SECTION 274100 - AUDIO/VIDEO SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. None.

1.2 SCOPE OF SPECIFICATION

A. The following terms are defined for this specification section:
   1. "Owner" or "End User" is Houston First Corporation.
   2. "Systems" are the audio and video systems.
   3. "Designer" or "Systems Designer" is the designer of the audio and video systems: Jaffe Holden Acoustics, Inc.
   4. "Electrical Engineer" is the designer of the Electrical Pathway & Wiring Systems: None.
   5. "Contractor" or "Systems Contractor" is the specialty contractor responsible for the installation of the audio and video systems.

B. This specification covers all Systems as described below for the project. The objective is to provide professional systems, installed, acceptance tested, and ready for use.

C. The written specification and the large format AV drawings shall be collectively referred to herein as the Contract documents. System features which are mentioned in one part may not be shown in the others. In case of conflict between the written specification and the drawings, Contractor must seek clarification from the Systems Designer. In the event that the Contractor fails to obtain such clarification, the interpretation of the Systems Designer will prevail.

1.3 CONTRACTOR RESPONSIBILITY

A. Specification drawings are detailed only to the extent necessary to show design intent and signal flow. It is understood and agreed by the Contractor that the work herein described shall be complete in every detail to supply a complete working system.

B. Equipment not mentioned herein nor shown on drawings but necessary to meet this requirement shall be provided without claim for additional payment.

C. Contractor should attend the Pre-Bid walkthrough at the facility to familiarize themselves with site conditions. No change orders will be allowed for unexpected costs due to failure to familiarize yourself with the site conditions. Schedule will be published with the Bid Documents.

1.4 SUMMARY DESCRIPTION

A. There is no Appendix A for this project.

B. Appendix B contains the Major Equipment list. This is not an exhaustive list of every cable and component required to make the system functional.

1.5 SCOPE OF WORK

A. Furnish all materials, labor and any engineering services to provide complete and professionally installed Systems in working order as described herein. Labor furnished shall be specialized and experienced in Systems installation.

B. Furnish all back boxes and enclosures.

C. Deliver to the job site and install all back boxes and enclosures.

D. Furnish and install all wire and cable.

E. Contractor to provide any necessary equipment settings, DSP and control system programming, and any network setup prior to acceptance testing, one full set of programming changes and adjustments, prior to handover to the Owner, and one additional set of changes and adjustments during the initial warranty period, as part of the base scope of work.

F. Furnish any additional items, not specifically mentioned herein, to meet system requirements as specified, without claim for additional payment. Such items may include, but are not limited to hardware, transformers, signal format converters, line/distribution amplifiers and other devices for proper installation, interface, isolation or gain structure.

G. Furnish shop drawings and receive approval, prior to fabrication and installation.

H. Provide frequency scanning and coordination for all audio/video systems wireless transmitters and receivers. Coordinate with other Contractors and Owner as necessary to account for local frequencies used by others within the building, and to account for available spectrum in the surrounding area.

I. Perform initial adjustments and verification tests. Submit verification test report.

J. Participate in acceptance tests and perform final adjustments.

K. Provide training sessions, as specified in section 3.15, to the Owner.

L. Provide any manufacturer required commissioning and/or training and properly schedule with the manufacturer for their staff to attend. Coordinate schedule and training syllabus with owner and consultant.

M. Provide system documentation including copies of all relevant drawings and equipment manuals.

N. Provide maintenance services for the specified period from the date of acceptance.

O. Guarantee all equipment and components for the specified period from the date of acceptance.

P. Requirements and materials that apply to the work of others related to the Systems are listed to define and establish Systems requirements.

Q. Work scope does not include the AC power system except as specifically called out in these specifications or in the drawings.

R. Coordination with the Owner is required to ensure that cabling is run on Owner approved routes and are properly supported or contained as is necessary.

1.6 SUBMITTALS

A. Pre-Bid Submittals

None for this project

B. Bid Submittals:

1. Contractors shall examine all drawings and read all divisions of this specification in order to avoid omissions and duplications and to ensure a complete job. No allowances shall be made for failure to read and understand these documents. Discrepancies between drawings and specifications or obvious omissions shall be referred to the Systems Designer for clarification before the bid date. Where discrepancies occur and pre-bid instructions have not been obtained, the contractor agrees to abide by the Systems Designer's decision.
2. Bid proposals shall include all work and all equipment as specified, as well as any other equipment and materials to be used in assembling the system.
3. Requests for clarification of specification intent shall be made, in writing, not later than ten (10) days prior to bid date.

4. No portion of the work herein may be assigned or sub-contracted to others unless the following requirements have been satisfied:
    a. The names of any proposed sub-contractors shall have been disclosed in the bid proposal.
    b. A statement of qualifications for each sub-contractor shall have been included with the bid proposal.
    c. All terms of this contract, including bidding and qualification requirements, shall apply to the sub-contractor.
5. The bid submittals shall include the following:
    a. The total Contract price
    b. An itemized list of all equipment and materials to be used in assembling the system
    c. Unit pricing for all items on the specified equipment list
    d. Lot pricing for miscellaneous items not on the specified equipment list
    e. A breakdown of the number of staff hours allotted for:
        1) Preparation of submittals, shop drawings, and system documentation
        2) On site coordination meetings and supervision
        3) In shop engineering, fabrication, and assembly
        4) On site fabrication, assembly, and installation
        5) On site verification and acceptance testing

C. Shop Drawing Submittals:
1. Within thirty (30) days after contract award, submit a Work Scope plan that lists all actions required to complete the work in this section. The Work Scope plan must include a complete schedule of all activities, particularly activities that require coordination with the Owner, and Systems Designer, and must reference all relevant documents related to each activity. Critical path must be identified, and all key moments relating to procurement and installation must be identified. All points of coordination must be vetted with the other affected parties prior to submittal to the Owner for review.
2. Within sixty (60) days after contract award, submit digital PDF files of detailed shop drawings to the Owner for approval. All shop drawings shall be marked with the related drawing number when submitted. Do not begin installation or fabrication without the approval of the Owner and Systems Designer.
3. Review of shop drawings shall not constitute final approval of system function. Said review does not in any way relieve the Contractor from the responsibility of furnishing material or performing work as required by the Contract documents.
4. Failure of the Contractor to submit shop drawings in ample time for evaluation shall not entitle the Contractor to an extension of contract time, and no claim for extension by reason of such default will be allowed.
5. Systems Designer will review submittals twice only without additional cost being charged to the project. If a submittal or portion of a submittal is rejected after two attempts, the Contractor is liable for additional cost for further reviews.
6. At minimum, the Shop Drawings shall include electronically bound copies of the following:
    a. Table of Contents
    b. Itemized list of all equipment and materials to be used in assembling the system
    c. Catalog cut sheets or data sheets for each listed item.
        1) Product data sheets must not be web page captures of specifications, unless there is no other recourse.
        2) Product data sheets with multiple options or part numbers must clearly be marked with the selection to be used for this project. All options must be called out. Anything the Contractor is not supplying that is shown on the sheet must be called out as an exclusion.
    d. One-line signal flow diagrams for all systems showing point to point wiring interconnection of all equipment with wire run numbers and patch bay designations. Show all transformers, switches, relays, control circuits, and

modifications to equipment. Show all equipment items which are required for realization of the functions described herein.

e. A complete list of all wire run numbers along with the termination location of each end of each wire run
f. Detailed 3-wire schematic diagrams for any custom circuitry
g. Detailed 3-wire schematic diagrams for typical connections between audio lines, patch bays, and rack mounted equipment
h. Drawings of all items which are to be custom fabricated or modified. Drawings shall be of scale suitable for use in fabrication. They shall show materials, finishes and panel/control markings. Submit samples of lettering/label size and typeface to be employed on custom plates, panels and other equipment.
i. Full size drawings illustrating the physical layout and labeling of patch bays
j. Mechanical drawings of all assemblies, major sub-assemblies, racks, and enclosures
k. Mechanical drawings showing proposed mounting details of all loudspeakers and associated rigging, and interface with adjacent architecture
l. All mounting systems not provided as a complete package from a single manufacturer must be engineered, approved, and have drawings stamped by a professional rigging engineer or licensed structural engineer, as approved by the Owner. The engineer shall verify that the design meets or exceeds design criteria for this particular use case. Each mounting system solution must be separately engineered, verified, and stamped.
m. Provide a detailed written plan for EDID and HDCP management for all video signals and interconnections between video devices.
n. Provide an IP Address table and addressing protocol in coordination with Owner's IT department.
o. Provide a mockup of all system graphical user interface screens and all source code/configuration files required for proper system operation.

