

GUIDELINES

HAS/IT/Design Division
Houston, Texas

ProjectTitle
Proj./CIP No.

(NOTE TO DESIGNER/SPECIFIER: These Guidelines are basic minimum criteria to be met in preparing the final specifications for this section, which is the responsibility of the Designer.)

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AUDIO COMMUNICATION SYSTEM

Rev 8-13-2010

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275113A - SUMMARY OF WORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General Conditions of Contract, including any and all Supplementary Conditions, in Section 007000 apply to this Section.

PART 2 - SUMMARY

2.1 OVERVIEW

- A. This section provides for an integrated **Error! Reference source not found.** for the **Error! Reference source not found.**
- B. The ACS Contractor shall provide and install a fully functioning multi-zone **Error! Reference source not found.** as described in the specifications and shown in the drawings.
- C. The ACS Contractor shall provide all labor required to install a fully functioning multi-zone **Error! Reference source not found.** as described in the specifications and shown in the drawings.
- D. The ACS Contractor shall provide all the necessary tools, lifts, ladders, scaffold, installation instrumentation, computers, and test equipment necessary to fulfill the scope of work specified herein and shown in the drawings.
- E. The ACS Contractor shall adhere to the installation timeline as outlined by the General Contractor and/or or the **Error! Reference source not found.**
- F. For modifications, additions, or updates to an existing **Error! Reference source not found.**, without the involvement of a General Contractor, the ACS Contractor shall provide the **Error! Reference source not found.** with a written project schedule. The schedule shall include, by date, the following information: start time, all break times, end time, employee names, and a description of the work to be performed. The first project schedule will be delivered one week prior to the start of the project. Weekly project schedules are due at Noon on Friday and shall include the following week's activities. Weekly project schedules may be submitted electronically or via e-mail.
- G. The ACS Contractor is responsible for all standard freight, delivery, and transportation necessary to meet the time-line for the scope of work specified herein.
- H. The ACS Contractor shall provide professional grade equipment required to program, test, and calibrate the completed **Error! Reference source not found.**

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- I. By accepting a contract to perform work on a **Error! Reference source not found. Error! Reference source not found.**, the Contractor agrees to deliver to the Owner, as part of the As-Built electronic documentation, all software programs and/or ACS Contractor generated programming installed as part of his work. Further, the ACS Contractor agrees that all system programming becomes the property the **Error! Reference source not found.**
- J. The ACS Contractor shall provide two types of documentation to the **Error! Reference source not found.**; Submittal Documentation and As-Built Documentation.
 1. Submittal Package: Within 30 days of contract, the ACS Contractor shall provide four (4) Submittal packages via the proper channels. The Submittal package shall include:
 - a. Data sheets for all specified or proposed **Error! Reference source not found.** equipment
 - b. Data Sheets for all audio, interconnect, and speaker cables
 - c. 70V Amplifier Loading Spreadsheet as specified in **Section 275113 3.1 10A**
 - d. **Four (4) sets of Shop Drawings utilizing HAS 2010-S1 & HAS 2010-A1**
 2. As-Built Package: 30 days after Owner Acceptance of the work performed on the **Error! Reference source not found.**, the ACS Contractor shall provide four (4) As-Built Packages to the **Error! Reference source not found.** via the proper channels. The **Error! Reference source not found. Error! Reference source not found.** As-Built Packages shall include the following:
 - a. A complete set of As-Built Drawings. The drawings shall include wire numbering, equipment descriptions, and all pertinent system information.
 - b. All operation manuals, warranty cards, software, and other equipment documentation provided by the various manufacturers.
 - c. A digital replica of all system software programs and ACS Contractor generated programming installed as part of his work and operating the **Error! Reference source not found.**
- K. The ACS Contractor shall provide a complete **Error! Reference source not found.** to the **Error! Reference source not found.** for the work performed as part of Section 27 51 00. **THE WARRANTY PERIOD SHALL BEGIN ON THE DAY THE OWNER ACCEPTS THE WORK PERFORMED AS BEING SUBSTANTIALLY COMPLETED AND IN COMPLIANCE WITH THE SPECIFICATIONS AND DRAWINGS.** During the warranty period the following conditions apply:
 1. If on-site service is required during the Warranty Period, the ACS Contractor shall provide all necessary parts, labor, travel expenses, transportation, overnight housing, at no charge to **Error! Reference source not found.**
 2. Service & Support Response Times – The ACS Contractor will provide the following warranty service support, during normal business hours, to the **Error! Reference source not found.**

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- a. System Failure or Critical Device Failures: The ACS Contractor shall provide a 2-hour "telephone" response time and a 6-hour "on-site" response time for a "System Failure or Critical Device" failure. This applies to failures that would prevent the **Error! Reference source not found.** from operating.
 - b. Device Failures: The ACS Contractor shall provide a 4-hour "telephone" response time and 8-hour "on-site" response time for non-critical "Device" failures during the Warranty Period. This clause covers situations or devices that prevent a portion non-critical function within the **Error! Reference source not found.** from operating. In other words, the system may be operational but a particular device is not.
 - c. The ACS Contractor shall provide an 8-hour "telephone" response time and a 2-Day "on-site" response time to requests from the **Error! Reference source not found.** for warranty service or device repair.
3. Related Work: Coordinate with the HAS staff or sub-contractors installing the Telco, VOiP, or IT systems regarding any cabling or devices that may be attached to, interfaced, or housed within the area the equipment racks being installed as part of the **Error! Reference source not found.**

1.4 CONTRACTOR

- A. The ACS Contractor shall follow all procedures and directive as detailed in Section 00 70 00 Article 3. ACS Contractor Qualifications for this section of work are listed in 275113B.

1.5 STANDARDS

- A. The governing reference and installation standards for all **Error! Reference source not found.** **Error! Reference source not found.**s are detailed in Section 275113C.
- B. All work, including updates, modifications, expansion, or repairs, being performed on an existing **Error! Reference source not found.** **Error! Reference source not found.** shall be performed in strict accordance with the Standards listed in Section 275113C.

1.6 EQUIPMENT

- A. Equipment or Software to be installed as part of a new or existing **Error! Reference source not found.** **Error! Reference source not found.** shall meet the technical, performance, compatibility, and quality standards listed in Section 275113F.

1.7 TRAINING

- A. The ACS Contractor shall conduct a comprehensive training session on the work performed for the **Error! Reference source not found.**. The training will include a review and demonstration of:

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1. The operation of the complete **Error! Reference source not found.**
2. Operation of all **Error! Reference source not found.** related equipment
3. Operation of all DSP, ACS Networks, audio monitoring, and advanced control systems
4. Operation of any and all new technologies installed as part of the work performed on the **Error! Reference source not found. Error! Reference source not found..**

1.8 ACCEPTANCE TESTING

- A. For work performed under contract with a General Contractor, the Consultant and the HAS Staff will conduct the ACS Acceptance Testing to ensure the desired system operation and Standards referenced herein have been meet.
- B. For work performed under contract with the **Error! Reference source not found.**, the HAS Staff will conduct the ACS Acceptance Testing to ensure the desired system operation and Standards referenced herein have been meet.
- C. After acceptance test and all components have passed there will be a 30 day burn-in time which once completed with then start the warranty period.

END OF SECTION 275113A

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SECTION 275113B - ACS CONTRACTOR QUALIFICATIONS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and all City of Houston General Conditions of Contract 2010 Edition, including any and all Supplementary Conditions, and other conditions listed in Section 007000 of the Contract Documents apply to this Section.

PART 2 - SUMMARY

2.1 OVERVIEW

- A. This section defines the minimum qualifications for all Contractors wishing to provide services to the **Error! Reference source not found.** on a new or existing **Error! Reference source not found.**(s).

PART 3 - DESCRIPTION

3.1 ACS CONTRACTOR QUALIFICATIONS

- A. ACS Contractors wishing to provide services to the **Error! Reference source not found.** for either a new or existing **Error! Reference source not found.**(s) shall provide the following information as part of their Qualifications package. An accepted and approved ACS Contractor Qualification package must be on file with the **Error! Reference source not found.** for all potential contractors prior to petitioning or bidding on any **Error! Reference source not found.** work. The ACS Contractor Qualification package shall include the following documentation:
 1. A manufacturer generated document stating the ACS Contractors is either an "IED Master Certified" dealer or has achieved the "Highest Manufacturer Certified Training Rating" for the ACS equipment specified for use in a **Error! Reference source not found.** **Error! Reference source not found.**
 2. Additionally, the following criteria defines the minimum experience level required to become an approved **Error! Reference source not found.** Contractor for the **Error! Reference source not found.**
 - a. Years in Business – Minimum five (5) continuous years experience in the installation of multi-zone and network based **Error! Reference source not found.**s. Provide a brief company history including similar projects, company milestones, and all ACS manufacturer certifications.

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- b. Company Profile – Submit a general business and marketing profile including a description of facilities, primary markets served, related businesses, technical staff, support staff, and any other relevant information.
- c. Staffing – The ACS Contractor must have a fulltime installation and technical staff that is large enough to fulfill the complete scope of work and services stated in the specifications. Provide the name(s) of the factory trained and/or certified staff that will be responsible for **Error! Reference source not found. Error! Reference source not found.**
- d. Manufacturer Approved Dealer – The ACS Contractor shall provide a list of the manufacturer's for which they are a factory-authorized dealer. This applies to particular to all equipment specified for the **Error! Reference source not found. Error! Reference source not found.**
- e. Contracting Groups - To ensure "single source responsibility" for the **Error! Reference source not found. Error! Reference source not found.**, groups comprised of multiple Contractors, or consortiums may not bid on this project.
- f. Local Service and Support – During the warranty period, the ACS Contractor shall maintain, or shall arrange for, Houston based service and support staff that is certified and trained on the ACS System installed as part of this section.

3.2 CLARIFICATIONS

- A. By providing an approved response for the work defined in Section 275113, the ACS Contractor indicates he or she has;
 - 1. Reviewed and understands the complete scope-of-work listed in the Request for Quotation (RFQ), Request for Proposal (RFP), and/or published in the associated specifications and drawings.
 - 2. Reviewed all ACS, Electrical, Structural, and Architectural drawings and understands the requirements, concepts, and functionality required for the **Error! Reference source not found.**
 - 3. Has read, and understands, the **Error! Reference source not found.** Design Narrative listed in the published specifications.

3.3 ADDITIONAL CLAIMS

- A. Additional Claims – Claims by the ACS Contractor for additional payment due to errors, omissions, or unfamiliarity with any portion of work specified in Section 275113A will not be considered.

END OF SECTION 275113B

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SECTION 275113C - REFERENCE STANDARDS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and all City of Houston General Conditions of Contract 2010 Edition, including any and all Supplementary Conditions, and other conditions listed in Section 007000 of the Contract Documents apply to this Section.

