable. All equipment is securely fastened. There is accessibility to equipment to be easily pulled for repair by one person, neatly dressed cables, bundled in forms (refer to Giddings, Davis and Davis, InfoComm), there are no excessive pressure on cables at termination points and connectors, utilize service loops, and each cable number is in agreement with the as-built drawings. This includes the equipment rack itself as well as all components mounted elsewhere (under tables, in pedestals, in credenzas, or behind displays). All switches and receptacles are logically and permanently labeled.	
6.1.7	The cabling and wiring is properly dressed, and allows for signal separation (cables carrying voltages differing by 20 dB or more must be separated by 4 inches), cable stress, serviceability, and cable management. All cables are labeled in a manner consistent with the documentation, and at both ends of each cable, with machine-generated labels that are permanently fastened, and positioned and oriented in a consistent manner that is legible and unambiguous. Refer to InfoComm Document F501.01:2015 "Cable Labeling for Audiovisual Systems". Cable supports are used when unsupported lengths exceed 12	

Test	Commissioning Test Description	Results & Supplementary Notes
	inches (depending on size and stiffness of cables), and that all terminations are free from stress due to gravity acting on the form.	
6.1.8	Terminations have sufficient service loop, allowing at least two re-terminations without having to open a form to lay in a new cable.	
6.1.9	All cables are within manufacture's recommended bend radius specification, usually given as a multiple of a cable's diameter.	
6.1.10	CatX or twisted pair cables have hook and loop fasteners, and there is no cable deformities caused by poor dress or fasteners being too tight; patch cables between the equipment cabinet and wall or floor receptacles are stranded and flexible, have a "home" near the panel, and are properly identified. This includes user interface cords (HD15, HDMI, audio, network, etc.) and any color convention used by the building/integrator, or used to identify POE, proprietary video or data cabling is conforming to plan.	
6.1.11	RJ terminations are solid in their connectors. Quality of RJ connector crimps has been verified by sampled inspection: wire is fully seated in each connector, copper is visible at the end of each wire slot, no loose pins exist, and copper is in no danger of shorting to another conductor.	
6.1.12	All fiber cables have hook and loop fasteners, and have been properly identified in an unambiguous manner; unterminated spares have dust caps; they are loosely dressed, and any color convention used by the building/integrator is labeled by the patch panel.	
6.1.13	Screw terminals have spade or ring lugs on wires.	
6.1.14	Rack elevation and flow drawings, cable labels and engravings are an accurate paper model of the furnished system, and in compliance with latest revised specifications. All nomenclature is consistent: drawings, touch screen, wall plates, floor boxes, patch panels, equipment, etc.	
6.1.15	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.	
6.1.16	All channels on amplifiers, especially on multi-channel amplifiers are properly labeled, so users can make quick adjustments without having to refer to the system drawings.	
6.1.17	All equipment in the rack is labeled in an appropriate and reasonable manner, and 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. This allow sfor easy	

Test	Commissioning Test Description	Results & Supplementary Notes
	serviceability, as well as prevent confusion in systems with multiples of similar equipment.	
6.1.18	Capture a representative sampling of the wiring practices of the System Under Test using digital photographs	
6.1.19	All unbalanced and balanced terminations are in agreement with the equipment manufacturer's recommendations.	
6.1.20	All connectors on input and output plates are identified in a discernible, consistent manner (i.e., there is only one "MIC 1" in the system), and in agreement with all other labels in the system.	
<b>6.2</b>	<b>Audio</b>	
6.2.1	No power amplifier has its rated load exceeded. <i>Record the impedance (and at what frequency) of each loudspeaker line on each power amplifier at 63, 250, and 1,000 Hz. ("Loudspeaker Impedance Test").</i>	
6.2.2	There is a "test plan", locating a representative sampling of all listener positions, with at least "center" and "corner" locations, and describe the identity and location of these positions.	
6.2.3	The ambient noise, <i>A-weighted, slow</i> , at each location on the test plan is recorded, along with the highest measurement and its location.	
6.2.4	At each location on the test plan a nominal operating level of __ (66) 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, has been recorded.	
6.2.5	The average STI-PA measurement has been recorded at each location on the test plan, and is greater than 0.62 for all listeners.	
6.2.6	The sound system is capable of producing an additional __ (14) dB above this level ( __ (80) dB SPL) for each audio source, with less than 0.5% THD (Total Harmonic Distortion) plus noise. <i>Measure THD plus noise when source is at __ (15) dB above nominal operating level at each "destination", for all sources selected.</i>	
6.2.7	The electrical noise levels for all audio channels are __ (55) dB below the normal operating level for all audio sources. "Noise" refers to hum, electrostatic noise, RF interference, etc.	
6.2.8	Program loudspeakers and speech loudspeakers are all connected in the same polarity ("Polarity Test").	