7. For the ease of drawing review, the following guidelines must be adhered to:
   a. Plot styles should be utilized so that color is only used for emphasis of specific line types.
   b. The paper size for all shop drawings must match that of all other construction drawings. All drawings must be legible at ½ size.
   c. Drawings should be in black and white but if color is used the drawings must still be legible with all design information easily seen, when printed black and white.
   d. CAD drawings should be delivered as PDF prints. Provide DWG files upon request.
   e. All revisions of drawings in drawing packages must include a revision number and date, with all changed drawings clearly indicated, with changes clouded and tagged with the revision number. Drawings that have not changed from previous releases should not be marked as revised. Already revised drawings should have revision clouds and tags removed from the previous revision so that current revisions are clear to see.
8. Document release must be simultaneous unless a tiered release is authorized by the Systems Designer. If utilizing a tiered document release system, each release must be a full release of documents within each tier, within the context of the entirety of this scope of work. The required order for tiered review is:
   a. Equipment and Panel Locations, and Conduit Riser (provided as indicated in the Work Scope Table in this section)
   b. Complete project equipment list and Product data sheets
   c. Single-line drawings, Panel details, Rack elevations, and Patchbay layouts
      1) Patchbay layouts must conform to the guidelines for Patchbay layouts included in this specification and on large format drawings.
      2) Panel drawings must indicate each panel and its engraving individually (if two 'AA' panels exist, for instance, they must have individual panel drawings

showing the connector numbering and other engraving specific to that panel at that location)

3) All custom rack panels must have a panel drawing as part of this submittal.

d. Rigging and Mounting Details

e. Control system and DSP system GUI mockup, functional control narrative, initial DSP programming, other software configuration files, HDCP/EDID plan and IP addressing plan.

9. All drawings shall be produced in AutoCAD, Revit, or in a similar and compatible computer drafting/graphics program. All submittal drawings must be engineered and drafted to represent actual fabrication and installation drawings and details. All details that are graphically unclear must be properly noted to clarify intent. Copies of the Contract Drawings are not acceptable as submittal drawings and will be rejected.

10. The use of electronic files generated by anyone other than the Systems Contractor (e.g., architectural backgrounds, Systems Designer's drawings, etc.) will not release the Contractor of the responsibility to supply Shop Drawings that represent a completely engineered, coordinated, and functional solution. The Contractor has the final responsibility to provide systems that meet or exceed all requirements of the contract documents.

D. Substitutions:

1. Substitutions may be permitted subsequent to Contract award, but only with the express written permission of the Systems Designer. The proposed substitutes must be equivalent to the specified products in quality, performance, construction, function and conformance to system objectives.

2. It is the responsibility of the Contractor to prove, to the satisfaction of the Systems Designer, that the proposed substitution is equal to the specified product, as demonstrated by submission of the following:

a. List of advantages to the Owner

b. Cost savings

c. Printed specifications or laboratory test data

d. Previous field experience

3. The Contractor shall list the unit price of each item proposed for substitution and indicate which specified items are to be deleted.

4. If the Systems Designer determines that the proposed product is not equal to the specified project, the Contractor shall supply the product specified in the Contract documents.

5. Where substitute materials or methods are approved, the Contractor shall make all adjustments to contingent work necessary to accommodate the substituted equipment, without claim for additional payment.

6. In the event that one or more of the products specified herein is unavailable, the Contractor shall make recommendations to the Systems Designer as to what substitutions are available to meet the intent of the specification.

7. The Systems Designer reserves the right to substitute new products which become available subsequent to the issuance of the Contract Documents, provided that:

a. The Contractor has not yet purchased the originally specified equipment.

b. The substitute equipment shall not materially increase the Contractor's costs.

8. Selected items of the systems are subject to rapid technology changes. Items that have a high likelihood of needing re-evaluation prior to installation are highlighted in the equipment list. The Contractor shall not purchase these items without 30 days prior notice to the Systems Designer.

E. Samples:

1. Submit samples of substitute equipment to the Systems Designer as required to prove equivalency to items specified.

2. Submit samples of custom work, finishes or other materials as required by the Owner or Systems Designer to verify appearance and quality. All panels within direct view of the public may require a custom finish. Provide the Owner with a list of any panels that meet

this criteria so that they may specify custom finishes. A sample of every type of finish specified other than standard finish as detailed in this specification must be provided to the Owner for approval.

3. Costs for shipping samples shall be the responsibility of the Contractor.
4. Submitted samples will not be returned.

F. Progress Reports must be submitted to the Owner every two weeks. The progress report will include:
   1. Work Scope Plan updates and any schedule changes
   2. Overall Project Status
   3. Work Completed by percentage complete
   4. Work planned for the next two week period
      a. Call out any coordination requirements for each item.
   5. Procurement report
      a. Percentage by dollar value of equipment that has been procured to date
      b. Procurement problems or concerns to be addressed by others
   6. RFI/Submittal List
      a. List outstanding RFI's and Submittals, showing the assigned document number and the date it was submitted.
      b. Highlight in Yellow any items that are overdue but are not affecting schedule or project quality.
      c. Highlight in red any items that are overdue AND are affecting schedule and/or project quality.

G. Written Guarantee (See Paragraph 1.9)

H. Verification Test Report (See Paragraph 3.13)

I. System Documentation and Operation Manuals (See Paragraph 3.15)

1.7 JOB CONDITIONS

A. Keep the job adequately staffed at all times. Unless illness, loss of personnel or other circumstances beyond the control of the Contractor intervene, keep the same individual in charge throughout.

B. Cooperate with all appropriate parties in order to achieve well-coordinated progress with the overall construction completion schedule and satisfactory final results.

C. Watch for conflicts with work of other contractors on the job and execute, without claim for extra payment, moderate moves or changes as are necessary to accommodate other equipment or to preserve acoustic performance, symmetry, and pleasing appearance.

D. Immediately report to the Owner and Systems Designer any design or installation irregularities, particularly architectural elements that interfere with the intended coverage angles of loudspeakers, or proper open sightlines to projection surfaces or displays so that appropriate action may be taken.

E. Do all cutting, patching and painting for proper and finished installation of the system and repair any damage done as a result of such installation. Clean up and dispose of trash from all Systems work areas.

1.8 QUALITY ASSURANCE

A. Parts listed shall be complete, type numbers accurate and equipment furnished shall conform to manufacturer's specifications.

B. All materials shall be new and shall conform to applicable provisions of Underwriters Laboratories and the American Standards Association.

C. Procure and pay for all permits, licenses and inspections and observe any requirements stipulated therein.

D. Comply with federal, state and local labor regulations and applicable union regulations.

E. Installation shall conform to latest federal, state and local electrical and safety codes or those of other authorities having jurisdiction. Where conflicts exist, the most stringent code or regulation shall apply.

F. If additional work by the Systems Designer is required as a direct result of deviations from approved drawings and specifications during construction, the Owner and/or Systems Contractor will be liable for those additional costs that the Owner may incur.

G. Government Standards: The Systems Contractor is to comply with all government regulations, standards, and laws that apply to the installation and use of the AV equipment and/or other scope of work specified in this section. The following agencies have laws and rules that apply.