PART 2 – SUMMARY

2.1 OVERVIEW

- A. This section contains a listing of the Governmental, Safety, and Technical standards that are to be followed for all work performed under Section 275113 for the **Error! Reference source not found.**

PART 3 – DESCRIPTION

3.1 REFERENCE STANDARDS

- A. Government Standards: The ACS Contractor shall comply with all government regulations, standards, and laws that apply to the installation and use of the **Error! Reference source not found.** equipment or scope of work specified in this section. The following agencies have laws and rules that must be followed.
 - 1. Federal Communications Commission (FCC): FCC rules are located in Title 47 of the Code of Federal Regulations. FCC rules located in Parts 2, 5, 15, and 17 of the Title. The official rules of the FCC are published, and maintained, in the Federal Register. The following is a partial list of the FCC regulations that may apply to **Error! Reference source not found.** equipment specified in this section of work:
 - a. Part 27: Wireless communications service.
 - b. Part 51: Interconnection.
 - c. Part 74: Experimental radio, special broadcast, and other program distribution services.
 - d. Part 95: Personal radio services.
 - 2. Federal Communications Commission (FCC): The FCC's Table of Frequency Allocations is listed in Section 2.106 of the Commission's Rules. Be aware that as of November 4, 2008, the United States frequency allocation within the "White Spaces" has changed.

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3. Occupational Safety and Health Administration (OSHA) – Follow all applicable standards for health and safety with particular attention given to sound pressure level exposure during acceptance testing.
4. ANSI Standards: American National Standards Institute (ANSI) standards are to be followed for this section of work. These standards cover safety, fabrication, assembly, installation, rigging, equipment handling, and testing.
5. Contributing Organizations – The following Accredited Organizations standards are used to establish the technical references to be followed under this scope of work. The consultant will provide a synopsis of the listed standards upon request.
 - 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. Institute of Electrical and Electronics Engineers (IEEE) (ASC C136) (802.1)
 - g. International Cable Engineers Association (ICEA) Formerly IPCEA
 - h. International Standards Organization (ISO)
 - i. National Electrical Manufacturer's Association (NEMA) (ASC C119)
 - j. National Fire Protection Associations (NFPA)
 - k. National Safety Council (NSC) (ASC A10)
 - l. Telecommunications Industry Association (TIA)
 - m. Underwriters Laboratories (UL) (ASC C101)
6. Other Applicable Standards – The following organizations' and government agencies' standards are to be followed concerning technical standards and practices within their respective industry. In the event ANSI and one of the following organizations publish a differing opinion, the ACS Contractor shall contact the **Error! Reference source not found.** for clarification.
7. Safety Standards – ACS Contractor will adhere to the following Safety Standards for all work identified in Division 275113A of **Error! Reference source not found.** specifications 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 system's

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- e. ANSI Z136.2-1997: Safe Use of Optical Fiber
 - f. ANSI Z359.1-1992 (R1999): Safety Requirements for Personal Fall Arrest System's, Subsystem's, and Components.
 - g. IEEE 142-1991: Grounding of Industrial and Commercial Power System's
 - h. IEEE 802.3AZ: Energy Efficient Ethernet is scheduled for release in September 2010.
 - i. UL514A: Scrub Water exclusion from ACS Floor Boxes
 - j. UL 1419-1995: Standard for Safety for Professional Audio Equipment in accordance with the National Electrical Code, ANSI/NFPA 70
 - k. UL 1651-1997: Standard for Safety for single and multiple Optical Fiber Cable
 - l. ANSI A10.8-2001: Safety Requirements for Scaffolding
 - m. ANSI A10.42-2000: Rigging Qualifications and Responsibilities
8. Applicable Performance Standards – Execute all **Error! Reference source not found.** 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 S12.2-1995 (R1999): Criteria for Evaluating Room Noise
 - d. ANSI T1.217-1991 (R1998): Integrated Services Digital Network (ISDN) Management – Primary Rate Physical Layer
 - e. AES15: ANSI S4.49: AES Recommended practice for Sound Reinforcement System's – Communications Interface PA-422.
 - f. AES14-1992 (r1998) AES standard for professional audio equipment -- Application of connectors, part 1, XLR-type polarity and gender
 - g. 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
 - h. AES26-2001 (Revision of AES26-1995) AES recommended practice for professional audio -- Conservation of the polarity of audio signals
 - i. ANSI/TIA/EIA 606-1993: Standard for the Telecommunications Infrastructure of Commercial Buildings
 - j. ANSI/TIA/EIA 607-1994: Commercial Building Grounding and Bonding Requirements for Telecommunications

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- k. 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.
- l. 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.
- m. 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.

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- n. IEEE 802.3 – 2008: A revision of base standard incorporating the 802.3an/ap/aq/as amendments, two corrigenda and errata.
 - o. IEEE 1100-1999: Powering and Grounding Sensitive Electronic Equipment
 - p. NEMA 250-2001: Enclosures for Electrical Equipment
 - q. TIA/EIA-568-B: Digital audio over Cat6 audio cable
 - r. UL 1047-1999: Isolated Power System's Equipment
 - s. UL 1581-1998: Reference Standard for Electrical Wires, Cables, and Flexible Cords
 - t. UL 467-1998: Grounding and Bonding Equipment
 - u. 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.
9. Applicable Performance Standards for Fiber Optical Cable – Execute work in accordance with the following standards:
- A. ANSI/TIA/EIA-568-A: Commercial Building Telecommunications Cabling
 - B. ANSI/TIA/EIA-569-A: Commercial Building Standard for Telecommunications Pathways and Spaces
 - C. ANSI/TIA/EIA-607: Commercial Building Grounding and Bonding Requirements for Telecommunications
 - D. ANSI/TIA/EIA TSB-72: Centralized Optical Fiber Cabling Guidelines
 - E. ANSI/TIA/EIA-526-14A: Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant
 - F. ANSI/TIA/EIA-526-7 Measurement of Optical Power Loss of Installed Single mode Fiber Cable Plant
 - G. ANSI/IEEE C-2 National Electrical Safety Code how to install cabling in accordance with the most recent edition of BICSI® publications:
 - H. BICSI Telecommunications Distribution Methods Manual (latest revision)
 - I. BICSI Cabling Installation Manual
- 10 The following standards apply to all new, expanded, modified, or redesigned **Error! Reference source not found.**(s) at an HAS facility:

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- A. Amplifier Loading – The maximum allowable load percentage for constant-voltage audio power amplifier (70V or 100V) installed in a **Error! Reference source not found. Error! Reference source not found.** is 75%. The following amplifier load chart shall be followed for all modular type amplifier cards:

HAS Standard 2010-A1

RMS Amp Wattage @ Output	Speaker Total Per Channel	Speaker TAP Wattage	Speaker Wattage Per Amp	Amp Load % @ Output
200	100	1.5	150	75.00%
200	50	3	150	75.00%
200	42	3.5	147	73.50%
200	20	7.5	150	75.00%
200	10	15	150	75.00%
200	5	30	150	75.00%
200	2	60	120	60.00%
400	200	1.5	300	75.00%
400	100	3	300	75.00%
400	84	3.5	294	73.50%
400	40	7.5	300	75.00%
400	20	15	300	75.00%
400	10	30	300	75.00%
400	5	60	300	75.00%
400	3	120	360	75.00%

- B. Ceiling Loudspeaker Coverage – The following charts will be used to define the center-to-center spacing for all 70V loudspeakers being installed as part of a **Error! Reference source not found. Error! Reference source not found.**: The charts apply to a loudspeakers -6dB response and a coverage rating of 45°, 60°, 90°, and 100° coverage patterns:

Speaker Center to Center Spacing Using Minimum Overlap Configuration											
Ceiling Height AFF		Ceiling Height above 5' listener		Center to Center Ceiling Speaker Spacing							
				45° Speaker		60° Speaker		90° Speaker		100° Speaker	
Feet	Meters	Feet	Meters	Feet	Meters	Feet	Meters	Feet	Meters	Feet	Meters
8.0	2.44	3.0	0.91	1.8	0.54	2.4	0.75	4.2	1.29	5.1	1.54
8.5	2.59	3.5	1.07	2.1	0.62	2.9	0.87	4.9	1.51	5.9	1.80
9.0	2.74	4.0	1.22	2.3	0.71	3.3	1.00	5.7	1.72	6.7	2.05
9.5	2.90	4.5	1.37	2.6	0.80	3.7	1.12	6.4	1.94	7.6	2.31
10.0	3.05	5.0	1.52	2.9	0.89	4.1	1.24	7.1	2.16	8.4	2.57

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10.5	3.20	5.5	1.68	3.2	0.98	4.5	1.37	7.8	2.37	9.3	2.83
11.0	3.35	6.0	1.83	3.5	1.07	4.9	1.49	8.5	2.59	10.1	3.08
11.5	3.51	6.5	1.98	3.8	1.16	5.3	1.62	9.2	2.80	11.0	3.34
12.0	3.66	7.0	2.13	4.1	1.25	5.7	1.74	9.9	3.02	11.8	3.60
12.5	3.81	7.5	2.29	4.4	1.34	6.1	1.87	10.6	3.23	12.6	3.85
13.0	3.96	8.0	2.44	4.7	1.43	6.5	1.99	11.3	3.45	13.5	4.11
13.5	4.11	8.5	2.59	5.0	1.52	6.9	2.12	12.0	3.66	14.3	4.37
14.0	4.27	9.0	2.74	5.3	1.61	7.3	2.24	12.7	3.88	15.2	4.62
14.5	4.42	9.5	2.90	5.6	1.70	7.8	2.36	13.4	4.09	16.0	4.88
15.0	4.57	10.0	3.05	5.9	1.79	8.2	2.49	14.1	4.31	16.9	5.14
15.5	4.72	10.5	3.20	6.2	1.87	8.6	2.61	14.8	4.53	17.7	5.39
16.0	4.88	11.0	3.35	6.4	1.96	9.0	2.74	15.6	4.74	18.5	5.65
16.5	5.03	11.5	3.51	6.7	2.05	9.4	2.86	16.3	4.96	19.4	5.91
17.0	5.18	12.0	3.66	7.0	2.14	9.8	2.99	17.0	5.17	20.2	6.16
17.5	5.33	12.5	3.81	7.3	2.23	10.2	3.11	17.7	5.39	21.1	6.42
18.0	5.49	13.0	3.96	7.6	2.32	10.6	3.24	18.4	5.60	21.9	6.68
18.5	5.64	13.5	4.11	7.9	2.41	11.0	3.36	19.1	5.82	22.8	6.94
19.0	5.79	14.0	4.27	8.2	2.50	11.4	3.48	19.8	6.03	23.6	7.19
19.5	5.94	14.5	4.42	8.5	2.59	11.8	3.61	20.5	6.25	24.4	7.45
20.0	6.10	15.0	4.57	8.8	2.68	12.2	3.73	21.2	6.47	25.3	7.71
20.5	6.25	15.5	4.72	9.1	2.77	12.7	3.86	21.9	6.68	26.1	7.96
21.0	6.40	16.0	4.88	9.4	2.86	13.1	3.98	22.6	6.90	27.0	8.22
21.5	6.55	16.5	5.03	9.7	2.95	13.5	4.11	23.3	7.11	27.8	8.48
22.0	6.71	17.0	5.18	10.0	3.04	13.9	4.23	24.0	7.33	28.7	8.73
22.5	6.86	17.5	5.33	10.3	3.12	14.3	4.36	24.7	7.54	29.5	8.99
23.0	7.01	18.0	5.49	10.5	3.21	14.7	4.48	25.5	7.76	30.3	9.25
23.5	7.16	18.5	5.64	10.8	3.30	15.1	4.60	26.2	7.97	31.2	9.50
24.0	7.32	19.0	5.79	11.1	3.39	15.5	4.73	26.9	8.19	32.0	9.76
24.5	7.47	19.5	5.94	11.4	3.48	15.9	4.85	27.6	8.41	32.9	10.02
25.0	7.62	20.0	6.10	11.7	3.57	16.3	4.98	28.3	8.62	33.7	10.27
25.5	7.77	20.5	6.25	12.0	3.66	16.7	5.10	29.0	8.84	34.6	10.53
26.0	7.92	21.0	6.40	12.3	3.75	17.1	5.23	29.7	9.05	35.4	10.79
26.5	8.08	21.5	6.55	12.6	3.84	17.6	5.35	30.4	9.27	36.2	11.04
27.0	8.23	22.0	6.71	12.9	3.93	18.0	5.48	31.1	9.48	37.1	11.30
27.5	8.38	22.5	6.86	13.2	4.02	18.4	5.60	31.8	9.70	37.9	11.56
28.0	8.53	23.0	7.01	13.5	4.11	18.8	5.72	32.5	9.91	38.8	11.82
28.5	8.69	23.5	7.16	13.8	4.20	19.2	5.85	33.2	10.13	39.6	12.07
29.0	8.84	24.0	7.32	14.1	4.29	19.6	5.97	33.9	10.35	40.4	12.33
29.5	8.99	24.5	7.47	14.4	4.37	20.0	6.10	34.6	10.56	41.3	12.59
30.0	9.14	25.0	7.62	14.6	4.46	20.4	6.22	35.4	10.78	42.1	12.84
30.5	9.30	25.5	7.77	14.9	4.55	20.8	6.35	36.1	10.99	43.0	13.10
31.0	9.45	26.0	7.92	15.2	4.64	21.2	6.47	36.8	11.21	43.8	13.36
31.5	9.60	26.5	8.08	15.5	4.73	21.6	6.60	37.5	11.42	44.7	13.61

