

Audio Visual System Specifications

Suggested Quality Assurance language for an RFP for audiovisual systems

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 (AV9000 Certified QA Designer) for Design and Engineering Review Audits and CQT (AV9000 Certified QA Technician) for Staging and Commissioning Audits. Affidavits shall reflect that the system passed 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, along with the individuals certification certificate. The “client” may also contact Association for Quality in Audio Visual Technology, Inc. (AQAV) via email, at admin@AQAV.org, to verify submitted credentials. 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.

Regulatory Agencies

Work shall be carried out in conformance with applicable Building and Electrical Codes, the requirements of OSHA and the applicable provisions of Underwriters Laboratories (U.L.), ANSI, Electronic Industries Association and National Fire Protection Association. All work shall be in accordance with all applicable codes, local, state, and national.

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 (Certified Quality Designer – AV) 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), 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.

- When devices are deployed on an Ethernet network, a Network Deployment Plan is included for review to allow all stakeholders the details to assure equipment will function as intended.
- 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 another 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.

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. Include a Network Deployment Plan (NDP) if applicable. 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	Description	Results & Supplementary Notes
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 racks 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	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 are 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 the 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 are 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 the latest revised specifications. All nomenclature is consistent: drawings, touch screen, wall plates, floor boxes, patch panels, equipment, etc. Record test results as pass/fail.	
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.	
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	

Test	Description	Results & Supplementary Notes
	description), control system, field plates, patch panels, and any labels associated with the system. This will allow for easy serviceability, as well as prevent confusion in systems with multiples of similar equipment.	
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.	
5.1.27	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. Record the highest measurement and where it was found.	
5.2.0	Audio	
5.2.1	All audio paths on the flow diagram have been verified (all lines marked).	
5.2.2	All audio channels can develop a headroom level with THD < __ (0.5)% Record results for all sources.	
5.2.3	All audio channels have a signal to noise (S/N) > __ (55) dB. Record results for all sources.	
5.3.0	Video	
5.3.1	All video paths on the flow diagram have been verified (all lines marked).	
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.) If the EDID plan does not modify the default resolution of the switcher, then a laptop or a generator with HDCP enabled acting as a source has been tested successfully using the entire cabling to be installed in the field, to the extent possible, at the switcher's default EDID timing.	
5.3.3	All displays are able to switch between different color spaces and resolutions. <i>Show a Blu-ray or TV (YUV) signal, then show a laptop (RGB) signal, and then switch back to the Blu-ray/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>	

Test	Description	Results & Supplementary Notes
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	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.	
5.3.8	A Blu-ray movie plays. <i>Sometimes HDCP is not enabled during the menus and previews, but only during the movie.</i>	
5.3.9	Typical client laptops have been successfully used with the system, inclusive of default resolution (works with switcher EDID), and any adapters, etc., especially if "duplicate" or "mirror" mode is required. <i>Client laptop(s) required.</i>	
5.3.10	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>	
5.3.11	Camera(s) image quality has a focused, acceptable image.	
5.3.12	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>	
5.3.13	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.	
5.4.0	Control and Network Integration	
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 have 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 IDs, subnet masks, default gateway, timeserver, Gatekeeper, alias, hostnames, etc. Confirm that these settings are listed in a report that will remain with the system.	
5.4.5	All web-based system control or monitoring features, and other IP functionality of the system (time servers, system-generated e-mail, etc.) has been verified.	

Test	Description	Results & Supplementary Notes
5.4.6	All system programming is installed (control system, DSP devices), and properly communicating with the equipment intended. If a control specification is present, it has been thoroughly tested.	
5.4.7	When the system is powered down, the system “up” sequence presents the system in a desirable state with no objectionable anomalies.	
5.4.8	All network logins and physical network security have been determined and verified to meet the client's and AHJ's network security best practices and requirements.	
5.5.0	Final Inspection	
5.5.1	Non-conformances, anomalies, etc. have been video recorded and included in this report.	
5.5.2	General Review 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 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. Distribute accordingly.	

References:

Weems, 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 2nd Edition”*

The Staging checklist must be reviewed and signed by someone within the organization, with the proper competencies (CQT) to attest that the system being installed has been 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.