1. Federal Communications Commission (FCC): FCC rules are located in Title 47 of the Code of Federal Regulations. The following is a partial list of the FCC regulations that apply to equipment specified in this section of work:
    a. Part 15: Radio frequency devices
    b. Part 22: Public mobile services.
    c. Part 24: Personal communications services.
    d. Part 25: Satellite communications.
    e. Part 27: Wireless communications service.
    f. Part 51: Interconnection.
    g. Part 74: Experimental radio, special broadcast, and other program distribution services.
    h. Part 95: Personal radio services.
2. Occupational Safety and Health Administration (OSHA) – Follow all applicable standards for health and safety particularly sound pressure level exposure.
3. ANSI Standards: American National Standards Institute (ANSI) standards cover safety, fabrication, assembly, installation, rigging, equipment handling, and testing.
4. Contributing Organizations – The Organizations listed below have published standards used to establish the technical references to be followed under this scope of work.
    a. Acoustical Society of America (ASA) (ASC S1)
    b. Alliance for Telecommunications Industry (ATIS) (ASC T1)
    c. American Society of Safety Engineers (ASSE) (ASC A1264)
    d. Audio Engineering Society (AES) (ASC S4)
    e. Electronics Industry Alliance (EIA) (CEMA)
    f. Entertainment Services and Technology Association (ESTA) (ASC E1)
    g. Institute of Electrical and Electronics Engineers (IEEE) (ASC C136) (802.1)
        1) IEEE 802.1AS: This standard specifies the protocol and procedures used to ensure that the synchronization requirements are met for time sensitive applications, such as audio and video, across Bridged and Virtual Bridged Local Area Networks consisting of LAN media where the transmission delays are fixed and symmetrical.
        2) IEEE 802.1QAT: This standard specifies protocols, procedures and managed objects, usable by existing higher layer mechanisms, that allow network resources to be reserved for specific traffic streams traversing a bridged local area network. It identifies traffic streams to a level sufficient for bridges to determine the required resources and provides a mechanism for dynamic maintenance of those resources.
        3) IEEE 802.1QAV: This standard allows bridges to provide guarantees for time-sensitive (i.e. bounded latency and delivery variation), loss-sensitive real-time audio video (AV) data transmission (AV traffic). It specifies per priority ingress metering, priority regeneration, and timing-aware queue

draining algorithms. This standard uses the timing derived from IEEE 802.1AS. Virtual Local Area Network (VLAN) tag encoded priority values are allocated, in aggregate, to segregate frames among controlled and non-controlled queues, allowing simultaneous support of both AV traffic and other bridged traffic over and between wired and wireless Local Area Networks (LANs). Bridges are increasingly used to interconnect devices that support audio and video streaming application. This standard will specify enhancements to bridge relay function to provide performance guarantees to allow for time-sensitive traffic in a local area network and harmonize delay jitter and packet loss for wired (e.g., IEEE 802.3 - "Standard for Information Technology - Telecommunications and Information Exchange Between Systems - Local and Metropolitan Area Networks - Specific Requirements Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications"), wireless (e.g., IEEE Std 802.11 - "Standard for Information Technology - Telecommunications and information exchange between systems - Local and Metropolitan networks - Specific requirements - Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications"), and mixed wired/wireless L2 networks. Most if not all entertainment media going forward is in digital form. Audio and video streaming and interactive applications over bridged LANs need to be enhanced to have comparable real-time performance of legacy out-of-band analog media distribution. There is significant vendor and end-user interest and market opportunity to consolidate layer 2 solution for both computer networking (e.g. internet access) and audio video services (e.g. home consumer electronics, professional A/V applications, etc) in mixed wired and wireless environments. The use of such consolidated network will realize operational and equipment cost benefits. This standard defines a set of enhancements to the Virtual Bridged LAN (802.1Q - "Standards for Local and Metropolitan Area Networks - Virtual Bridged Local Area Networks").This will enable end-to-end quality of service guarantee agreement for audio and video streaming negotiated over SRP protocol to be realized in a bridged LAN, while interoperating with existing 802.1D - "Standard for Local and Metropolitan Area Networks: Media Access Control (MAC) Bridges" and Q bridges. There is currently no interoperability among bridges that support Audio and Video streaming, nor generally accepted means of achieving such service guarantees in a bridged LAN.

4) IEEE 802.3 – 2008: A revision of base standard incorporating the 802.3an/ap/aq/as amendments, two corrigenda and errata. Link aggregation was moved to 802.1AX.
5) IEEE 802.3AZ: Energy Efficient Ethernet is scheduled for release in September 2010.
6) IEEE 802.3bd: Defines a MAC Control Frame to support 802.1Qbb Priority-based Flow Control.

h. International Cable Engineers Association (ICEA) Formerly IPCEA
i. International Standards Organization (ISO)
j. National Electrical Manufacturer’s Association (NEMA) (ASC C119)
k. National Fire Protection Associations (NFPA)
l. National Safety Council (NSC) (ASC A10)
m. Photographic and Imaging Manufacturer’s Association (PIMA)
n. Society of Motion Picture and Television Engineers (SMPTE)
o. Telecommunications Industry Association (TIA)
p. Underwriters Laboratories (UL) (ASC C101) (CE)
q. NTSC

r. National Association of Broadcasters (NAB) – System technical standards for video and RF compliance are listed in the most recent edition of the NAB Handbook

5. Safety Standards – Contractor will adhere to the following Safety Standards for all work identified in Division 27 41 00 and as part of the General and Supplementary sections of the Division-1 Specifications.
   a. ANSI A14.2-2000: Safety Requirements for Portable Metal Ladders
   b. ANSI A14.7-2000: Safety Requirements for Mobile Ladder Stands and Mobile Work Platforms.
   c. ANSI C2-2002: National Electrical Safety Code
   d. ANSI Z136.1-2000: Safe Use of Lasers and laser systems
   e. ANSI Z136.2-1997: Safe Use of Optical Fiber
   f. ANSI Z359.1-1992 (R1999): Safety Requirements for Personal Fall Arrest Systems, Subsystems, and Components.
   g. ANSI/PIMA IT7.101-1999: Recommended Practice for the Safe Handling and Operating of Audiovisual Equipment.
   h. IEEE 142-1991: Grounding of Industrial and Commercial Power Systems
   i. UL 514A: Scrub Water exclusion from AV Floor Boxes
   j. UL 1419-1995: Standard for Safety for Professional Video and Audio Equipment in accordance with the National Electrical Code, ANSI/NFPA 70
   k. UL 1492-1994: Standard for Safety for Audio-Video Products and Accessories
   l. UL 1651-1997: Standard for Safety for single and multiple Optical Fiber Cable
   m. UL 1667-1996: Audiovisual Systems Safety Standard for Tall AV Institutional Carts for use with Audio, Video, etc.
   n. ANSI E1.1-1999: Construction and Use of Wire Rope Ladders to prevent most injuries
   o. ANSI A10.8-2001: Safety Requirements for Scaffolding
   p. ANSI A10.42-2000: Rigging Qualifications and Responsibilities
6. Applicable Performance Standards – Execute all Division work in accordance with the following standards:
   a. ANSI S4.48-1992 (R1998): Recommended Practice for the Application of Connectors, Part 1, XLR-Type polarity, and gender
   b. ANSI S4.55-1997: Recommended Practice for conservation of the Polarity of Audio Signals
   c. ANSI S4.56-1997: Recommended Practice for the subjective evaluation of Loudspeakers
   d. ANSI S12.2-1995 (R1999): Criteria for Evaluating Room Noise
   e. ANSI T1.217-1991 (R1998): Integrated Services Digital Network (ISDN) Management –Primary Rate Physical Layer
   f. ANSI T1.522-2000: Quality of Service (QOS) for Business Multimedia Conferencing. Specifies classes of Service for conferencing on IP Networks
   g. AES15: ANSI S4.49: AES Recommended practice for Sound Reinforcement Systems –Communications Interface PA-422.
   h. AES-R1-1997 AES project report for professional audio: Specifications for audio on high capacity media
   i. AES14-1992 (r1998) AES standard for professional audio equipment -- Application of connectors, part 1, XLR-type polarity and gender
   j. AES24-1-1999, (Revision of AES24-1-1995) AES standard for sound system control - Application protocol for controlling and monitoring audio devices via digital data networks
   k. AES26-2001 (Revision of AES26-1995) AES recommended practice for professional audio -- Conservation of the polarity of audio signals
   l. ANSI/TIA/EIA 606-1993: Standard for the Telecommunications Infrastructure of Commercial Buildings
   m. ANSI/TIA/EIA 607-1994: Commercial Building Grounding and Bonding Requirements for Telecommunications