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32.0	9.75	27.0	8.23	15.8	4.82	22.0	6.72	38.2	11.64	45.5	13.87
32.5	9.91	27.5	8.38	16.1	4.91	22.5	6.84	38.9	11.85	46.3	14.13
33.0	10.06	28.0	8.53	16.4	5.00	22.9	6.97	39.6	12.07	47.2	14.38
33.5	10.21	28.5	8.69	16.7	5.09	23.3	7.09	40.3	12.28	48.0	14.64
34.0	10.36	29.0	8.84	17.0	5.18	23.7	7.22	41.0	12.50	48.9	14.90
34.5	10.52	29.5	8.99	17.3	5.27	24.1	7.34	41.7	12.72	49.7	15.15
35.0	10.67	30.0	9.14	17.6	5.36	24.5	7.47	42.4	12.93	50.6	15.41
35.5	10.82	30.5	9.30	17.9	5.45	24.9	7.59	43.1	13.15	51.4	15.67
36.0	10.97	31.0	9.45	18.2	5.53	25.3	7.71	43.8	13.36	52.2	15.92
36.5	11.13	31.5	9.60	18.5	5.62	25.7	7.84	44.5	13.58	53.1	16.18
37.0	11.28	32.0	9.75	18.7	5.71	26.1	7.96	45.3	13.79	53.9	16.44
37.5	11.43	32.5	9.91	19.0	5.80	26.5	8.09	46.0	14.01	54.8	16.70
38.0	11.58	33.0	10.06	19.3	5.89	26.9	8.21	46.7	14.22	55.6	16.95
38.5	11.73	33.5	10.21	19.6	5.98	27.4	8.34	47.4	14.44	56.5	17.21
39.0	11.89	34.0	10.36	19.9	6.07	27.8	8.46	48.1	14.66	57.3	17.47
39.5	12.04	34.5	10.52	20.2	6.16	28.2	8.59	48.8	14.87	58.1	17.72
40.0	12.19	35.0	10.67	20.5	6.25	28.6	8.71	49.5	15.09	59.0	17.98
40.5	12.34	35.5	10.82	20.8	6.34	29.0	8.83	50.2	15.30	59.8	18.24
41.0	12.50	36.0	10.97	21.1	6.43	29.4	8.96	50.9	15.52	60.7	18.49
42.5	12.95	37.5	11.43	22.0	6.70	30.6	9.33	53.0	16.16	63.2	19.26
43.0	13.11	38.0	11.58	22.3	6.78	31.0	9.46	53.7	16.38	64.0	19.52
43.5	13.26	38.5	11.73	22.6	6.87	31.4	9.58	54.4	16.60	64.9	19.78
44.0	13.41	39.0	11.89	22.8	6.96	31.8	9.71	55.2	16.81	65.7	20.03
44.5	13.56	39.5	12.04	23.1	7.05	32.3	9.83	55.9	17.03	66.6	20.29
45.0	13.72	40.0	12.19	23.4	7.14	32.7	9.95	56.6	17.24	67.4	20.55
45.5	13.87	40.5	12.34	23.7	7.23	33.1	10.08	57.3	17.46	68.3	20.81
46.0	14.02	41.0	12.50	24.0	7.32	33.5	10.20	58.0	17.67	69.1	21.06
46.5	14.17	41.5	12.65	24.3	7.41	33.9	10.33	58.7	17.89	69.9	21.32
47.0	14.33	42.0	12.80	24.6	7.50	34.3	10.45	59.4	18.10	70.8	21.58
47.5	14.48	42.5	12.95	24.9	7.59	34.7	10.58	60.1	18.32	71.6	21.83
48.0	14.63	43.0	13.11	25.2	7.68	35.1	10.70	60.8	18.54	72.5	22.09
48.5	14.78	43.5	13.26	25.5	7.77	35.5	10.83	61.5	18.75	73.3	22.35
49.0	14.94	44.0	13.41	25.8	7.86	35.9	10.95	62.2	18.97	74.2	22.60
49.5	15.09	44.5	13.56	26.1	7.95	36.3	11.07	62.9	19.18	75.0	22.86
50.0	15.24	45.0	13.72	26.4	8.03	36.7	11.20	63.6	19.40	75.8	23.12
50.5	15.39	45.5	13.87	26.7	8.12	37.2	11.32	64.3	19.61	76.7	23.37
51.0	15.54	46.0	14.02	26.9	8.21	37.6	11.45	65.1	19.83	77.5	23.63
51.5	15.70	46.5	14.17	27.2	8.30	38.0	11.57	65.8	20.04	78.4	23.89
52.0	15.85	47.0	14.33	27.5	8.39	38.4	11.70	66.5	20.26	79.2	24.14
52.5	16.00	47.5	14.48	27.8	8.48	38.8	11.82	67.2	20.47	80.1	24.40
53.0	16.15	48.0	14.63	28.1	8.57	39.2	11.95	67.9	20.69	80.9	24.66
53.5	16.31	48.5	14.78	28.4	8.66	39.6	12.07	68.6	20.91	81.7	24.91
54.0	16.46	49.0	14.94	28.7	8.75	40.0	12.19	69.3	21.12	82.6	25.17

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54.5	16.61	49.5	15.09	29.0	8.84	40.4	12.32	70.0	21.34	83.4	25.43
55.0	16.76	50.0	15.24	29.3	8.93	40.8	12.44	70.7	21.55	84.3	25.69
55.5	16.92	50.5	15.39	29.6	9.02	41.2	12.57	71.4	21.77	85.1	25.94
56.0	17.07	51.0	15.54	29.9	9.11	41.6	12.69	72.1	21.98	86.0	26.20
56.5	17.22	51.5	15.70	30.2	9.20	42.0	12.82	72.8	22.20	86.8	26.46
57.0	17.37	52.0	15.85	30.5	9.28	42.5	12.94	73.5	22.41	87.6	26.71
57.5	17.53	52.5	16.00	30.8	9.37	42.9	13.07	74.2	22.63	88.5	26.97
58.0	17.68	53.0	16.15	31.0	9.46	43.3	13.19	75.0	22.85	89.3	27.23
58.5	17.83	53.5	16.31	31.3	9.55	43.7	13.31	75.7	23.06	90.2	27.48
59.0	17.98	54.0	16.46	31.6	9.64	44.1	13.44	76.4	23.28	91.0	27.74
59.5	18.14	54.5	16.61	31.9	9.73	44.5	13.56	77.1	23.49	91.9	28.00
60.0	18.29	55.0	16.76	32.2	9.82	44.9	13.69	77.8	23.71	92.7	28.25

- C. Wall Mounted Loudspeaker Coverage – When wall mounted loudspeaker is installed as part of a Houston Airport System ACS, the following design criterion shall be followed:
1. The estimated ambient level of an outside area with vehicular traffic present shall be calculated at 85dBa.
 2. The loudspeaker shall be tapped at a level to ensure the level at the listener shall be +10dBa above the ambient level shown above.
 3. Spacing shall be calculated at 6'-0" AFF with the -6dB response at 1kHz being edge to edge.
 4. Loudspeaker selection shall be from the approved list of transducers specified in 275113E.
- D. Special Conditions – When a particular zone within an **Error! Reference source not found.** Airport Communication System requires a unique loudspeaker solution, the ACS Contractor shall submit his recommended device on a separate Submittal to the HAS Staff for review. If approved, the ACS Contractor will be notified in writing to proceed. If rejected, the ACS Contractor will be notified in writing and asked to provide another potential loudspeaker solution.

END OF SECTION 275113C

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SECTION 275113D- INSTALLATION STANDARDS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and all City of Houston General Conditions of Contract 2010 Edition, including any and all Supplementary Conditions, and other conditions listed in Section 00 70 00 of the Contract Documents apply to this Section.

PART 2 – SUMMARY

2.1 OVERVIEW

- A. Provide a complete and fully functional **Error! Reference source not found.** for **Error! Reference source not found.** as described in the specifications and the drawings.

PART 3 - DESCRIPTION

3.1 INSTALLATION STANDARDS

- A. All Exterior Communications Pathways shall be installed in accordance with HAS Standards listed in Specification 270543.
- B. All Interior Communication Pathways shall be installed in accordance with HAS Standards listed in Specification 270528.
- C. Quality of Work: The ACS Contractor shall perform all labor and installation in accordance with the Reference Standards listed in Section 275113C and the Installation Standards listed in Section 275113D.
- D. The ACS Contractor shall follow accepted industry standards, and all state and local codes in order to provide **Error! Reference source not found.** a functional and properly operating **Error! Reference source not found.**
- E. Coordination of Work: Coordinate work with **Error! Reference source not found.** personnel, General Contractor, Electrical Contractor, and other trades, as required.
- F. Structural Engineering Approval: Prior to the installation of any “suspended” equipment specified in section 275113E, the ACS Contractor shall submit drawings of his rigging or mounting designs, via the Shop Drawings listed in Section 275113B, to the Architect, Structural Engineer, and HAS Staff for review and approval.