Commissioning Tests

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. Include a Network Deployment Plan (NDP) if applicable. Depending on the equipment being provided, not all tests may apply.

Test	Description	Results & Supplementary Notes
6.1.0	Physical	
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 cable installation has acceptable cable dress, 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 AVIXA 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.	
6.1.8	Terminations have a 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 the 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 are 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	

Test	Description	Results & Supplementary Notes
	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 allows for easy 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.	
6.1.21	Ensure ceiling device labels are oriented in the same direction or in accordance with scope of work.	
6.2.0	Audio	
6.2.1	No power amplifier has its rated load exceeded. Measure the out-of-circuit impedance of each loudspeaker line on each power amplifier at 63, 250, and 1,000 Hz, and verify it to be higher than the calculated lowest-rated amplifier impedance. Record both the calculation and the associated line's impedance measurements. ("Loudspeaker Impedance Test").	

Test	Description	Results & Supplementary Notes
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, A-weighted, slow, 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. Measure THD plus noise when source is at __ (15) dB above nominal operating level at each "destination", for all sources selected.	
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").	
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. Inspect DSP mixer telephone line levels, both transmit and receive, when normal speech is encountered in the room.	
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.	

Test	Description	Results & Supplementary Notes
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.	
6.2.17	For wireless microphone systems, be sure to save frequency coordination solution in project folder which includes selected frequency, power mode, and audio level for each channel.	
6.2.18	For wireless microphone systems, consider locking out front panel so users cannot change settings.	
6.3.0	Video	
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.). If the EDID Plan does not modify the default resolution of the switcher, then a laptop or generator with HDCP enabled acting as a source has been tested successfully with the switcher's default EDID timing.	
6.3.2	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.	
6.3.3	Displays are focused, centered, and evenly illuminated. When direct-view displays are employed, ambient lighting conditions do not create too much glare. <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 the white portion of the screen) and photograph if necessary.</i>	
6.3.4	Displays can switch between different color spaces and resolutions. <i>Show a Blu-ray or TV (YUV) signal, then show a laptop (RGB) signal, and then switch back to the Blu-ray/TV (YUV) signal. The source should always display properly.</i>	
6.3.5	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>	
6.3.6	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>	
6.3.7	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>	

Test	Description	Results & Supplementary Notes
6.3.8	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.	
6.3.9	A Blu-ray movie plays. <i>Sometimes HDCP is not enabled during the menus and previews, but only during the movie. Blu-ray disc required.</i>	
6.3.10	Typical client laptops have been successfully used with the system, inclusive of default resolution (works with switcher EDID), any adapters, etc. Client laptop required.	
6.3.11	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.	
6.3.12	The displayed image height relative to furthest viewer ratio has been measured: ____ (1:6) Record each, compared to recommended ratio.	
6.3.13	The TV levels are acceptable, and any channel presets are accurate.	
6.3.14	On-Screen Displays/Menus are disabled, or not in specified by the user.	
6.3.15	Video projectors, if any, have 'blue screen' or 'no image screen' disabled, or not, if directed by the user.	
6.3.16	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>	
6.3.17	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>	
6.3.18	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>	
6.3.19	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.	
6.4.0	Control and Network Configuration	
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	

Test	Description	Results & Supplementary Notes
	equipment being controlled without the need to reset any item of equipment. Every intended user-system interaction at every interaction point of the control system has been exercised 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 the client is loaded into the system, including IP address, network IDs, subnet masks, default gateway, timeserver, Gatekeeper, alias, hostnames, etc. All network functions specified by the customer are shown to function properly on the customer's LAN, and all the conditions listed in the “Network Deployment Plan” have been met. 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 the system (time servers, system-generated e-mail, etc.) are functioning.	
6.4.5	Measurements 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.	
6.4.6	All network logins and physical network security have been determined and verified to meet the client's and AHJ's network security best practices and requirements.	
6.5.0	VTC (Video Teleconferencing)	
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	Log all test conference calls (audio and video). The 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.	
6.6.0	Final Inspection	
6.6.1	Video record non-conformances and anomalies as required, facilitating corrective actions.	
6.6.2	General Review: 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. Does the user have 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	Prepare document report, certifying the product, performance, and practices are in compliance, and noting any exceptions. Distribute accordingly.	