n. IEEE 149-1979 (R1990): Test Procedure for Antennas
o. IEEE 1100-1999: Powering and Grounding Sensitive Electronic Equipment
p. NEMA 250-2001: Enclosures for Electrical Equipment
q. SMPTE 292M: SMPTE 292M defines the base 1.485Gbps HD-SDI. Note: This standard can handle all HD formats except 1920*1080 @ 50P and 60P.
r. SMPTE 372M: Uncompressed Dual-Link HD-SDI for 50P & 60P
s. SMPTE 424M: 2.97 Gbps HD-SDI for 50P & 60P
t. TIA/EIA-568-B: Digital audio over Cat5 audio cable
u. UL 1047-1999: Isolated Power Systems Equipment
v. UL 1581-1998: Reference Standard for Electrical Wires, Cables, and Flexible Cords
w. UL 1682-1998: Standard for Safety for Plugs, Receptacles, and Cable Connectors, of the Pin and Sleeve Type up to 800 Amperes and up to 600 volts ac or dc.
x. UL 467-1998: Grounding and Bonding Equipment
y. UL 813-1999: Commercial Audio Equipment and accessories for use in commercial enterprises… this standard was originally listed for public review in the October 13, 1995 issue of Standards Action. It is being resubmitted owing to substantive changes in the text.
z. ANSI/TIA/EIA-568-A: Commercial Building Telecommunications Cabling
aa. ANSI/TIA/EIA-569-A: Commercial Building Standard for Telecommunications Pathways and Spaces
bb. ANSI/TIA/EIA-607: Commercial Building Grounding and Bonding Requirements for Telecommunications
cc. ANSI/TIA/EIA TSB-72: Centralized Optical Fiber Cabling Guidelines
dd. ANSI/TIA/EIA-526-14A: Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant
ee. ANSI/TIA/EIA-526-7 Measurement of Optical Power Loss of Installed Single mode Fiber Cable Plant
ff. ANSI/IEEE C-2 National Electrical Safety Code how to install cabling in accordance with the most recent edition of BICSI® publications:
gg. BICSI Telecommunications Distribution Methods Manual
hh. BICSI Cabling Installation Manual

1.9 GUARANTEE AND SERVICE

A. All systems and components shall be guaranteed free of defects in materials and workmanship for a period of one (1) year (or to the length of the Manufacturer's warranty if longer) from the date of acceptance and shall be repaired or replaced within forty-eight (48) hours following report of such defects by the owner.

B. The Contractor shall be available on call and on eight (8) hour notice during the first month following acceptance of the system, to assist the Owner's representatives in any problems which may arise during the initial period of operation. If corrective measures on-site are required they will be performed within 12 hours of the determination of a need for a site visit.

C. If, during the Guarantee period, any component is out of service for more than seven (7) days due to unavailability of parts or service, Contractor shall supply and install an identical new component. If an identical component is not available, Contractor will substitute equivalent equipment, with the approval of the Owner.

D. During the course of the Guarantee period, the Systems Contractor will provide the Owner with a 24 hour service phone number for emergency calls. A service engineer will respond to all emergency calls within one (1) hour. The personnel answering this call must be fully qualified to troubleshoot problems and propose solutions. A qualifying emergency event is defined as an event that may cause severe hardship or cause the systems to be inoperable or unusable for a scheduled class or event.

E. During the course of the Guarantee period, the Contractor shall provide a minimum of three (3) service visits to the site for inspection and adjustment of equipment. Contractor shall submit proposed schedule for these visits and shall notify Owner and Systems Designer in writing at least one month in advance of each visit.

F. During the course of the guarantee period, the Systems Contractor will supply the Owner with any published updates of manufacturer provided operating programs for any and all software-controlled equipment that are issued to correct “bugs”. During the Guarantee period, the Owner will rely on the Systems Contractor to determine when to update the software, unless it is needed to correct a situation that renders the systems unstable, non-functional, or otherwise affects operations.

G. Repeated device failures, defined as the failure of a device or a single type of device three or more times over three contiguous months, will be considered as a failure of a manufactured system and all items of this type shall be replaced at no charge to the Owner.

H. At least one representative of the Systems Contractor, well versed in the installation and the operation of the systems, shall be on site in support of the Owner for the first significant public event in each space (as determined by the Owner) where the system will be used. The Contractor representative(s) for this event shall also be competent in show operations.

I. Contractor is to coordinate ongoing remote access to AV Systems Networks for support and troubleshooting. Owner to provide the access at their discretion.

1.10 INSURANCE

A. All equipment and materials shall be fully insured against loss or damage up until acceptance of the system by the Owner or until Owner relieves the Contractor in writing of this responsibility, whichever is earlier, regardless of the location of the equipment. All equipment is deemed to be under the control of the Systems Contractor until acceptance of the system by the Owner or until Owner relieves the Contractor in writing of this responsibility, whichever is earlier.

1.11 EXISTING CONDITIONS

A. Visit the site prior to making a bid. No subsequent allowance will be made due to failure to thus observe and verify conditions which may affect the work. Report to the Owner and Systems Designer any discrepancies among this specification and existing conditions and similarly report obvious omissions.

1.12 WORK SCOPE SUMMARY TABLE - NOT APPLICABLE

EQUIPMENT

1.13 GENERAL EQUIPMENT

A. Whenever any equipment is specified by manufacturer and model number, it is for purposes of establishing a standard of quality, performance, construction and function.

B. All materials and equipment shall be new and of the latest design or model offered for sale by the manufacturer.

C. Equipment models provided shall operate at the required AC line voltage and frequency.

D. Contractor shall provide quantities as indicated in the equipment list, detail drawings, location drawings, schedule of terminations, and as required for a complete installation.

E. Audio & Video Wire and Cable
   1. All wire numbers listed in the drawings are Belden unless otherwise noted.
   2. THHN wire is not an allowable substitute for twisted pair stranded loudspeaker wiring.
   3. Approved manufacturers: Belden, Canare, Gepco, West Penn, Whirlwind
   4. Where conflict exists with any codes or ordinances, such codes and ordinances shall take precedence.
   5. Where conflict exists with electrical specifications, the higher standard or more stringent requirement shall apply.

F. Wiring Devices
   1. Duplex Receptacles: per electrical drawings
   2. AV Technical power plates for receptacles must be labeled with the panel number and breaker number for the circuit(s) they are connected to (to be provided and installed by DIV. 26)

G. AV System Plates and Panels:
   1. Specifications – Rack Mount Panels
      Material: 11 gauge steel or 1/8" Aluminum, minimum thickness
      Finish: Black or to match adjacent equipment
      Size: 19" wide, standard EIA mounting hole spacing, height as specified
   2. Specifications – Back Box Enclosures
      Material: Code grade steel
      Finish: Black or galvanized
      Size: As specified
   3. Specifications – Plug Box and Termination Panels
      Material: 11 gauge steel or 1/8" Aluminum, minimum thickness
      Finish: Black (unless instructed otherwise by Owner)
      Size: As specified
   4. Approved Manufacturers: Steel City, Raco, Hoffman, Whirlwind, Pro Co, Wireworks

H. Audio Transformers
   1. All transformers shall be selected for proper interface and loading in the circuits as required by as-built conditions and per manufacturer's recommendations.