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- G. Infrastructure Coordination: Coordinate and verify the installation of all necessary conduits for correct size, quantity, and location. Verify that all junction boxes, specialized back boxes, floor boxes, ACS technical power panelboard, earth ground, and the connection of all high voltage circuits to ACS Equipment Racks and equipment are installed per **Error! Reference source not found.** specifications and drawings.
- H. IT Coordination: Coordinate the installation of Ethernet or LAN cabling that may be terminated to connectors located in the ACS equipment racks or plates.
- I. ACS Technical Power Coordination: Coordinate and verify installation of the ACS technical power panelboard, technical power outlets, and the connection of all high voltage circuits to the ACS equipment racks.
- J. Technical Ground: Earth ground is to be established between the technical power panelboard and solid earth ground. Each circuit connected to an ACS equipment Rack or a Technical Power receptacle shall have its own "home run" isolated ground conductor connected that is terminated at the technical power panelboard. This grounding path should eliminate electromagnetic and electrostatic hum and/or ground noise. Disconnecting a unit's ground pin to eliminate a ground problem is unacceptable and in violation of the National Electric Code.
- K. Wiring Codes: Follow all Low-Voltage wiring Standards as stated in the NEC Handbook. Follow accepted industry standards for the installation of audio, fiber, and Control system's as defined by the AES, NAB, NSCA, and ICIA. Additional standards and practices are illustrated in the Don and Carolyn Davis book Sound System Design, Second Edition.
- L. Cable Groups & Separation: ACS cabling shall be divided into the following groups: Speaker level, Audio (-60 to +4dBm), Control (RS-232, RS-422, RS-423, and RS-485), and Fiber Optic cable. All audio, video, and control lines must be at least 12" from high-voltage circuit or line. When cables are installed in conduits, Groups are to be maintained. Separation: Speaker Level to other cable groups must be separated by 8". If a permanently installed electrical circuit and any ACS cable must cross, the intersection shall be perpendicular.
- M. Plenum Rated Cable: Plenum rated cable may be used in accessible ceilings when conduit is not Installed or specified.
- N. Cable Markers: Mark all cables permanently with indelible "machine printed" wire markers. Provide both a printed and electronic cross-referenced wiring summary as noted in Section 275113C -1.6B.
- O. Signal Polarity: Maintain signal polarity in accordance with Section 275113C.
- P. Connectors: Use approved audio, control, fiber, and electrical connections for proper installation in accordance with manufacturer's specifications and all state and local codes.
- Q. ACS Device Location Changes: Adjustments of device locations may be requested or required for a variety of reasons. When an ACS device location change is required because of field conditions, the ACS Contractor will notify the Consultant or HAS Project Manager immediately before any change is implemented.

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- R. Labeling & Engraving: The ACS Contractor will engrave and backfill all wall plate and JB text shown on the ACS drawings.
- S. Termination: All outdoor loudspeakers shall have Phoenix or other weatherproof connectors.
- T. Network: All Data Communication Network Equipment shall adhere to HAS Standards listed in Specification 272100 and labeled per Specification 270553. The Data Communication Network shall support, but not be limited to, the following standards: IEEE 802.3, 10BASET, IEEE 802.3u, 100BaseTX, 1000BaseFX, IEEE 802.11, Ethernet MIB (RFC 1643), and SNMO MIB II (RFC 1213). A Fast Ethernet Switch shall be used to form a peer-to-peer 10Base-T network with a minimum of 8 users. The unit shall have data rates of 10/100/1000 Mbps and be interconnected using Category 5, or better, cabling for networking. The unit shall have a star topology. The speed per port shall be as follows: Half Duplex: 10Mbps or 100Mbps; Full Duplex: 20Mbps or 200Mbps; Gigabit Port: 1000 Mbps or 2000 Mbps. The unit shall have LED indicators for all critical functions including, but not limited to: Line-Voltage, 10/100 Ethernet, FD/Col, Link/Act, Full and Half Duplex, 1000 Link Act, and 1000 FD/Col. The unit shall include a built-in or external 3.3VDC, 5A power supply. The unit dimensions will vary between manufacturers but the reference unit measures: 1.88"H x 7.31"W x 6.6"D (48mmx186mmx154mm). The reference unit weighs 13.6 oz (.39kg) including power supply. The unit shall have a temperature operating range from 32F to 122F. The unit's humidity operate shall be within 10% to 85%.

3.2 CONDUIT & CABLE

- A. All Cable shall adhere to HAS Standards listed in Specifications 271300 and 271500.
- B. Manufacturers offering products that may be incorporated into the Work include, but are not limited to, SYSTIMAX, SCS and other manufacturers as referenced in the HAS Standards listed in Specifications 271300 and 271500. Substitutions for Systemax products are not permitted.
- C. All Conduit and Cable shall be installed in accordance with the HAS Standards listed in Specifications 270528 and 270543.
- D. Conduit, Cable, Disconnect, and Circuit Identification: Each of these elements shall be legibly identified and clearly labeled to indicate its purpose within the system. All labels shall be machine printed, assigned a numerical identity, and documented in accordance with the section detailing "As-Built Documentation" and HAS Specification 270553. See the ACS drawings for any labeling required on electrical plates with the TP designation.
- E. Copper Conductors: When the NEC refers to a conductor size; it is in reference to the material of copper (CU), unless aluminum is specifically specified. For the purpose of clarification, all conductors being installed in this project shall be copper (CU).
- F. Conductor Sizes: Conductor sizing for this project shall follow the NEC and is expressed in American Wire Gauge (AWG) or circular mils, except for conductors larger than No. 4/0 AWG, which are identified in kick mils (thousand circular mils).

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- G. Electrical Conductor Termination: Dissimilar conductor materials must not make contact in a terminal or splicing device, unless the device is identified for the purpose.
- H. Low-Voltage Terminations: In all instances, terminals, connectors, and terminations shall accept no more than one wire per termination. Where more than one inline termination is required, barrier strips shall be used. They will be mounted to a non-metallic surface and identified termination must be identified, either within the equipment instructions or on the terminal itself.
- I. Damaged Parts: Any device or part of electrical equipment with problems such as cracked insulators, poorly bonded grounds, and missing arc shields shall be removed and replaced with a properly operating device.
- J. Work Space: An open and a safe working space is required for all equipment racks, primary system junction boxes, electrical disconnects, panelboard, and other devices. The area necessary to install a safe working space is influenced by the need to examine, adjust, service, or maintain the system while it is in operation. The ACS Contractor will verify field-conditions do not adversely impact the ACS Systems open work space.
- K. Protection: The Contractor shall protect and guard the system equipment during assembly and installation in order to prevent physical damage. System equipment and / or devices should be installed where they would be exposed to either physical or airborne contamination damage. See the NEC Sections 240-24(c) and 300-4 for clarification and requirements.
- L. ACS Conduit System - All Audio, Video, Control, Data, RF, and Speaker wiring being permanently installed shall be installed within a metal conduit. Metal conduit is also referred to as Electrical Metallic Tubing (EMT), Intermediate Metal Conduit (IMC), or Rigid Metal Conduit (RMC). The use of EMT, IMC, or RMC applies to all ACS conduits located: above the ceiling, surface mounted, in a wall, in a floor, or located within the concrete foundation. The use of any type of PVC, plastic, fiberglass or any other non-metallic conduit in this system is prohibited unless special conditions exist. It is the responsibility of the ACS Contractor to insure that the Electrical Contractor adheres to this specification.
- M. Conduit Safety Note: The National Electric Code (NEC) for Proposals the installation of communication cables in the same conduit with high-voltage power cables.
- N. Conduit Assembly: Conduits should be properly assembled and constructed to insure all of the interior walls are smooth and will not damage and cables during installation.
- O. Conduit Bends: The maximum number of bends allowed between pull boxes within a single conduit run cannot exceed 170 degrees. This can be any combination of 90 degree and 45 degree bends that when totaled do not exceed the total of 170 degrees in accordance with the NEC code.
- P. Empty Conduit: Empty conduits may be installed and designated for future use. All "future use" conduits require the installation of a pull line and a 36" service loop in every pull box.
- Q. Conduit Sizing - The ACS conduit system for the **Error! Reference source not found.** has a MAXIMUM conduit fill capacity of 40% for all ACS cabling. The ACS Contractor shall verify the

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ACS conduit has been properly installed by the Electrical Contractor. The following chart defines the maximum 40% fill for all EMT sizes for the project.

	Conduit Size									
	1/2"	3/4"	1"	1-1/4"	1-1/2"	2"	2-1/2"	3"	3-1/2"	4"
Nominal ID:	0.62	0.82	1.05	1.38	1.61	2.07	2.73	3.36	3.83	4.33
31% Fill:	0.09	0.17	0.27	0.46	0.63	1.04	1.82	2.74	3.58	4.57
40% Fill:	0.12	0.21	0.35	0.60	0.81	1.34	2.34	3.54	4.62	5.90
53% Fill:	0.16	0.28	0.46	0.79	1.08	1.78	3.10	4.69	6.12	7.82

- R. Wire Pull Tension - All ACS cabling shall be pulled into place by means of an approved wire-pulling machine and according to the manufacturer's recommended pull tension, specifications to ensure cables are not pulled or stretched beyond their respective pulling tension. The following table lists the absolute maximum recommended pulling tensions for specific conductor sizes. For multi-conductor cables, multiply the appropriate value by the total number of conductors. During installation, the total pulling tension must be equally distributed among all conductors.

Wire Pull Tension Guide	
AWG Gauge	Maximum Pull Tension
24	4 Lbs.
22	7 Lbs.
20	12 Lbs.
18	19 Lbs.
16	30 Lbs.
7	48 Lbs.
12	77 Lbs.

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3.2 ACS TECHNICAL POWER & GROUNDING

- A. Telecommunications Grounding and Bonding shall be executed in accordance with HAS Standards listed in Specification 270526.
- B. The National Electric Code (NEC) for Proposals the installation of communication cables in the same conduit with power cables.
- C. Technical Power and Technical Ground - The Technical Power service and Technical Ground for this ACS System has been designed to follow the National Electric Code (NEC) low-noise, Hospital Grade (HG) Isolated Ground specifications defined in Section 250-75. The NEC low-noise, HG style Isolated Ground design is used in order to obtain an "Equipotential Ground" at all Edison receptacles, duplex outlets, or any circuits to which any audio, video, control, film, or computer device will be connected. Isolation transformers shall be used for all ACS Technical Power requirements.
- D. Technical Ground - The purpose of a technical grounding system is to provide a stable ground reference for all audio and video equipment in this system. This technical grounding will insure the entire systems specified herein will be free from ground loops, electrically induced noises, Electro Magnetic Interference (EMI), or Radio Frequency Interference (RFI) present.
- E. Technical Power and Technical Ground Testing - A neutral-to-ground and a neutral-to-signal-reference measurement will be made on each circuit connected to the Technical Power Panelboard. The ACS Contractor will conduct a Technical Power and Technical Ground testing and measurements with the assistance of the ACS Contractor. The results of these tests will be written down and become part of the ACS Contractor's System Documentation Package. The acceptable range for these tests is Zero (0) VAC to .007 VAC Maximum. Anything else indicates the grounding of a device at two or more locations. Electrical Ground loops are unacceptable.

3.3 ACCEPTANCE TESTING

- A. Acceptance Testing Timetable: The ACS Contractor shall coordinate a date and time for testing, calibration, and acceptance testing with the Consultant, or for HAS direct work, the HAS Project Manager.
- B. Acceptance Testing Conditions: In order for ACS system testing to take place, all ACS system equipment must be installed and operating in accordance with the drawings and specifications for **Error! Reference source not found.** Equipment should be tuned, calibrated, with all system software installed, and all system devices operating correctly.
- C. Acceptance Testing Procedure: The ACS Contractor shall test and document the technical performance of all ACS system equipment in order to establish an "As-Built" performance specification set for the **Error! Reference source not found.** All testing shall be performed in accordance with the following:
 - 1. ANSI S1.4-1983 (R2001): Revises American National Standard Specification for Sound Level Meters S1.4 -1971 It conforms as closely as possible to the IEC Standard for Sound Level Meters, Publication 651, First Edition issued in 1979. This revision

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represents a significant improvement over ANSI S1.4 - 1971, particularly in its specifications relating to measurement of transient sound signals.