Test	Commissioning Test Description	Results & Supplementary Notes
6.2.9	The System Under Test has no more than a __ (1) dB variance in program source levels, when each program source is playing a calibrated media (CD, video tape, setup test tone, etc.).	
6.2.10	There is no audible vibration caused by improper mechanical installation when using a 16 second continuous sweep signal at headroom level. Audible devices are identified and at what frequencies. ("Buzzes and Rattles Test").	
6.2.11	The speech reinforcement system is stable (no feedback) for the entire talker and listener areas specified.	
6.2.12	For audio conference systems, the microphone input gain settings are such that the "standard talker" (60 dB SPA at 1 m, IEC 60268-16), positioned at each talker position in the room, produces a nominal "0 dB" level at the input of the mixer bus of the audio conference DSP device. If there is local reinforcement ("mix-minus"), AGC and ALC may need to be restricted. <i>Inspect DSP mixer telephone line levels, both transmit and receive, when normal speech is encountered in the room.</i>	
6.2.13	For conferencing mode, at the __ (65) dB SPL listening level, the system can demonstrate full duplex operation, with no reports of echo or "speech trails" (as detected from the far end).	
6.2.14	The equalizers are adjusted for best intelligibility, and in accordance with the preferred acoustic level response curves.	
6.2.15	Wireless microphone systems, with all wireless microphones turned on, there are no dropouts, intermodulation interaction between wireless systems, or RF caused artifacts throughout the specified operating area for the transmitter. There is little or no RF activity on a receiver's "S" meter when the designated microphone transmitter is off.	
6.2.16	There is RF immunity at areas where users are expected to operate cell phones, mobile devices, smart phones, etc.	
<b>6.3</b>	<b>Video</b>	
6.3.1	The system has been configured in accordance with the client's EDID needs, and the designer's EDID Plan, where applicable, and that the system performs as intended (resolutions, displayed images, audio formats, etc.)	
6.3.2	If there are any composite video sources, the system displays optimum brightness, contrast, and color in displays using SMPTE source with PLUGE (Picture Line Up Generation Equipment) display, and that each display (or "sink") receives 1 volt peak-to-peak +/- 10% (or 1dB). If	

Test	Commissioning Test Description	Results & Supplementary Notes
	several displays are visible in the same place, there is consistency in colors across all of them.	
6.3.3	There is consistency in colors when several displays are visible in the same space. For RGB and digital video signals use a colorimeter and test color signal software to confirm consistent images. Confirm +/- ____ (5%) tolerance in brightness, black levels and color temperature.	
6.3.4	For RGB sources, there is 700 mV +/- 10% (or 1 dB) at each destination. <i>(If requested only) record results using a flat-field pattern signal at the highest resolution specified, or at least 1024 by 768 resolution (VESA 8). For RGB sources measure and record peak-to-peak voltage for peak white signal, and record "peak" and "Level" control settings on any interface at the positions whereby the 700 mV voltages were attained.</i>	
6.3.5	Displays are focused, centered, and evenly illuminated. <i>If requested, confirm using the 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.</i>	
6.3.6	The system displays stable images, with no scaling-related visual artifacts when switching between, at a minimum, ____ (1024 x 768), (1280 x 1024), (1920 x 1080) and (1280 x 720) sources, and/or all those specified in the performance criteria for this system. <i>Record test results.</i>	
6.3.7	Displays can switch between different color spaces and resolutions. <i>Show a BluRay or TV (YUV) signal, then show a laptop (RGB) signal, and then switch back to the BluRay/TV (YUV) signal. The source should always display properly.</i>	
6.3.8	Automatic CEC controls do not affect the displays. <i>With the displays powered on, power off each source in the system. The displays should remain on (no Power Off command sent from a source).</i>	
6.3.9	All sources can be routed to all expected destinations. <i>Disregard any routes that are not permitted by design, as described in the narrative, such as HDCP sources routed to a codec.</i>	
6.3.10	All HDCP sources can be routed to all expected destinations at the same time. <i>There are some devices with a limited capability to display on multiple displays. The system requires that each source can display on the required number of displays in the system.</i>	