1.14 MAJOR EQUIPMENT

A. Equipment provided shall be that specified herein or approved substitute (see Paragraph 1.6.B).

B. Detailed performance specifications shall be those published by the manufacturer effective on the date of this document for all equipment listed.

C. See spreadsheet of major equipment in Appendix B.

1.15 DETAIL DRAWINGS

A. The drawings herein may detail custom built equipment and system details.

B. Furnish all materials and labor to provide complete and finished work even though not specifically shown on the drawings.

C. Detail drawings are located in large format AV drawings.

PART 2 EXECUTION

2.1 AUDIO SYSTEM REQUIREMENTS

A. Requirements herein refer to materials and work which are related to or part of the Systems. Where conflict exists with other specifications concerning such work or materials, this specification takes precedence unless otherwise approved in writing by the Owner.

2.2 INSTALLATION OF SYSTEMS

A. Locate all apparatus requiring adjustments, cleaning or similar attention so that it will be accessible for such attention. Equipment racks shall be positioned to permit full access for operation and service.

B. Furnish and install brackets, braces and supports. All mounting hardware shall be included.

C. All bolts and fasteners must be Grade 5 or better.

D. All bolted attachments to have lock washers or other self-locking fasteners.

E. Provide all required mounting brackets and framing, hardware and components, safety systems and rigging systems using the following minimum design factors (given as ratio of working load limit (WWL) : rated breaking load):
   1. 5:1 – Minimum design factor for all mounting components regardless of mounting condition.
   2. 5:1-8:1 – Minimum design factor for manufacturer provided mounts & assemblies where engineered stamped documentation and destructive testing data is provided by manufacturer.
   3. 10:1 – For all hardware and connecting assemblies between manufacturer rated assemblies when equipment is hung above the general public. This includes but is not limited to wire rope, bolts, shackles, turnbuckles, beam clamps, supplemental steel provided by Systems contractor and other connecting hardware.
   4. Design factor calculations to be provided with all equipment mounting details.
   5. Systems Contractor shall coordinate required additional blocking, supplemental steel or channel strut supports with Main Contractor & specific trade contractors.
   6. All mounting systems not provided as a complete package from a single manufacturer must be engineered, approved, and have drawings stamped by a professional rigging engineer or licensed structural engineer, as approved by the Main Contractor. The engineer shall verify that the design meets or exceeds design criteria for this particular use case. Each mounting system solution must be separately engineered, verified, and stamped.

F. All supporting structures and enclosures supplied by the Contractor not having a standard factory paint finish shall be painted. Paint specifications will be supplied by the Owner or indicated herein.

G. Provide custom color or finish for any equipment or materials supplied which are exposed to public view. Color and finish of all such equipment or materials shall be approved in writing by the Owner. This does not exclude equipment or materials where standard colors and finishes may be specified herein.

H. Finish of blank panels and custom assembly panels shall match adjacent equipment panels. Verify all panel colors with Owner. All color choices should be clearly indicated on panel drawing submittals, and on the panel schedule.

I. Switches, connectors, jacks, receptacles, outlets, cables and cable terminations shall be logically and permanently marked. Custom panel nomenclature shall be engraved, etched or screened. Markings for these items are detailed in the drawings to ensure consistency and clarity. Verify any changes in working type size and/or placement with the Systems Designer prior to marking.

J. Protect equipment and related wiring where construction conditions may cause damage or environmental conditions exceed manufacturer's specifications.

K. The standard reference for the layout and construction of the system shall be:
   1. Giddings, Philip. Audio Systems Design and Installation.

2.3 CONDUIT

A. No conduit will be provided or required. All AV Systems cabling must be plenum rated versions of the cabling called out in the systems drawings and specifications.

B. Cable runs consisting of STP, UTP, and COAX wire types must be installed so that the final length of the cable runs does not exceed maximum cable lengths as stated in 3.8.N and 3.8.O.

C. Cable runs will be properly supported by cable tray, j-hooks, or other means acceptable to the Owner. Verify all cable routing path with the Owner.

2.4 SIGNALSEPARATION

A. Systems wiring is divided into wiring groups according to their nominal voltage levels (refer to Schedule of Terminations):

	Wiring Type
Group A	Microphones and other sensitive wiring (0 mV to 100 mV)
Group B	Line level wiring (100 mV to 10 V)
Group C	Loudspeaker and control wiring (10 V to 70 V)
Group D	Telephone, video, control and digital circuits
Group E	Category Cable, and Fiber optic cable
Group F	Spare Conduit

Note: These wiring groups must never be intermixed within a given cabling run.

B. Minimum separation between wiring of different groups is:

	Group A	Group B	Group C	Group D	Group E
Group A	adjacent	12"	24"	24"	24"
Group B	-	adjacent	24"	12"	12"
Group C	-	-	adjacent	12"	12"
Group D	-	-	-	adjacent	adjacent
Group E	-	-	-	-	adjacent
Group F	12”	12”	12”	12”	12”

Note: Ninety degree crossings in close proximity are acceptable. Separations must be maintained until within six feet of box or gutter entry.

C. Minimum separation between wiring and other electrical service conduit is:

	Group A	Group B	Group C	Group D	Group E	Group F
Dimmer controlled lighting	48"	24"	12"	24"	24”	48”
SCR controlled services	48"	24"	12"	24"	24”	48”
220/440V circuits	12"	12"	adjacent	adjacent	adjacent	48”
All other services	12"	12"	adjacent	adjacent	adjacent	48”

Note: Heavy current demands in or long parallel runs with the above services may dictate greater separations to avoid interference in the Systems. Separations must be maintained until within six feet of box or gutter entry.

D. Contractor must have written authorization from the Systems Designer for any wiring installation which does not conform to these requirements.

2.5 ELECTRICAL POWER

A. Review and coordinate electrical power system installation with Owner if additional power is required at the equipment rack.

B. Verify that all AC power circuits designated for Systems equipment are wired with correct polarity and isolated ground. Report in writing any discrepancies found to the Owner for corrective action.

C. Provide distribution of electrical power within the equipment racks with a minimum of one spare AC receptacle for each four in use per branch circuit.

2.6 STEEL SUPPORTS

A. Fabricate and install any supports so that the installation does not weaken or overload the building structure. Do not impose the weight of equipment or fixtures on supports provided for other trades or systems. No drilling or cutting of concrete beams, joists, or structural steel, nor welding to structural steel, will be permitted except as authorized, in writing, by the Owner.

2.7 BOXES

A. With the exception of portable equipment, all boxes, conduits, cabinets, equipment and related wiring shall be held in place and the mounting shall be plumb and square.

B. All boxes shall be securely mounted to building structure. All boxes shall be installed so that wiring contained in them is accessible. Install blanking devices or threaded plugs in all unused holes.

C. Wiring groups and circuits shall be isolated as indicated herein. Common pull or junction boxes are not permitted except as authorized, in writing, by the Systems Designer.

D. Clean all box interiors before installing plates, panels or covers.

E. Using permanent marker on the box or on wire tags, indicate the lengths of installed cable for all COAX and Category wiring inside the box.

F. Using permanent marker, inside the box, indicate the box name, for example “AA”.

2.8 WIRING METHODS AND PRACTICES

A. Provide installation of all Systems wire and cable, ensuring proper:
   1. Pulling Tensions
   2. Quantities
   3. Types
   4. Lengths
   5. Routing
   6. Wire Group Separation
   7. Identification

B. The interconnection of equipment in a rack shall use the same wire by type as specified for runs external to racks unless otherwise indicated on AV single line drawings. All wiring within racks shall be direct between devices without splices.

C. Interconnection wire between amplifiers and loudspeaker transition panels will be type LSXFR (refer to wire types on AV0.01).

D. Connector polarity shall be maintained except for terminations at equipment manufactured to other standards. In the event that manufactured equipment can be ordered with, or internally set to, various standards, the equipment shall be configured as follows:
   1. Polarity for XLR style connector shall be: pin 2-high, pin 3-low, and pin 1-shield.
   2. Polarity for TRS style connector shall be: tip-high, ring-low, and sleeve-shield.