2. ANSI S1.6-1984 (R2001), Preferred Frequencies, Frequency Levels, and Band Numbers for Acoustical Measurements Defines the preferred frequencies, or nominal band-center frequencies to be used for acoustical measurements. Frequency levels or band numbers are associated with these sets of frequencies and the preferred frequencies are rounded values obtained from those for which the corresponding frequency levels or band numbers are integers
 3. EIA SE 103: Speakers and Sound Equipment
 4. EIA 276: Acceptance Testing of Dynamic Loudspeakers
 5. EIA 310: Cabinets, Racks, Panels, and Associated Equipment
- D. ACS System Calibration: The Consultant or HAS Project Manager will verify the ACS Contractor's system calibration, programming, and test results. The ACS Contractor and the Consultant or the HAS Project Manager will verify the final system tuning, timing and equalization. The Contractor's project manager and lead technician will be present during acceptance testing.
- E. ACS System Acceptance: The ACS Contractor shall demonstrate to the Consultant and/or HAS Project manager that the **Error! Reference source not found. Error! Reference source not found.** is installed according to the specifications and drawings.
- F. Upon completion of acceptance testing and all components have passed there shall be a 30 day burn-in period before substantial completion will be issued.

PART 3 EXECUTION (NOT APPLICABLE), SEE SECTION 275113D.

END OF SECTION 275113E

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SECTION 275113E - EQUIPMENT

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and all City of Houston General Conditions of Contract 2010 Edition, including any and all Supplementary Conditions, and other conditions listed in Section 007000 of the Contract Documents apply to this Section.

PART 2 – SUMMARY

2.1 OVERVIEW

- A. This section describes the equipment necessary for the Airport Communication System as specified for HAS ACC System(s). Provide all material, equipment, and labor required to install a fully functioning system.
- B. All work shall be performed in accordance with Section 275113 for the **Error! Reference source not found.**

PART 3 – DESCRIPTION

3.1 EQUIPMENT SUBSTITUTIONS

- A. Product Substitution: To request an ACS equipment substitution, the ACS Contractor must submit the request in writing as called for under Section 275113C. The ACS Contractor should submit his justification for the proposed substitution to the Consultant along with a copy of the products data sheet. Product substitutions may require the Contractor to provide the proposed equipment to the Consultant for product for equivalency testing. The Consultant in conjunction with the HAS Project Manager will make the final decision for any proposed substitution. Changes to the original design need to be approved by HAS via RFI.

3.2 DISCONTINUED PRODUCTS

- A. Discontinued Products: All equipment listed in Section 275113E shall be new, the most recent factory version, and include all firmware and software upgrades available at the time of installation. In the event a product is discontinued, the replacement model shall be from the same manufacturer to ensure the same performance and functionality of the original unit is provided.

3.3 QUANTITIES

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- A. Quantities provided as part of a Request for Proposal (RFP) or as part of the specification bid forms are provided as a convenience to all parties. However, it is the ACS Contractor's responsibility **TO VERIFY THE EXACT EQUIPMENT QUANTITIES REQUIRED** in order fulfilling the specification before proposing, ordering, or installation. Any errors or omissions in equipment quantities are the sole responsibility of the ACS Contractor.

3.4 ACS EQUIPMENT

Section 275113E contains a listing of various equipment types that are required to build a functioning ACS System. Further, this list contains the devices that are approved for use in a Houston Airport System **ERROR! REFERENCE SOURCE NOT FOUND..** For each device listed as an Approved Device, the manufacturer's name and model are provided. If an or-equal product can provide comparable performance to the HAS Approved Device, while maintaining complete compatibility with the existing HAS ACS System(s), they will be considered as an or-equal.

3.5 ACS SYSTEM OVERVIEW

All Airport Communication Systems installed at a Houston Airport System facilities are networked based solutions. Each ACS system consists of a number of system components that, when properly configured, form a fully functioning Airport Communications System. The typical HAS ACS system includes the following devices from an approved list of manufacturers:

1. A central server or mainframe: This unit shall contain the CPU or Central Microprocessor, hard drive(s), digital record & playback, keyboard, video, and mouse switching (KVM), and associated connectivity. The unit may be a traditional server and/or a multi-slot mainframe/card cage design. Regardless of the design type, it shall have redundant power supplies.
2. A series of managed networking switches.
3. A 10Base-T Twisted Pair to Fiber Optic Transceiver. Note: Refer to networking specs for correct interface.
4. A Modular Power Amplifier Mainframe designed to house Power Amplifier cards.
5. Digital Microphone Stations that are powered over Ethernet.
6. Ambient noise sensing devices for each zone of the ACS system.
7. Each zone shall be equipped with an adequate number of loudspeakers to ensure the dB-SPL of all paging announcements is 10dB above the ambient level.

3.5 APPROVED HOUSTON AIRPORT SYSTEM ACS EQUIPMENT

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AACS1 AMBIENT ANALYSIS CONTROLLER SOFTWARE: The Ambient Analysis Software shall provide control for sound system channel levels in response to ambient or background noise levels. All parameter governing the manner in which the system responds to noise and adjusts the program signal may be individually set for each channel. The Model 625 software package is provided to set up the system, observe and tailor its operation, permanently save the setup parameters, and produce a printed record of them. The system shall operate in real time and shall not be a "sample and hold" system. The system shall include an automatic calibration sequence. All setup, configuration and monitoring controls shall be software based and provide the ability for multiple ambient sensors to be averaged for control of a single channel or for a single sensor to control multiple channels. The sensors shall utilize control signaling and levels that allow cables to be collocated with the speaker cable for cable routing efficiency. The software shall provide have three modes of operation: Automatic Mode – Changes attenuation levels in response to noise levels reported by remote sensors. Slaved Mode: Changes attenuation levels based on remote sensors of an automatic channel. Fixed Mode: Fixed attenuation as set by the computer and / or user. The unit shall meet or exceed the following specifications:

Fixed Mode Channel Attenuation range: _____ 0 - 85 dB
Fixed Mode Channel Attenuation increments: _____ 1/3 dB
Emergency Mode Channel Attenuation range: _____ 0 - 85 dB
Emergency Mode Channel Increment: _____ 1/3 dB
Channel Input Level display (dBV)
Analog: _____ -60 to +20 dBV
Digital: _____ -56 to +29 dBV
Increments: _____ 0.3 dB
Remote Sensor (SPL)
Analog: _____ 50 to 120 dB
Digital: _____ 50 to 130 dB
Increments: _____ 0.3 dB
Computed Attenuation (dB)
Analog: _____ 0 to 90 dB
Digital: _____ 0 to 90 dB
Increments: _____ 0.01 dB
Channel Attenuation (dB)
Analog: _____ 0 to 90 dB
Digital: _____ 0 to 90 dB
Increments: _____ 0.0001 dB
Scaling Constant: _____ 1.0 to 3.0
Increments: _____ 0.1
Feedback Constant: _____ -85 to +85 dB
Increments: _____ 1 dB
Attenuation Offset: _____ -85 to +85 dB
Increments: _____ 1 dB
Channels per rack: _____ 44, Max
Racks per system: _____ 1 to 7
Address range: _____ 0 - 255
Port Range: _____ 0 - 15
Attack Time: _____ 1 to 18900 seconds (5.25 Hours)
Release Time: _____ 1 to 18900 seconds (5.25 hours)

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Attack Window: _____ 0 - 127 dB
Release Limit: _____ 0 - 127 dB
Clock (24 Hour format): __Month, Day, Year, Hours, Minutes, and Seconds

Install new:

IED T9032NS OR APPROVED EQUAL

ACP1 ACS CENTRAL PROCESSOR: The ACS Central Processor shall consist of an ACS Mainframe, a Networking Switch and a KVM. The ACS Mainframe is designed to provide mounting means and connections to the plug-in cards. The unit has 13 usable slots. The card slots are numbered from 1 to 13 with slot 1 being on the left as viewed from the front. Slot 13, the rightmost slot is the only slot in which the Microprocessor Card can be mounted. The Microprocessor Card requires ± 12 VDC. All other cards in the system operate on ± 15 VDC. The remaining slots can be filled with the following card types: Hard Drive, Digital Record/Playback, Microphone Station Interface, Zone Output, and Relay.

The eight port networking switch can be used to form a peer-to-peer 10Base-T network with up to 8 users. The unit shall have a data rate of 10/100/1000 Mbps. The unit shall use Category 5 or better cabling. The unit shall have Star topology. The unit shall have the following speeds per port: Half Duplex: 10Mbps or 100Mbps; Full Duplex: 20Mbps or 200Mbps; Gigabit Port: 1000 Mbps or 2000 Mbps. The unit shall have LED indicators for the following functions: Power, 1000, 10/100, FD/Col, Link/Act, Full/Half Duplex, 1000 Link Act, 1000 FD/Col. The unit shall require 3.3VDC, 5A power. The unit shall have dimensions 1.88"H x 7.31"W x 6.6"D (48mm x 186mm x 154mm) and weigh 13.6oz (0.39kg). The unit shall have an operating temperature range of 32F-122F (0C-50C).

The KVM shall permit control of four computers with a single keyboard and monitor (and mouse, if used). Computer selection can be made by keyboard or button on the unit. The unit shall support VGA, SVGA, MultiSync video modes. The unit shall have 1 ready status LED indicator and 4 port status LED indicators. The unit shall require 9VDC, 450mA power. The unit shall have the following connections: Keyboard: 5-pin DIN Female input to Female output; Monitor: 15-pin Sub D Female input to Male output; Mouse: 9-pin Sub D Male input to Female output. The unit dimensions shall be: 10" L x 7.1"W x 3.2"H (25.4cm L x 18cm W x 8.2cm H) and weigh 6.51lb (2.96 kg). Install new:

IED 510ACS OR APPROVED EQUAL

ACP1PS1 ACS CENTRAL PROCESSOR POWER SUPPLY TYPE 1: The ACS power supply shall supply +5 VDC at 20 A with an input voltage range is 105 VAC to 130 VAC to the Announcement Control System. The unit shall have two LED indicators, one of which shall display the power supply load, the other of which shall display the power supply status. The unit shall have an on-board microcontroller allows the main microprocessor to have access to on-board information and control. The on-board microcontroller enables the microprocessor to switch the supply On and Off by use of a relay on the mother board. It allows the microprocessor to adjust the output voltage. The microprocessor can measure the heat sink temperature of the supply and check the status of the output fuse. The microcontroller also drives the status LED on the front panel.