6.3.11	<p>Using an appropriate HDMI generator, with HDCP enabled, the following resolutions and timings, as required in the design can be displayed(check all that apply):</p> <p>_1920x1200@60    _1920x1080@60    _1600x1200@60    _1280x720@60          _1280x768@60    _1280x800@60    _1024x768@60    _800x600@60          _640x480@60    _1080P @ 60    _1080P @ 59.9    _1080@30          _720@60    _720@59.9</p> <p>(base default, in case the PC has issues and boots up in default mode). Leaving the signal on for several seconds does not present "sparklies". – Appropriate HDMI Generator required.</p>	
6.3.12	<p>A report is obtained when the switcher makes available a system status report with information regarding each source and destination signal integrity, EDID and CEC status information, etc. If a printed or 'pdf' report is not included, a screen print showing the status of the system (including source and destination communications with the switcher) is obtained and it is included.</p>	
6.3.13	<p>A BluRay movie plays. <i>Sometimes HDCP is not enabled during the menus and previews, but only during the movie. BluRay disc required.</i></p>	
6.3.14	<p>Typical client laptops have been successfully used with the system, inclusive of default resolution (works with switcher EDID), any adapters, etc. Client laptop required.</p>	
6.3.15	<p>Analog audio is satisfactorily distributed for laptops with digital outputs and the audio is not embedded in an HDMI connection, or if the user connects to his audio output. Client laptop required.</p>	
6.3.16	<p>The displayed image height relative to furthest viewer ratio has been measured: ____ (1:6) Record each, compare to recommended ratio.</p>	
6.3.17	<p>The TV levels are acceptable, and any channel presets are accurate.</p>	
6.3.18	<p>On-Screen Displays/Menus are disabled, or not if specified by the user.</p>	
6.3.19	<p>Video projectors, if any, have 'blue screen' or 'no image screen' disabled, or not if directed by the user.</p>	
6.3.20	<p>There are no lost or stuck "on" pixels when Full White Test signal is displayed (follow manufacturer's specification). <i>Note number and location of lost pixels, if any.</i></p>	
6.3.21	<p>Motion video has satisfactory lip sync. <i>While observing each display using a video of someone clapping their hands, confirm that there are no objectionable latency issues</i></p>	

6.3.22	The Contrast Ratio is obtained for front projection systems, and the ambient lighting in the vicinity of the screen when the lighting is set for projection is as intended. Also, the intended contrast ratio (using the 16 box checkerboard pattern is verified. <i>Take the ratio of averaged white squares divided by the averaged black squares when the light meter faces the projector) and confirm contrast levels have been meet the client's needs and/or performance specification noted in the design (7:1-Passive Viewing, 15:1-Basic Decision Making, 50:1-Analytical Decision Making, 80:1-Full Motion Video).</i>	
6.3.23	AV equipment configuration and control system programming has been optimized for the least switching time when selecting different sources. In the event switching time goes beyond a reasonable time (__(5) seconds), the User receives a visual message with the estimated time to execute the command. Record the maximum switching time experienced.	
<b>6.4</b>	<b>Control and Network Configuration</b>	
6.4.1	The Control System performs all the functions as indicated on the function list ("control system specification") provided, with stability, and in sync with the equipment being controlled without the need to reset any item of equipment. Every single button on every panel has been pressed and the system provided the expected results.	
6.4.2	When system is powered down, system "up" sequence presents the system in a desirable state with no objectionable anomalies.	
6.4.3	All IP information provided by client is loaded into the system, including IP address, network ID's, subnet masks, default gateway, timeserver, Gatekeeper, alias, hostnames, etc. All network functions specified by the customer are shown to function properly on customer's LAN. These settings are listed in a report that will remain with the system.	
6.4.4	Any web-based system control or monitoring features, and other IP functionality of system (time servers, system-generated e-mail, etc.) are functioning.	
6.4.5	Measures were taken of the total power consumption used by the AV system in standby mode, and in "full on" mode. Identify conditions for the highest power consumption.	
<b>6.5</b>	<b>VTC (Video Teleconferencing)</b>	
6.5.1	VTC Camera(s) are able to capture a clear shot of the presenter at the appropriate location (lectern, table, DAIS, etc.)	
6.5.2	VTC Camera(s) lighting (key, fill, wash lighting) acquires a satisfactory image.	