E. Spare wire runs of each group and type shall be pulled to each termination location. The number of spares shall be ten percent of those in actual use or one, whichever is greater.

F. Splicing of cables is not permitted between terminations of specified equipment.

G. Do not pull wire or cable through any box fitting or enclosure where change of raceway alignment or direction occurs without written approval from the Systems Designer; do not bend conductors to less than recommended radius. Employ temporary guides, sheaves, and rollers to protect cables from excess tension, abrasion or damaging bending during installation.

H. Provide wire pulling lubricants and pulling tensions in accordance with the wire and cable manufacturer's recommendations.

I. All wires shall be permanently identified at each wire end by marking with self-laminating adhesive labels fully covered with clear heat shrink tubing, and a chart kept of each wire's function. This applies to wire within a rack assembly as well as wire running in conduit.

J. Wire ends should be wrapped with heat shrink tubing. Each shield or drain wire should be covered with heat shrink to avoid unintentional connections.

K. Use Wago or Entrelec DIN rail mounted terminal blocks for all terminal block wiring connections. Do not exceed one wire per terminal connection point. Do not cut strands from conductors to fit lugs or terminals. Spare terminal blocks, equivalent to 10% of those in actual use, shall be provided.

L. Form, in an orderly manner, all conductors in enclosures and boxes, wire ways and wiring troughs, providing circuit and conductor identification. Tie using wraps of appropriate size and type. Limit spacing between ties to six (6) inches and provide circuit and conductor identification at least once in each enclosure.

M. Provide service loops, minimum 6', at each termination so that plates, panels, patch bays, and equipment can be dismounted and placed on an adjacent horizontal work surface allowing for safe service and inspection without disconnection.

N. Maximum installed length of Category cables is 200'

O. Maximum installed length of Coaxial cable for HD-SDI, 3G-SDI, 6G-SDI, and 12G-SDI is 200'

P. Provide lengths of installed cables marked inside each termination back box using legible and permanent markings.

2.9 GROUNDING

A. Audio system wiring shall conform to the following procedures:
   1. Audio equipment AC ground pins shall connect to AC isolated ground.
   2. Audio equipment chassis shall connect to AC isolated ground or rack frames.
   3. Audio rack frames shall connect to AC isolated ground bus in panelboard by means of #2 gauge (minimum) conductor.
   4. Audio shields between AC powered pieces of equipment, where signal shield is tied to chassis ground, shall be directly connected to ground at the initiating end only. Capacitively terminate the receiving end with a 0.1µF capacitor.
   5. Audio signal paths between AC powered pieces of equipment shall be connected using balanced lines and/or transformer isolation as required. No unbalanced signal paths may be connected to the patch bay.
   6. Isolate all Systems wiring from racks, back boxes and conduit.

7. Isolate all Systems racks from conduit and other conductive surfaces. Use insulated bushings for conduit connections and a dielectric plinth between racks and conductive flooring materials.
8. AC isolated ground system shall be isolated from all other facility grounds except at the single point of connection at the AV isolation Transformer.
9. All metallic conduit, boxes and enclosures shall be grounded in accordance with the current National Electrical Code.

B. Metallic enclosures containing active equipment shall be grounded with due regard for the minimization of electrical noise. This may include the provision of grounding conductors separate from the AC ground.

2.10 EQUIPMENT RACKS

A. The equipment racks shall be considered as custom assemblies and shall be assembled, wired and tested in the Contractor's shop. Assembly of racks on-site will not be permitted, without written approval from the Systems Designer (except for system wiring which must terminate directly to the patch bays via soldering, punch-down or other non-connectorized termination process).

B. Placement of equipment in equipment racks, as shown in the drawings, is for maximum operator convenience. Verify any changes in placement of the equipment with the Systems Designer before assembly.

C. Racks shall be installed plumb and square without twists in the frames or variations in level between adjacent racks.

D. All wire, cable, terminal blocks, rack mounted equipment, and active slots of card frame systems shall be clearly and logically labeled as to their function, circuit, or system. Labeling on manufactured equipment shall be by engraved plastic laminate or by thermal printer on adhesive tape, with white lettering on black background or dark background that is similar to panel finish.

E. Provide stiffeners to custom panels to prevent panel deformation during normal plugging or switching operations.

F. All wires and cables used in assembling custom panels and equipment racks shall be formed into harnesses which are tied and supported in accordance with accepted engineering practice.

G. Harnessed cables shall be combed straight, wrapped every six (6) to ten (10) inches, and attached to the structure as necessary. Each cable that breaks out from a harness for termination shall be provided with an ample service loop so that panels, patch bays, and equipment can be dismounted and placed on an adjacent horizontal work surface allowing for safe service and inspection without disconnecting.

H. Harnessed cables shall be formed in either a vertical or a horizontal relationship to equipment, controls, components or terminations.

I. Cable shields shall be connected to the isolated ground system with due regard for ground loops. (See Giddings reference book, Chapter 10)

J. All system components and related wiring shall be located with due regard for the minimization of induced electro-magnetic and electrostatic noise, for the minimization of wiring length, for proper ventilation, and to provide reasonable safety and convenience for the operator.

K. All rack mounted equipment, with front panel controls, shall be provided with security covers to avoid tampering with preset levels. If specific security covers are not included in the equipment list, the Contractor will provide the manufacturer's security cover for each specified device or a suitable alternate.

L. Every device shall be installed with regard for proper polarity. Absolute polarity shall be maintained through the entire Systems signal chain.

M. Any permanently mounted electronic device must be balanced. Contractor will provide balancing transformers for unbalanced equipment connections where necessary.

2.11 VERIFICATION TESTS

A. Test each point to point wire segment individually, and test any linkage of multiple point to point cables that form an end to end link.

B. Contractor must document all verification test requirements and results for submission (see 3.13.A below).

C. Confirm that each individual wire and cable run (whether in a rack or in conduit) is identified with a unique number. These numbers are affixed to both ends of each cable and are clearly visible. Provide a complete list of these numbers along with the termination location of each end of the wire run.

D. Verify all circuits and extensions for correct connection, continuity and polarity. Absolute polarity must be maintained between all points in the system.

E. Identify installed length of all copper and fiber cabling.

F. Confirm that all system outputs are free of spurious signals including oscillations and radio frequency signals. A wide band oscilloscope shall be used to verify this condition.

G. Confirm that the system is free of audible clicks, pops, and other noises when any operating control is activated, with or without input signal.

H. For all microphone lines, tie lines, return lines and effect loudspeaker lines, confirm:
   1. Proper circuits appearing at each termination location
   2. Proper circuits appearing at each jack bay position
   3. Continuity of all conductors
   4. Proper polarity is maintained
   5. Absence of shorts between conductors within each circuit
   6. Absence of shorts between circuit conductors and conduit
   7. Perform a sweep test to 0.5MHz

I. For RF Coaxial cabling confirm:
   1. Receptacles output does not exceed +15dBmv (50-400MHz - +6 dBmv minimum, above 400MHz - +3dBmv minimum)
   2. For each modulated video output, tap to meet +9dBmv (+/- 3dBmv)
   3. Verify that all TV channels are visible and free of any interference or signal distortion
   4. Frequency sweep test from 5MHz to 1000MHz.

J. For all other Coaxial cabling confirm:
   1. Verify that the installed cable meets, at a minimum, the requirements set forth in SMPTE ST 2081 for 6G-SDI single-link and 12G-SDI dual-link.
   2. Verify that TDR impedance is 75 +/-3 ohms
   3. Frequency sweep test from 5MHz to 6GHz.

K. For Category Cabling:
   1. Use Category 6A cable pair tester to verify compliance with TIA/EIA standards referenced above (including all current addendums)
   2. Test each cable using the permanent link procedure for opens, shorts, reversals, cross twists and mis-wiring. Check NEXT, ELFEXT, Delay Skew, Return Loss, and Alien Crosstalk.
   3. Report all mis-wiring or failures found and report retests as needed.
   4. If any conductors report open or short, replace the entire wire and re-test.