References:

Weems, 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 2nd Edition"*

The Commissioning Checklist must be reviewed and signed by someone within the organization, with the proper competencies (CQT) to attest 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.

The "Results and Supplementary Notes" must contain as many measurements and comments as applicable and **should be reviewed by the Design Team who originally designed the system for possible corrective actions or continual improvement information.**

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.

Calibrated Test Instruments required (minimum)

Test	Description
9.0.0	Test Instruments
9.1.0	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.
9.2.0	Sound Pressure Level Meter, ANSI Type II, with A and C weighting filters, fast or time averaged.
9.3.0	Audio Signal generator, 20-30 kHz, sine wave, pink noise, and continuous sine wave sweep.
9.4.0	Amplified loudspeaker 100 mm producing 60 dBA at one meter, and 70 dBA at one-meter, pink noise, sine wave, speech files.
9.5.0	200MHz oscilloscope, with TV sync (analog video only), with terminator.
9.6.0	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, up to 4K resolutions.
9.7.0	The ability to measure STI-PA (source and analyzer).
9.8.0	Colorimeter/luminance meter, 10% accuracy.
9.9.0	Infrared Thermometer.
9.10.0	Test Media with known levels (audio, video, etc.): CD's, VHS, DVD's, etc.
9.11.0	AC/DC Multimeter.
9.12.0	Light meter, lux/foot-candles.
9.13.0	Outlet tester (to test power outlet wiring).
9.14.0	The ability to measure electrical power (watt meter, clamp meter, etc.).
9.15.0	Cable sets, cable assemblies, adapters as required to sample and measure in-or out of circuit as required.

Workmanship

The contractor is responsible for keeping the jobsite clean, and removes all rubbish at the end of each day. The contractor must cooperate with building officials to keep the disruption to the jobsite at a minimum, and shall be responsible for all damages and marring of finishes caused by the installation.

Operator Training

The system shall include criteria-based training of designated operators. That is, besides written instructions, there is a formal presentation with Power Point handouts, and each "system operator" specified by the customer shall demonstrate a basic proficiency in using the system in all its designed functionality. Successfully trained operators shall then issue certificates by a qualified instructor (CQD, CQT, CTS-D, CTS-I) certifying that the individuals were successfully trained. If required in the contract, training shall also include training that addresses determining the readiness of the system by personnel designated by the customer using the AV9000 Readiness Checklist as a basis.

Documentation

Four sets of as built drawings, operator instructions, and training materials shall be delivered before training and acceptance. Documentation also shall include the data files for drawings, system operator instructions, equipment user manuals and peripherals, usernames and passwords, AV LAN IP addresses, DSP files, and control system files including uncompiled source codes and touch panel layouts on CD or USB memory stick.

Acceptance

At the time of training, when the documentation is handed over and the system is well exercised the successful contractor shall certify that: all work has been completed on the Audio-Visual System; it is fully in compliance with the specification and that there are zero defects in the system (no punch-list); all engineering, fabrication, installation, testing, and checkout of the AV System are complete; documentation drawings and manuals have been turned over and training with the designated operators has been performed.

Warranty and Preventive Maintenance

All work shall be guaranteed for one year from acceptance against defects in materials and workmanship. If manufacturers' warranties exceed one year, these warranties will apply.

The specified system is mission-critical communications for an enterprise. As such, the warranty period shall include unlimited telephone support, on-site service, and one predictive maintenance visit as part of the base contract. These visits include a review with a designated representative, a complete function check, where detailed inspection takes note of any system deterioration, cleaning of air filters, surfaces, etc., noting of projector lamp hours (as applicable), and other maintenance tasks in accordance with a prescribed checklist. A complete maintenance history shall be maintained, and an engineering review shall take place at the end of the period.

Detailed Specifications

[Plain language Narrative of the system and its intended functionality]

Major Items of Equipment.

Item #	Qty	Manufacturer	Description

Prospective vendor shall furnish with their response a complete list of equipment costs for each item to be furnished, as well as a breakdown in labor costs for each category of labor: Project Management, Engineering, Drafting, Programming, Fabrication and Staging, field preparation, Installation and Commissioning, Operator Training, Warranty and Preventive Maintenance Visits. Indicate total price for equipment and labor.

[End of Boilerplate Specification]