6.5.3	(VTC Cameras – there is no excessive vibration on the cameras at full telephoto position, when someone walks by the camera, or when applicable when someone walks on the floor directly above.	
6.5.4	Camera presets are programmed as specified by the user.	
6.5.5	All codec options specified by the customer have been installed.	
6.5.6	<i>Log all test conference calls (audio and video). Log should include time, line used, number called, success of connection, who we spoke with, success of full duplex, success of auto disconnect, level in the room, note static or jitter/packet loss, etc. Note if auto disconnect functions as specified.</i>	
<b>6.6</b>	<b>Final Inspection</b>	
6.6.1	<i>Video record non-conformances and anomalies as required, facilitating corrective actions.</i>	
6.6.2	Sanity check: Any possible user objections have been corrected or noted? Everything plumb and square, clean and blemish-free. Displays and equipment free of fingerprints and dust. The user has a safe, injury-free environment?	
6.6.3	The system under test satisfies ALL of the system requirements as laid out by the client-approved narrative/signed proposal.	
6.6.4	<i>Prepare document report, certifying the product, performance, and practices are in compliance, and noting any exceptions. Distribute accordingly.</i>	

**References:**

Infocomm, 2003, *“Basics of Audio and Visual Systems Design”*

Davis and Davis, 1987 *“Sound System Engineering”*

Giddings, 1990, *“Audio Systems Design and Installation”*

ANSI/NAPM IT7.288-1997 *“Electronic Projection – Fixed Resolution Projectors”*

Maltese, 2006, *“AV 9000: Defining Quality in Engineered Audio Visual Systems”*

Infocomm, 2009, *“AV Installation Handbook 2<sup>nd</sup> Edition”*

AQAV, 2016, *“AQAV Standard AV9000:2016 Quality Management System For the Audio Visual Technology Industry” Revision 7/1/16”*

**Affidavit:**

I hereby certify that the system installed is complete, all items on the above checklist have been completed, that rack elevations are as specified, that all equipment is new, and that all engineering, fabrication, programming, installation, testing and checkout is in accordance with the specification in product, practice and performance. I further accept that if a third party testing and verification service provider is required to re-test due to reasons that are within my company's control, that the costs in doing so may be offset by the retainer.

Signed: \_\_\_\_\_

### 3.4.4 Calibrated Test Instrumentation Required

This list constitutes the minimum instrumentation required to perform the tests in the checklists, and does in no way imply a comprehensive list for engineered AV. In fact, in many cases additional instrumentation is required to verify performance on an item of equipment, or to quantify environmental and other issues so as to expedite corrective actions by others.

	Test Instruments
7.1	Sensitive AC voltmeter, -80 dBU sensitivity or more, 20Hz-30 kHz response, able to measure signal to noise ratio, THD, electrical audio levels within the system. Note that some systems require measurements up to 100 volts and may require an external pad.
7.2	Sound Pressure Level Meter, ANSI Type II, with A and C weighting filters, fast or time-averaged.
7.3	Audio Signal generator, 20-30 kHz, sine wave, pink noise, and continuous sine wave sweep
7.4	Amplified loudspeaker 100 mm producing 60 dBA at one meter, and 70 dBA at one meter, pink noise, sine wave, speech files.
7.5	200MHz oscilloscope, with TV sync (analog video only).
7.6	Analog Video Signal Generator NTSC/PAL, plus computer patterns at all required resolutions and refresh rates required for the systems under test. For systems with composite video, include PLUGE pattern. (analog video only)
7.7	Digital Video Signal Generator for computer patterns for all resolutions and refresh rates required for the systems under test, HDMI/DVI, with and without HDCP.
7.8	The ability to measure STI-PA (source and analyzer).
7.9	Colorimeter/luminance meter, 10% accuracy.
7.10	Infrared Thermometer.
7.11	Test Media with known levels (audio, video, etc): CD's, VHS, DVD's, etc.
7.12	AC/DC MultiMeter.
7.13	Light meter, lux/footcandles.