L. For Fiber cabling:
   1. Using appropriate test devices and proper factory terminated jumpers, measure all fiber optic line attenuations, end to end, as required by TIA/EIA-526-14A.
   2. Optical budget may not exceed the cable performance by length plus splice and connector losses (0.03 dB for each fusion splice, 0.3dB for each mechanical splice, and/or 0.4 dB for each connector).
   3. Overall attenuation must meet TIA/EIA-568B standards. Perform attenuation tests at 850nm and 1300nm.

M. Confirm that loudspeakers and mountings are free of buzzes and rattles when the loudspeaker is swept with sine wave tones over its rated bandwidth at one-half (1/2) its maximum rated power.

N. For all permanently mounted loudspeaker terminations, provide impedance measurement of each pair of loudspeaker lines with all loudspeakers connected and all amplifiers disconnected. These measurements shall be documented as editable tabular data listing impedance for each 1/3 octave band from 20 Hz to 20 kHz and shall be accurate to the nearest tenth of an Ohm.

O. For all intercom terminations, confirm proper operation by initiating and receiving audio communication and call light. For single lines connected to a matrix, test each line with each channel in the matrix. Verify that all channels are quiet and without spurious noise.

P. For all electronic devices mounted in racks and connected to patch bays, confirm:
   1. Every input and output is balanced.
   2. Proper polarity is maintained throughout the entire audio path.
   3. Tip connection of each TRS jack is connected to the positive terminal of each corresponding input or output.

Q. For all devices requiring IP addressing:
   1. IP addressing scheme must make use of subnets such that all devices, regardless on which network (Audio, Video, Control, or House) they reside, have a unique IP address to eliminate the possibility of duplicate IP addresses if networks are inadvertently cross-patched.
   2. All devices must have static IP addresses.
   3. Create a spreadsheet of all devices and their IP addresses, Subnet Masks, MAC Addresses, and other pertinent IP configuration information.
   4. Coordinate all IP addressing schemes with the Owner.

R. If the Audio, Video, and Control network switches are dedicated to these systems and the systems do not rely on Owner furnished and configured network switches:
   1. Configure network switches to operate properly and provide the proper network configurations to support the network devices and protocols used by those devices.
   2. Configure, as needed, VLANS, IGMP, QOS, and other protocols requiring configuration to provide a fully functioning and robust network system.
   3. With all networks configured and operating, and all network devices configured and operating, confirm that the networks are behaving as expected and as required.

S. Electrical Contractor, coordinating with the Systems Contractor must confirm that there are no shorts between the Neutral and Isolated Ground conductors, and between the isolated ground conductor and building ground for each AV Technical Power circuit. Electrical Contractor, coordinating with the Systems Contractor must confirm there are no Bootleg Grounds or Neutral-Ground Reversals on each AV Technical Power circuit.

T. The Contractor is responsible for the programming and configuration of all DSP systems and control systems necessary as specified in this project specification and AV large format drawings.
   1. Programming and configuration must be complete and ready prior to System Designer's arrival for verification of functionality and acceptance testing.

2. Programming for the DSP systems must contain control pages to support normal operations, and to support Acceptance Testing and System Tuning operations, as described in this specification and the large format AV drawings.
3. Programming for the Control Systems must include all master controller code and touch panel code and graphics, working together to provide the function as described in this specification and the large format AV drawings.

U. Test all Audio, Video, and Control system controls, including but not limited to mixing consoles, switchers, routers, touch panels, paging stations, volume controls, and source selectors for proper operation.

V. Test proper operation of any portable controls at each designated control location (Stage Manager's rack, for example).

2.12 INITIAL ADJUSTMENT

A. All initial adjustments must be documented and submitted as part of the Verification Test Reports (see 3.13).

B. Make all adjustments and modifications so that the system is operational and fully functional including but not limited to:
1. Update all device software and firmware to the latest manufacturer's recommended release that allows for proper operation with ALL OTHER DEVICES in the systems.
2. Make all adjustments and modifications for system gain structure per recommendations of major component manufacturers.
3. Properly configure all EDID and HDCP settings to allow for proper function of all video systems.
4. Install all programming for digital mixing consoles, DSP, Control and any other software based devices in the systems, and verify that audio and video signal passes as designed through these systems. Verify that control systems function as specified. Contractor to provide initial DSP and control system programming prior to acceptance testing, one full set of programming changes and adjustments, prior to handover to the Owner, and one additional set of changes and adjustments during the initial warranty period, as part of the base scope of work.
5. Properly balance all 70 Volt loudspeaker zones to be consistent from zone to zone using amplifier settings and loudspeaker taps to adjust for differing loudspeakers or installation height. All 70 Volt loudspeakers within a given zone must not have a broadband SPL variation of greater than +/- 2dB.
6. Properly adjust delay and equalization for all loudspeaker systems using SIM, SMAART or other similar dual FFT type measurement devices. All testing and adjustment shall be in accordance with all manufacturer recommendations and industry standard practice. Contact the Systems Designer for further system delay and equalization requirements.
7. Capture traces showing magnitude and phase response for each loudspeaker or loudspeaker cluster before and after equalization and delay adjustments.
8. Capture traces showing magnitude and phase response for the systems operating as a whole from 3 locations in each major seating area. One of these areas should be the House Mix Position, if applicable.
9. Equalization and timing of the loudspeaker systems shall be further adjusted as required by the Systems Designer and Owner during Acceptance Testing.

2.13 VERIFICATION TEST REPORT

A. Submit written report detailing the results of Initial Adjustments and Verification Tests. Report to include, at minimum, the following:
1. Copies of all relevant drawings, charts, test instrument data, and photographs.
a. PDF copies of all available manufacturers' operation and service literature for each major system component.

b. Copy of all programming files including, but not limited to, Audio DSP programming and Graphic User Interface (GUI) files, Control system Touch Panel GUI files and control system control programming files including un-compiled source codes.
c. All other documentation and results of testing and initial settings as referenced in 3.11, and 3.12 above.
d. Written certification that the installation conforms to the requirements stated herein, is complete in all respects, and is ready for inspection, Acceptance Testing, and tuning.

2. Prepare and submit an InfoComm standard Commissioning Checklist for each system in this specification.
3. Prepare and submit a training syllabus for Owner training (see section 3.15).

B. This report shall be completed and submitted to the Systems Designer for review a minimum of five (5) days prior to Acceptance Testing and final tuning.

2.14 ACCEPTANCE TESTING

A. Acceptance Testing shall be performed by the Systems Designer and Contractor during a period designated by the Owner. Contractor shall furnish a minimum of two (2) technicians or one technician per Systems Designer commissioning team, for the acceptance testing period, and one or more engineers fully capable of programming DSP and Control systems, and making any other engineering adjustments to equipment in the systems. Contact Systems Designer for number of commissioning teams that will be deployed. For Bid purposes assume there will be one commissioning team(s).

B. The minimum time required for Acceptance Testing is one working days, including ½ day of dedicated quiet time. Coordinate this time period so that free access, work lighting, and electrical power are available on the site.

C. Ensure that Systems areas are in a clean and orderly condition ready for acceptance testing.

D. Provide test equipment (meeting the following minimum specifications) on site, at all times during Acceptance Testing. Prior to Acceptance Testing, provide the Systems Designer with a listing of the specific equipment to be made available (**).
1. Oscilloscope: 10MHz Bandwidth, Sensitivity – 1mV/cm
2. Digital Multi-meter: 1% Accuracy
3. Function Generator: 1MHz Bandwidth, Distortion < 1%
4. Real Time Analyzer: 1/3 Octave with microphone
5. SMAART Analysis package with V.8 software and a minimum of two matching test microphones (Earthworks M30 or better)
6. Pink Noise Source: 20 Hz – 20 kHz Bandwidth
7. Test mic tone calibrator
8. Impedance Sweep Meter: 20 Hz – 20 kHz Range, 1 Ohm – 50 kOhm
9. Polarity Checker: Mic, line, or loudspeaker level
10. Video Test Signal Generator(s): must provide all signals, resolutions, and output formats as needed to fully test the systems.