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The unit shall have dimensions: Height: (17.8 cm) 7.0", Width: (4.87 cm) 1.92", Depth: (23.2 cm) 9.15", and Weight: (623 gm) 1.37 lb. Install new:

IED 405L OR APPROVED EQUAL

ACP1PS2 ACS CENTRAL PROCESSOR POWER SUPPLY TYPE 2: The ACS power supply shall supply ± 15 VDC at 6 A with an input voltage range is 105 VAC to 130 VAC to the Announcement Control System. The unit shall have two LED indicators, one of which shall display the power supply load, the other of which shall display the power supply status. The unit shall have an on-board microcontroller allows the main microprocessor to have access to on-board information and control. The on-board microcontroller enables the microprocessor to switch the supply On and Off by use of a relay on the mother board. It allows the microprocessor to adjust the output voltage. The microprocessor can measure the heat sink temperature of the supply and check the status of the +15 V output fuse. The microcontroller also drives the status LED on the front panel. The unit shall have dimensions: Height: (17.8 cm) 7.0", Width: (4.87 cm) 1.92", Depth: (23.2 cm) 9.15", and Weight: (623 gm) 1.37 lb. Install new:

IED 415L OR APPROVED EQUAL

ACPU1 ACS CENTRAL PROCESSING UNIT: The ACS CPU shall be one of the plug-in cards that make up the Announcement Control System. The unit shall: Control the microphone stations through the input and network cards; Manage audio routing by controlling the input, network, and output cards; Energize/de-energize relays on the routing card(s); Manage Record/Playback on the routing card(s); Manage non-volatile storage including ACS configuration data and digital audio which shall be loaded from the on-board hard drive to/from the routing card; Communicate with the Rack Mount Computer through its Ethernet port. The unit shall occupy one card slot and plug into the terminal strip which mounts on the rear of the Mainframe. Install new:

IED 510CPU OR APPROVED EQUAL

ADRP1 ACS DRP: The ACS DRP shall be an 8-Channel Digital Record/Playback card with up to 131 seconds of recording time per channel. There shall not be a time limit on live announcements or prerecorded messages. The unit shall be capable of playing 8 announcements or messages simultaneously. Prerecorded messages shall be capable of being played on any of the eight output channels. The unit shall mount in the ACS Mainframe through which it shall also receive power. The unit shall receive audio signals from the input card via a 20-conductor ribbon cable. Background music and 20 kHz test tones shall be introduced through the Interface Card mounted on the rear of the mainframe. The audio signals shall be digitized and stored in DRAM. The unit shall include an audio detector circuit which causes an announcement to be terminated and deleted if no audio is detected for 5 seconds. If the message is ended normally (microphone or announce switch released), it shall be played back under CPU (Central Processing Unit) control. When an announcement or message is played back, the digitized signal shall be converted back to analog format and is output through a 20-pin ribbon cable which connects to the output card. If a message is to be stored permanently, it shall be transmitted to the Hard Drive Card or the Processor Card in digital format via a bidirectional

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parallel port through a 26-conductor ribbon cable. Conversely, permanent messages shall be retrieved from the hard drive in digital form through the parallel port, converted to analog, and are output to the output Card. Instructions from the CPU of the ACS shall be sent to the routing card where they are received and interpreted by the local MPU (Micro Processor Unit). The normal sampling rate shall be 16 kHz which results in a 7.2 kHz bandwidth, but it shall be capable of being increased up to 48 kHz resulting in a 21.6 kHz bandwidth. Digital processing and storage shall be performed in 16-bit mode. Each of the 8 channels shall have an input gain of 0 - 22.5 dB adjustable in 1.5 dB steps. Each of the 8 channels shall have an output attenuation of 0 - 94.5 dB adjustable in 1.5 dB steps. Gain and attenuation control shall be adjusted under software control. There shall be 8 tricolor LED's mounted on the front edge of the card, one per channel. When the channel is being used to record or load, its LED shall be red. When the channel is playing back or saving to the Hard Drive card, the LED shall be green. When in bypass mode (passing through a live announcement) the LED shall be yellow. There are two additional LED's mounted on the front edge of the routing card. A green LED shall indicate that the local processor (MPU) is running. A red LED shall light when the MPU is reset. Reset shall be accomplished, when necessary, by a front mounted momentary push switch. Install new:

IED 500R OR APPROVED EQUAL

AGS1 ACS GIGABIT NETWORK SWITCH: The ACS Gigabit Network switch shall have 48 autosensing 10/100/1000BASE-T ports and 4 small form-factor pluggable (SFP) ports, providing a total of 52 Gigabit Ethernet ports. The 4 SFP ports shall be wire-speed, and the 48 10/100/1000BASE-T ports shall be capable of bursting to Gigabit Ethernet line rate and sharing 12 Gbps of capacity (or 6 Gbps full-duplex) into the switching fabric. All ports shall use Gigabit Ethernet or IEEE 802.3ad for high-speed interconnection applications. All ports shall use the standard IEEE 802.3x flow control (PAUSE frame) mechanism to control Gigabit Ethernet host traffic. Install new:

CISCO CATALYST 3750 OR APPROVED EQUAL

AIC1 ACS INPUT CARD: The ACS Input Card shall be one of the plug-in cards that make up the ACS System. It shall perform all functions necessary to interface 8 remotely located IED microphone stations or telephone interfaces to the ACS System. These functions consist of: Directing the audio from the microphone stations to the appropriate internal audio buses as determined by the software; Supplying short circuit protected +30 VDC for phantom powering of its microphone stations; Addressing and decoding as required for the microprocessor card; Individually reading and controlling all functions of its microphone stations; Buffering, isolating, and routing the up to 8 audio signals, each through one of eight 1 x 8 solid state switches to 8 internal audio buses; Indication of microphone station status and activity via 8 green and 8 red LED's. Each card shall have 9 green and 8 red LED's, one of each for each channel through which a microphone station may be served. One green LED shall indicate the internal phantom power supply is functioning. A red LED lit shall mean that the input to that channel is enabled in software, but that there is faulty or no communication with the microphone station. A green LED solidly lit shall mean that the microphone station connected to that input is currently in use. If neither LED is lit the indication shall be that the microphone station has been designated as unused (not enabled) by the software. A rapidly flashing green LED shall mean that the input is

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enabled in software, but not currently in use. The input card shall be designed to plug into the ACS Mainframe using 2 card edge connectors. The 80 pin upper connector, which shall be mounted on the mainframe mother board, shall be used for connections to the microprocessor bus and to the DC power supplies. The 60 pin lower connector shall be mounted on the Microphone Interface Terminal Strip which is part of the ACS Mainframe. It shall accept microphone station audio and control cables through its compression type screw terminal connectors. The control cable shall carry digital control information to and from the microphone station superimposed on the +30 VDC from the ACS. Control data shall be transferred at a 19.2 kBaud rate. Install new:

IED 500C OR APPROVED EQUAL

ANC1 ACS NETWORK CARD: The ACS Dynamic Audio Network Card shall be one of the plug-in cards that make up the ACS System. It provides all the functions necessary to interface up to 192 Digital Microphone Stations over an Ethernet network. It also provides digital audio linking between ACS Systems over Ethernet. The unit shall send and receive digital audio over Ethernet. The unit shall have two RJ45 connections to allow for the use of redundant Ethernet networks. The unit shall also contain two auxiliary inputs and outputs for additional functionality. Each card shall have two sets of eight LED's to provide a visual indication of the status of the audio bus inputs and audio bus outputs. Two sets of LED's shall be provided to indicate the link status and activity of the primary and secondary Ethernet audio ports. The card shall also contain a status indicator LED and a reset switch. The unit is designed to plug into the ACS Mainframe using two card edge connectors. The unit shall have an 80 pin upper connector, which is mounted on the mainframe mother board, to be used for connections to the microprocessor bus and to the DC power supplies. The 60 pin lower connector shall be mounted on the Network Interface Terminal Board which is part of the ACS Mainframe. It shall accept two RJ45 connections for connection to the primary and secondary audio networks. It shall accept connections to the two auxiliary inputs and outputs through removable compression type screw terminal connectors. The card shall contain two 20-pin ribbon cable connectors. The upper connector shall interface with the 8 buses that send audio to the DRP card. The lower connector shall interface with the 8 busses that receive audio from the DRP card. The unit shall have low latency (less than 10 ms), and operate over Ethernet (100BASE-T). It shall use a sample rate of 48 kHz, with a word length of 16 bits. Install new:

IED 510N OR APPROVED EQUAL

AOC1 ACS OUTPUT CARD: The ACS Zone Output Card shall be one of the plug-in components of the Announcement Control System. Its primary function shall be to distribute the audio from the internal audio buses to the system outputs (zones) under computer control, allowing software to select any signal from any one of the 8 internal audio buses to be directed to any output at any given time. The unit shall also have provisions for independent remote control of the background music levels of the eight zones by use of eight VCA's on the card. The VCA's shall also provide 20 dB of automatic ducking of the background music during any announcement or message. The unit shall be designed to plug into the ACS Mainframe using 2 card edge connectors. The 80 pin upper connector, which is mounted on the mainframe mother board, shall connect the unit to the microprocessor bus and the DC power supplies. The 60 pin lower connector shall be mounted on the Zone Output Terminal Board which mounts on the rear of

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the mainframe. The compression-type screw terminal connectors which allow the unit to be connected to the 8 zones shall be mounted on the Zone Output Terminal Board. Two modes shall be provided for background music feed. One mode shall utilize the background music bus and feeds the same signal to all zones. The other shall permit the introduction of individual background music feeds to each zone. The mode shall be selected by plug-in SIP resistor networks or individual resistors. In either case, a background music level control shall be provided for each zone. The unit shall also distribute test tones to all zones. There shall be 8 green LED's which indicate the zone activity of the card. They shall be mounted on the front edge and shall be visible when the card is in place. When a zone is being used for an announcement or message, its LED shall be lit. Card address selection shall be accomplished by use of an eight position DIP switch near the top of the card. An additive binary (powers of 2) code shall be used. Each position shall be numbered on the printed circuit board with its value. The card address shall be the sum of the values of all positions in which jumpers have been placed. With this arrangement there shall be 128 possible addresses (0 through 127). Install new:

IED 500D OR APPROVED EQUAL

ALVIO1 AMPLIFIER LOGIC-VOLTAGE I/O COLLECTOR – The Logic I/O collector shall provide (32) ports for interfacing logic or voltage signals into the system. The 32 ports can be configured as inputs or outputs, and they can be configured for logic or voltage. However, the configuration options must be consistent in each of the banks of eight ports. For example, configuration options include: 16 logic inputs X 16 logic outputs, 8 voltage inputs X 24 voltage outputs, etc. The unit shall mount in a 19-inch equipment rack/cabinet, taking up only 1 rack unit (RU), or 1.75" of vertical space. Connection to the system shall be via a 100BaseT Ethernet port. The collector shall be configurable in banks of (8) channels for logic inputs, logic outputs, voltage inputs, or voltage outputs. The inputs shall be designed to handle up to 24V for logic signaling and shall measure input voltages in the 0-10V range. It shall be software selectable as to whether inputs are treated / reported as logic states or voltage values. The collector shall be powered through the PoE Ethernet Port or with an optional modular power supply. The unit shall weigh 7 lbs (3.2kg). The unit shall operate within a temperature range of 32F to 122F (0 to 50C). Install new:

IED T9032LVIO OR APPROVED EQUAL

AMF1 AMPLIFIER MAINFRAME: The Integrated Power Amplifier Mainframes shall be designed to house, supply power to, and cool up to nine power amplifier cards. In addition, the mainframes shall provide digital audio network connections, utilizing digital audio network technology, to an audio network controller. Local program or background music (BGM) inputs connect via analog connections. The mainframe's nine power amplifier card slots shall be configured for eight main amplifier cards to drive loudspeaker circuits and one backup amplifier card to serve as a hot standby/backup amplifier. The mainframes shall also automatically switch to the backup amplifier as necessary. Digital Signal Processing on each of 16 incoming signals shall include functions such as input level controls, paging routing, automatic ducking of BGM audio, equalization (up to 9 parametric bands per amplifier channel), signal delay, and technology for ambient analysis based automatic level control. Monitor/test functions shall also be included inside of the Mainframe System. The system shall provide the built-in amplifier test,