<b>Test Instruments</b>	
<b>7.14</b>	Outlet tester (to test power outlet wiring).
<b>7.15</b>	The ability to measure electrical power (watt meter, clamp meter, etc.)
<b>7.16</b>	Cable sets, cable assemblies, adapters as required to sample and measure in-or out of circuit as req'd.

## 3.5 Documentation and Training

### 3.5.1 As-Built Drawings

- 3.5.1.1 One physical set of as-built drawings shall be left with the system in the equipment rack.
- 3.5.1.2 A soft copy of the drawings, in PDF and DWF formats, shall be stored on a USB drive and also left with the system. This USB will also store any relevant documents (control system program, touch panel file, audio site file, system equipment inventory, IP Schedule with login credentials, User Manual, etc.). The USB drive will allow operators to maintain and update system documentation through the life of the system.
- 3.5.1.3 A copy of this USB drive that it left with the equipment rack, as described above, will also be delivered to the Owner.
- 3.5.1.4 A copy of all the files on the USB drive will be stored on the Contractor's file server for as long as the Service and Warranty period lasts between the Owner and Contractor.

### 3.5.2 User Manuals

- 3.5.2.1 Three sets of User Manuals shall be delivered with each system: one that stays with the system, one for the room, and one for the Owner. Additional soft copies will be saved to the two USB drives delivered with the system.
- 3.5.2.2 The User Manual shall include the following sections:
  - Custom User Interface Instructions: This differs from the button by button control system submittal. These instructions should be function-based, rather than command based. It shall be organized based on how users access each function of the system, rather than just a list of what each button does.
  - A copy of the final Commissioning Report.
  - A complete, alphabetical equipment list.
  - Manufacturer's Equipment Manuals for each device in the system.
  - Service notes, including equipment warranty information, filled out registration cards, maintenance schedules, and a blank service log.
  - A full set of as-built drawings, printed on B-sized paper
  - A full function list that can be used to fully test the system during a preventive maintenance visit
- 3.5.2.3 Three Quick Start Guides shall also be delivered to the Owner with the system. These Quick Start Guides shall be a condensed version of the Custom User Interface Instructions described above. They shall be laminated and left with the system. They should be limited to one, double-sided page, if possible.

### 3.5.3 Software

- 3.5.3.1 A copy of all device software required to operate the system shall be included with the User Manual documents, either on CD/DVDs, or provided on a USB Drive.
- 3.5.3.2 A copy of any uncompiled, unprotected, editable configuration file (audio, DSP, control, etc.) shall be included on the USB drives that get delivered with the system.
- 3.5.3.3 Any control system programming and user interface files that be included on the USB drives that get delivered with the system. These shall be in uncompiled, unprotected, editable formats. The Contractor shall also deliver compiled versions of the software to be used a backup.
- 3.5.3.4 Once delivered to the Owner, all software shall become the property of the Owner.

### **3.5.4 Training**

- 3.5.4.1 The Contractor shall provide criteria-based training of the Owner-designated operators. That is, besides written instructions, there is a formal presentation with handouts, and each "system operator" specified by the Owner shall demonstrate a basic proficiency in using the system in all its designated functionality.
- 3.5.4.2 Successfully trained operators shall then issue certificates by a qualified instructor (CQD, CQT, CTS-D, CTS-I) certifying that the individuals were successfully trained.
- 3.5.4.3 The Contractor shall provide a list of training attendees, as well as which attendees received certificates, to the Owner after the training is completed.

### **3.6 Acceptance**

- 3.6.1 At the time of training, the User Manual, training materials, and system documentation shall be turned over to the Owner.
- 3.6.2 During training, the system will be well exercised, and every function demonstrated for the designated users.
- 3.6.3 The Contractor shall certify that all work has been completed on the AV System.
- 3.6.4 The Contractor shall certify that the system is in full compliance with the specification and that there are zero defects in the system, that all engineering, fabrication, installation, testing, and checkout of the AV system has been completed.
- 3.6.5 The Contractor shall certify that all system documentation (drawings, manuals, software, login credentials, etc.) have been turned over to the Owner.
- 3.6.6 The Contractor shall certify that criteria-based training with the designated operators has been performed.
- 3.6.7 Once certified by the Contractor and Owner, the system can be accepted and the warranty period can begin.