** Note: Systems Designers may choose to supply some of their own test equipment. Confirm specific requirements prior to commissioning.

E. Be prepared to verify the performance of any portion of the system by demonstration, listening tests and instrumented measurements.

F. Be prepared to facilitate the visual inspection of system components and wiring, including removal of termination panels for inspection of wiring termination and wire management practices.

G. Be prepared to demonstrate all software and control systems.

H. Be prepared to go through the commissioning checklist and verify all items as complete.

I. Make additional mechanical and electrical adjustments within the scope of the work and which are deemed necessary by the Systems Designer as a result of the Acceptance Tests. This may include realigning of loudspeaker systems, changes in system gain structures, grounding, filtering or interfaces.

J. Final acceptance will be contingent upon issuance by the Systems Designer of a letter of acceptance stating that the work has been completed and is in accordance with the contract documents.

K. Contractor will bear any costs incurred for additional Systems Designer's time and expenses due to failure to have the system functioning in accordance with specification requirements at the times scheduled for Systems Designer's Acceptance Testing.

2.15 USER TRAINING

A. Contractor will provide in-depth training in operation and regular maintenance of all systems and on all equipment included in the scope of work contained in this specification and the AV large format drawings.

B. Training to include (but is not limited to):
   1. Detailed operation of mixing consoles, video switchers and routers, computer control systems and other essential system elements as relevant to their installation in this project.
   2. Maintenance and repair of system equipment, including replacement procedures for user-replaceable parts.
   3. Review of Operation and Maintenance Manual (See 3.16)

C. Contractor will provide a minimum of two training sessions of four hours each with times and dates to be approved by the Owner.

D. If the Systems Designer, and/or Owner judge any work to be deficient and/or not substantially complete at the time scheduled for training, the training will be postponed until the Systems Designer, and Owner judge the entire AV system conforms to this specification and the AV large format drawings.

E. Contractor will bear any costs incurred for additional Systems Designer's time and expenses due to failure to have the system functioning in accordance with specification requirements at the times scheduled for User Training.

2.16 SYSTEM DOCUMENTATION

A. Within thirty (30) days of the Acceptance Testing, prepare and submit a CD-ROM of the preliminary Operation and Maintenance manual for approval by the Systems Designer. Manual to include, at minimum, the following documents in PDF format:
   1. Table of contents
   2. Written Guarantee and service policy
   3. Basic power on/off and operational procedure
   4. Copies of all shop drawings which have been updated to include any changes made during the installation process
   5. All available manufacturers' operation and service literature for each major system component
   6. One line signal flow diagram with all cable runs and patch points identified by alpha-numeric character
   7. Copy of the Verification Test report
   8. Copy of conduit riser diagram
   9. Copy of the final tuning settings as provided by the Systems Designer
   10. Copy of the IP Addressing table
   11. Copy of all uncompiled source codes and configuration files which have been updated to include any changes made during the installation process.

B. Systems Designer will review the above system documentation. Upon approval, Contractor shall prepare and submit to the Owner:
   1. Five (5) copies of the final Operation and Maintenance manual on CD-ROM or DVD.
   2. Two (2) hard copies of the final Operation and Maintenance manual printed and neatly bound

C. Provide framed or laminated copy of the as-built signal flow diagram for each theater to be mounted in each control room. This diagram shall have all cable runs and patch points identified by alpha-numeric character.

APPENDIX TO FOLLOW

END OF SECTION

Miller Outdoor Theater
Wireless Systems Upgrades

Major Equipment List

Notes:

1. Dollar value allowances are provided for establishing an equipment value at bid time and are priced per each.
2. A/R = As Required for a complete and functional system.
3. All network switches between venues to interconnect over fiber. Include All necessary SFPs. Integrate with existing network switches.
4. Contractor to confirm all equipment & patching quantities
5. All racks to be fully closed, using blanks or brush panels as necessary
6. Finish color of all facilities panels & equipment in public view (touchpanels, loudspeakers, etc) must be confirmed with Owner
7. Specification may call out conduit and cable path provided by others. For this project there will be no conduit. Contractor must provide and install plenum rated equivalent cabling, provide and install any cable supports, and provide and install all back boxes and panels.
8. Refer to specification section 27 41 00 and the large format AV drawings for other applicable project requirements.

FUNCTION	ITEM	MFR	MODEL	QTY
PERSONAL MONITORS				
	Personal Monitor System TRANSMITTER	SHURE	P10T	4
	Antenna Combiner 8chan	SHURE	PA821-B	1
	Antenna Helical	RF VENUE	CPB	1
	Antenna Cable 50ft	SHURE	UA850	1
	Personal Monitor System Receiver	SHURE	P10R	16
	Ear Buds	SHURE	SE425-CL	16
	CHARGER RACK	SHURE	SBRC-US	2
	CHARGER MODULE	SHURE	SBC-AX	8
	BATTERIES	SHURE	SB900A	18
INTERCOM				
	Wireless Intercom BASE STATION	CLEARCOM	FSII-BASE-II	1
	Wireless Intercom BELTPACK	CLEARCOM	FSII-BP19-X4-US	16
	Wireless Intercom Battery Charger 4pack	CLEARCOM	AC60	4
	Wireless Intercom Battery	CLEARCOM	BAT60	24
	WIRELESS INTERCOM TRANSCEIVER	CLEARCOM	FSII-TCVR-19-US	8
	WIRELESS INTERCOM TRANSCEIVER SPLITTER	CLEARCOM	FSII-SPL	2
WIRELESS MICS				
	Axient Digital - 4 ch rx	SHURE	AD4QUS	8
	Axient Digital - MICRO BODYPACK	SHURE	ADX1M	32
	Axient Digital - HANDHELD - B58	SHURE	ADX2FD/B58	14
	Axient Digital - HANDHELD - K8	SHURE	ADX2FD/K8B	12
	Axient Digital - HANDHELD - K9	SHURE	ADX2FD/K9B	6
	Axient Digital - ACCESS POINT	SHURE	AD610	3
	Antenna Helical	RF VENUE	CPB	1
	Antenna Spotlight	RF VENUE	RF SPOTLIGHT	2
	Antenna Combiner RF Mics	RF VENUE	4 ZONE	1
	Antenna Distributor	RF VENUE	DISTRO 4	1
	Antenna Cable 50ft	SHURE	UA850	3
	MIC ELEMENT	DPA	4061-OC-C-F03 BEIGE-PREWIRED WITH LEMO	20
	MIC ELEMENT	DPA	4061-OC-C-F03 BLACK-PREWIRED WITH LEMO	10
	MIC ELEMENT	DPA	4061-OC-C-F03 BROWN-PREWIRED WITH LEMO	10
	CHARGER	SHURE	SBRC-US	4
	CHARGER MODULE	SHURE	SBM910M	16
	CHARGER MODULE	SHURE	SBM920	16
	BELTPACK BATTERY	SHURE	SB910M	40
	RF SPECTRUM MANAGER	SHURE	AXT600US	1
	DANTE AUDIO MONITOR-RACKMOUNT	NIXER	NIXER RD DANTE	1
	RF BELTPACK BELT POUCH NEOPRENE	WIRELESS MIC BELTS.COM	BP-SH-ADX1M-T	32
	RF BELTPACK BELT POUCH BELT	WIRELESS MIC BELTS.COM	BELT-xx (confirm size with owner-allow $8 each)	50
NETWORK				
	NETWORK PATCH CABLING	PER CONTRACTOR	CAT6A SHIELDED	A/R
	48 PORT POE+ 4SFP	CISCO	WS-C2960L-48PS-LL	2