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loudspeaker line test, and ground fault detection, and these tests are all accomplished inside of the Mainframe with no external test circuit wiring required. Several models of power amplifier cards shall be able to be put into the mainframe including single channel or dual channel configurations, and loudspeaker driving options of 4 Ohm, 8 Ohm, 70 Volt distributed and 100 Volt distributed. Each amplifier card shall be capable of supplying 400 Watts of continuous power to its designed load type, which means there will be either 200 or 400 Watts per channel depending on the amplifier card type. So, a full frame is capable of driving 16 channels of 200 Watts or 3200 Watts total. The reference mainframe requires 6-rack units (or 10.5" of vertical space in a 19" equipment rack/cabinet. All cooling shall be back to front. Local program or background music inputs shall be provided on the back via plug-in lugless compression-type screw terminals. Loudspeaker connections are made via larger scale terminals of the same type. The power amplifier cards shall slide in from the front and have individual power switches on the front along with power and signal presence LED's. The Mainframes shall be compatible with optional ambient noise collector units that are used to bring in ambient sensor readings for various ACS system zones back to the mainframe. The unit shall include the optional Monitor/Test Collector for additional monitor/test points. These add-on options shall be linked via the Ethernet connection. Audio signals shall come into the Mainframe either via the local analog program connections or via the Ethernet connection utilizing a digital audio network technology. Network audio shall be controlled over two 100Base-T modular-8 networks with RJ-45 connectors. There shall be level controls for 16 Program, 16 BGM, and 16 Overall Channel Levels. Full output AC power requirement shall be approximately 4,115 Watts. The unit shall have 9-bands of digital parametric EQ per channel. The unit shall have a digital signal delay range of 0 to 2 Seconds in 1 m-sec steps. The unit shall have ambient analysis and provide for a minimum of for up to four ambient sensors per channel. The unit shall have automated multi-frequency and 20 kHz testing of all channels, amplifiers and speaker line current load plus ground fault detection of all speaker lines automatic or slaved modes. The unit shall have the capability to listen to any test point plus additional monitor-only points in the mainframe locally or via the network at another location. All of the following specifications apply with program input via the network (digital audio network), or with direct inputs to the power amplifier:

Frequency Response: _____ ± 0.2 dB 20 Hz - 20 kHz
Total Harmonic Distortion: _____ $< 0.01\%$ 20 Hz - 20 kHz
Signal-to-Noise Ratio: _____ > 93 dB 22 Hz - 22 kHz, weighted
Maximum Input: _____ +14 dBu
Maximum Output: _____ +14 dBu
Gain
 Via the network: _____ Unity
 Direct Input: _____ 25 dB, Max
 Background Music: _____ 25 dB, Max
Analog-to-Digital Converter, A/D: _____ 24 bit
Digital-to-Analog Converter, D/A: _____ 24 bit
Internal processing: _____ 32-bit, floating point
Sample Rate: _____ 48 k
Latency: _____ < 1 ms
Crosstalk: _____ below -75 dB @ $f = 2$ kHz
Backup Amplifier Switching Time: _____ < 4 Seconds

Install new:

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IED TITAN 9160L MAINFRAME OR APPROVED EQUAL

AML1 AMPLIFIER MODULE LINE-LEVEL MODULE: The unit shall be a stereo line-level module designed to interface with the digital Integrated Power Amplifier Mainframe or in the analog Power Amplifier Mainframe. Any card may be placed in any slot in the main frames with out any configuration settings needing to be made on the amplifier cards. The Line-Level Amplifier Module is a member of the Titan® Series Digital Distribution System and design to provide signals to remotely located power amplifiers or self-powered loudspeakers. The unit shall have two low impedance balanced floating active outputs to drive very long +4 lines. In addition, the unit shall have transformerless outputs to provide wider bandwidth while minimizing distortion at all frequencies. The stereo line-level module can be operated digital Integrated Power Amplifier Mainframe or in the analog Power Amplifier Mainframe.

IED T6002L/H OR APPROVED EQUAL

AMM1 AMPLIFIER MODULE MONO: The unit shall be a Class D (switching mode) single channel 400W amplifier into 8 Ohms. The amplifier shall be used in the digital Integrated Power Amplifier Mainframe or in the analog Power Amplifier Mainframe. Any card may be placed in any slot in the main frames with out any configuration settings needing to be made on the amplifier cards. The amplifier card shall have 32 dB of input gain and no attenuation controls onboard. Attenuation shall be handled ahead of the power amplifier by electronics or controls on the amplifier main frames. The power amplifier shall have built-in voltage limiting to protect the loudspeakers being driven. In addition, a temperature sensor on the heat sink shall automatically shut down an amplifier that be comes too hot, such as due to cooling fan block age or failure, so as to protect the electronics. In the amplifier main frame application, the temperature and other status conditions of the power amplifier shall be reported back to the digital controller in the IED main frame for reporting to a user, generation of alarm conditions or for automatic throttling of input signals to try to keep the amplifier operating within safe limits. The amplifier card shall have 3 LED's located on its front edge. There shall be one green LED for the card plus one multi-color LED per channel. The green LED when lit steadily, shall represent that the amplifier is powered up. The channel LED shall be yellow to represent output signal presence of the amplifiers. The signal presence indicator shall turn on when 1 Watt is detected on the amplifier output. This same LED shall change to red to indicate when the voltage limit has been reached on that channel. There shall be a switch on the front of the power amplifier to turn it off with out taking the whole frame down. This may be used for example, to remove/replace an amplifier with out affecting any other channels in the frame. The unit shall provide +24V through current limiting resistors for operation of the fans in the rear of the main frame. Install new:

IED 6481 OR APPROVED EQUAL

AMS1 AMPLIFIER MODULE STEREO: The unit shall be a Class D (switching mode) dual channel 200W amplifier into 8 Ohms. The amplifier shall be used in the digital Integrated Power Amplifier Mainframe or in the analog Power Amplifier Mainframe. Any card may be placed in any slot in the main frames with out any configuration settings needing to be made on the amplifier cards. The amplifier card shall have 29 dB of input gain and no attenuation controls onboard. Attenuation shall be handled ahead of the power amplifier by electronics or controls

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on the amplifier main frames. The power amplifier shall have built-in voltage limiting to protect the loudspeakers being driven. In addition, a temperature sensor on the heat sink shall automatically shut down an amplifier that becomes too hot, such as due to cooling fan blockage or failure, so as to protect the electronics. In the amplifier main frame application, the temperature and other status conditions of the power amplifier shall be reported back to the digital controller in the IED main frame for reporting to a user, generation of alarm conditions or for automatic throttling of input signals to try to keep the amplifier operating within safe limits. The amplifier card shall have 3 LED's located on its front edge. There shall be one green LED for the card plus one multi-color LED per channel. The green LED when lit steadily, shall represent that the amplifier is powered up. The channel LED shall be yellow to represent output signal presence of the amplifiers. The signal presence indicator shall turn on when 1 Watt is detected on the amplifier output. This same LED shall change to red to indicate when the voltage limit has been reached on that channel. There shall be a switch on the front of the power amplifier to turn it off without taking the whole frame down. This may be used for example, to remove/replace an amplifier without affecting any other channels in the frame. The unit shall provide +24V through current limiting resistors for operation of the fans in the rear of the main frame. Install new:

IED 6482 OR APPROVED EQUAL

ANSC1 AMBIENT NOISE SENSOR COLLECTOR: The ambient analysis sensor collector shall accept inputs from the ambient analysis sensors, process their data, and transmit the data to the appropriate amplifier system. Connection to the system shall be via a 100BaseT Ethernet port. The collector shall be rack mounted in 1RU and accept inputs from up to 32 ambient noise sensors. The collector shall be powered through the PoE Ethernet Port or with an optional modular power supply. The unit shall use the IEEE 802.3x standard for Full-Duplex Operations, the IEEE 802.3u standard for Fast Ethernet, 100Mbps, and the IEEE 802.3af standard for Data Terminal Equipment Power via Media Dependent Interface (PoE). The unit shall have Modular 8 (RJ-45) connectors for Ethernet connectivity. The unit shall require 10 W for fully loaded operation. The unit shall weigh 7 lbs (3.2kg). The unit shall operate within a temperature range of 32F to 122F (0 to 50C). Install new:

IED T9032NS OR APPROVED EQUAL

ANSM1 AMBIENT NOISE SENSOR MICROPHONE: The Ambient Analysis Sensors shall detect ambient noise levels in respective speaker zones. Noise levels shall be processed using an A-weighted curve and converted to a DC waveform for transmission to the Ambient Analysis Sensor Collector. The sensor shall consist of an omnidirectional condenser microphone, a preamplifier, and an analog conversion module. The analog conversion module shall convert the audio signal to a varying DC waveform for use by the system. Install new:

IED 540S OR APPROVED EQUAL

APS1 ACS POWER SUPPLY: The ACS shall be powered with redundant power supplies. Power supply cards shall be housed in the modular mainframe and allow power supplies to be replaced without interrupting system operation. Each power supply module shall include a line

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power or auto-off switching. The power supplies shall be load-sharing and, in the event of a failure, the remaining supply shall power the system. The unit shall provide failure notification via the network interface. Install new:

IED 510PU OR APPROVED EQUAL

ARC1 ACS RELAY CARD: The ACS Relay Card shall be one of the plug-in components of the Announcement Control System. Its primary function shall be to provide contact closures under computer control. Zone assignments are made the same as for the **AOC1**. When audio is detected for a zone, the corresponding relay shall be activated. The unit shall be designed to plug into the ACS Mainframe using 2 card edge connectors. The 80 pin upper connector, which shall be mounted on the mainframe motherboard, shall connect the unit to the microprocessor bus and the DC power supplies. The 60 pin lower connector shall be mounted on the Zone Output Terminal Board which shall be mounted on the rear of the mainframe. The compression-type screw terminal connectors, which allow the relay contacts to be connected to their loads, shall be mounted on the unit. Each relay card shall have 8 relays. The relays shall have Form C, SPDT contacts. There shall be three contact options which are selected at the factory. They shall be: 1) Form C with the Common grounded (standard), 2) SPST, normally open, floating, and 3) SPST normally closed, floating. There shall be 8 green LED's on each relay card which indicate relay activation. They shall be mounted on the front edge and are visible when the card is in place. The relays shall be assigned as additional zones. When an announcement or message is being made, the relays for any assigned zones shall be energized, and their LED's shall be lit. Card address selection shall be accomplished by use of a seven position (14 pin) array located near the 60 pin lower card edge connector. An additive binary (powers of 2) code shall be used. Each position shall be numbered on the printed circuit board with its value. The card address shall be the sum of the values of all positions in which jumpers have been placed. With this arrangement there are 128 possible addresses (0 through 127). Install new:

IED 500DR OR APPROVED EQUAL

DMS1 DIGITAL MICROPHONE STATION TYPE 1: Full function horizontal flush-mount communication stations shall have a 12-button keypad for data entry, (8) soft function keys and a color graphical LCD. The station shall be a network appliance with control communicating on the digital audio network. The unit shall be a network appliance with its own unique IP address. Connection to the system shall be 100BaseT with power provided by a PoE switch port or PoE mid span power. Microphones shall be provided as handheld or gooseneck as required. Each microphone shall utilize a magnetic mount and include a line amplifier in the microphone shell to eliminate microphone signal levels beyond the microphones. Each station shall support the connection of up to three remote stations. Stations shall be provided in vertical, horizontal, surface, flush, or desktop as noted on the drawings and based on the mounting situation required. The unit shall use the IEEE 802.3x standard for Full-Duplex Operations, the IEEE 802.3u standard for Fast Ethernet, 100Mbps, and the IEEE 802.3af standard for Data Terminal Equipment Power via Media Dependent Interface (PoE). The unit shall have an operating temperature of 32F to 104F. Install new:

IED 528HFM-H OR APPROVED EQUAL

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DMS2 DIGITAL MICROPHONE STATION TYPE 2 Full function vertical flush-mount communication stations shall have a 12-button keypad for data entry, (8) soft function keys and a color graphical LCD. The station shall be a network appliance with control communicating on the digital audio network. The unit shall be a network appliance with its own unique IP address. Connection to the system shall be 100BaseT with power provided by a PoE switch port or PoE mid span power. Microphones shall be provided as handheld or gooseneck as required. Each microphone shall utilize a magnetic mount and include a line amplifier in the microphone shell to eliminate microphone signal levels beyond the microphones. Each station shall support the connection of up to three remote stations. Stations shall be provided in vertical, horizontal, surface, flush, or desktop as noted on the drawings and based on the mounting situation required. The unit shall use the IEEE 802.3x standard for Full-Duplex Operations, the IEEE 802.3u standard for Fast Ethernet, 100Mbps, and the IEEE 802.3af standard for Data Terminal Equipment Power via Media Dependent Interface (PoE). The unit shall have an operating temperature of 32F to 104F. Install new:

IED 528VFM-H OR APPROVED EQUAL

DMS3 DIGITAL MICROPHONE STATION TYPE 3: Rack Communication Stations shall have a 12-button keypad for data entry, (8) soft function keys and a color graphical LCD. The station shall be a network appliance with control communicating on the digital audio network. The unit shall be a network appliance with its own unique IP address. Connection to the system shall be 100BaseT with power provided by a PoE switch port or PoE mid span power. Microphones shall be provided as handheld or gooseneck as required. Each microphone shall utilize a magnetic mount and include a line amplifier in the microphone shell to eliminate microphone signal levels beyond the microphones. The unit shall use the IEEE 802.3x standard for Full-Duplex Operations, the IEEE 802.3u standard for Fast Ethernet, 100Mbps, and the IEEE 802.3af standard for Data Terminal Equipment Power via Media Dependent Interface (PoE). The unit shall have an operating temperature of 32F to 104F. The station shall include a flush speaker for monitoring selected audio. The speaker shall be powered by an 8-watt power amplifier and include a panel volume control. The station shall use no more than 4 standard rack units. Install new:

IED 528SRM-H OR APPROVED EQUAL

DMSA1 DIGITAL MICROPHONE STATION ENCLOSURES: For station mounting locations requiring desktop, angled vertical, or angled horizontal, provide factory enclosures to match the finish of the station. Enclosures shall be non-metallic and include rubber feet. Install new:

IED 528VBB OR 528HBB OR APPROVED EQUAL

DMSA2 EXPANSION DIGITAL MICROPHONE STATION: Expansion stations shall act as an intelligent slave station to a full function station. Expansion stations shall include (4) soft function keys that can be programmed for operations independent of the master station to which it is connected. This shall allow flight announcements and other cued messages to be controlled from the expansion location. Microphones shall be provided as handheld and include a line amplifier in the microphone shell to eliminate microphone signal levels beyond the microphone.

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The station shall mount in a standard 2-gang wall box and connect to the full function station with Cat5e cable and RJ45 modular connectors. Install new:

IED 528SK OR APPROVED EQUAL

- EOL1 END OF SPEAKER LINE DETECTOR:** The End of Line Module shall work in conjunction with the testing system to provide detection of speaker line faults. The unit shall augment automatic testing of 70 Volt and 100 Volt constant voltage speaker lines. The unit shall allow testing continuity of speaker wiring all the way to the end of the line with out the need and expense of a return wire from the line end. When used with the 20 kHz test of a Monitor/Test system, the unit shall enable testing the integrity of the speaker lines of any balanced audio amplifier in the range of 100 W to 400 W. Install at the last speaker of each speaker zone. Install new:

IED 596EOL OR APPROVED EQUAL

- ISS1 INFRASTRUCTURE - 70V SPEAKER CABLE:** Provide a UL Listed 12AWG speaker cable (for runs over 1,000 feet) or a 14 AWG speaker cable (for runs less than 1,000 feet) that meets Article 725 (UL 444 for plenum applications) cable. Cable shall be tinned copper with PVC insulation and a PVC jacket. Install new:

BELDEN OR WEST PENN WIRE OR APPROVED EQUAL

- ISS2 INFRASTRUCTURE - FIBER OPTIC CABLE:** Fiber Optic Cable shall be 62.5/125 um multi-mode fiber optic cable or 9/125 single-mode fiber optic cable as recommended by the system manufacturer. Cable and installation shall meet all requirements of TIA/EIA 569B and 568-B.3. Install new:

REFERENCE HAS SPECIFICATION 271300 & 271500

- ISS3 INFRASTRUCTURE - AMBIENT SENSOR CABLE:** Provide a UL Listed cable that meets Article 725 (UL 444 for plenum applications) cable. Cable shall be shielded twisted pair with 22 AWG tinned-copper conductors, low-loss polyethylene insulation and a 22 AWG stranded tinned copper drain wire. Install new:

BELDEN 8451 OR APPROVED EQUAL

- ISS4 INFRASTRUCTURE - RMS CABLE:** Provide a twisted pair cable. The cable shall be a 20AWG design and interface with the Weldmuller 2-Conductor locking connector. Install new:

BELDEN 8205 OR APPROVED EQUAL

- MC1 MULTIPURPOSE COLLECTOR:** The Multipurpose Collector shall provide connections for (16) ambient noise sensors, (16) Logic/Voltage I/O's, and (8) Relays. Connection to the system shall

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be via a 100BaseT Ethernet port. The collector shall be powered through the PoE Ethernet Port or with an optional modular power supply. The unit shall provide the power required by the ambient noise sensors and shall collect samples and readings from the samples several times per second and send the readings to the Mainframe unit. The Logic/Voltage I/O ports may be configured for logic or voltage and can be configured for input or output. However the configuration options must be consistent in each of the two banks of 8 ports. The unit shall also have software selectable pull up/down resistors on the inputs to allow it to handle different logic type systems such as voltage signaling, current sink and open-collector signaling. This setting is configurable for each bank of 8 inputs. The unit shall use the IEEE 802.3x standard for Full-Duplex Operations, the IEEE 802.3u standard for Fast Ethernet, 100Mbps, and the IEEE 802.3af standard for Data Terminal Equipment Power via Media Dependent Interface (PoE). The unit shall have Modular 8 (RJ-45) connectors for Ethernet connectivity. The unit shall mount in a 19-inch equipment rack/cabinet, taking up only 1 rack unit (RU), or 1.75" of vertical space. The unit shall weigh 7 lbs (3.2kg). The unit shall operate within a temperature range of 32F to 122F (0 to 50C). Install new:

IED T9040NLR OR APPROVED EQUAL

MTP1 MONITOR/TEST POINT COLLECTOR: The Monitor/Test Point Collector shall collect (32) external test points and route the audio back to a DSP or Mainframe for processing. Connection to the system shall be via a 100BaseT Ethernet port. The collector shall be powered through the PoE Ethernet Port or with an optional modular power supply. The unit shall use the IEEE 802.3x standard for Full-Duplex Operations, the IEEE 802.3u standard for Fast Ethernet, 100Mbps, and the IEEE 802.3af standard for Data Terminal Equipment Power via Media Dependent Interface (PoE). The unit shall have Modular 8 (RJ-45) connectors for Ethernet connectivity. The unit shall mount in a 19-inch equipment rack/cabinet, taking up only 1 rack unit (RU), or 1.75" of vertical space. The unit shall weigh 7 lbs (3.2kg). The unit shall operate within a temperature range of 32F to 122F (0 to 50C). Install new:

IED T9032MT OR APPROVED EQUAL

RC1 RELAY COLLECTOR: Relay Collector shall provide (16) software controlled form C relays. The unit shall used for general purpose applications such as zone output switching to override volume controls in paging zones or zone output relays to trigger external lights and strobes. Connection to the system shall be via a 100BaseT Ethernet port. The collector shall be powered through the PoE Ethernet Port or with an optional modular power supply. The unit shall mount in a 19-inch equipment rack/cabinet, taking up only 1 rack unit (RU), or 1.75" of vertical space. The unit shall weigh 6.9 lbs (3.13kg). The unit shall operate within a temperature range of 32F to 122F (0 to 50C). Install new:

IED T9016RY OR APPROVED EQUAL

RMS1 RMS SOFTWARE & RMS SYSTEM SWITCHES: Provide software that operates the remote monitoring system. The Software will be installed in a computer located in the HAS offices and monitoring will occur via the Ethernet. Provide all necessary switches for the remote monitoring system including the Twisted-Pair to Cat5 switch and a 48 Port with PoE and rack mount

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hardware. The Exact model of the switch will be provided by HAS to the PA Contractor. Install new:

MEYER SOUND LABORATORIES RMS SOFTWARE

CISCO 48 PORT WITH POE SWITCH AND RACK MOUNTING HARDWARE

ILON 10 TWISTED PAIR SWITCH

- S1 LOUDSPEAKER TYPE S1:** The loudspeaker shall be of in-ceiling design, consisting of a 100 mm (4 in) low frequency transducer, a coaxially-mounted 19 mm ($\frac{3}{4}$ in) high frequency transducer, and frequency dividing network installed in a ported enclosure. The low frequency voice coil shall be 25 mm (1 in) in diameter and the coil former shall be of aluminum for maximum heat dissipation. Performance specifications of a typical production unit shall be as follows: Measured sensitivity (SPL at 1m [3.3ft] with 4V input, averaged from 100 Hz to 10 kHz) shall be at least 86 dB-SPL. Usable frequency response shall extend from 80 Hz to 20 kHz (10 dB below rated sensitivity in half-space) with no external equalization. Rated power shall be at least 40 watts continuous pink noise power, defined as conforming to international standard IEC268-5 (shaped pink noise with peak-to-average ratio of 6 dB) for a period of 100 continuous hours. The high frequency transducer shall be horn-loaded to more evenly cover a minimum 130° polar conical coverage area. The loudspeaker back can shall be constructed of formed steel and the baffle of UL94V-0 fire rated medium impact polystyrene. An enclosed terminal box shall be included providing strain relief for use with either plenum-rated wire, $\frac{1}{2}$ in (13 mm inside diameter) conduit, or flexible conduit up to 22 mm ($\frac{7}{8}$ in) outside diameter. The external wiring shall be accomplished via a removable lockable wiring connector with screw-down terminals to provide both secure wire termination and prewiring capability before loudspeaker installation. An attachment loop shall be provided on the back panel for cabling to building structure as a secondary support point. The system shall include a support backing plate to reinforce the ceiling material and tile support rails for use on either 2 x 4 ft or 600 x 1200 mm suspended ceiling tiles and which can all be installed from beneath the ceiling tile. Overall front face diameter shall not exceed 195 mm (7.7 in); overall depth from the bottom of the ceiling shall not exceed 183 mm (7.2 in), and shall weigh no more than 2.7 kg (6 lb). The loudspeaker shall be equipped with transformer for use in either 70.7 or 100V distributed-line speaker systems, with taps selectable by rotary switch located on the front panel so that the speaker does not have to be removed to adjust tap settings. Taps shall be nominally 30W @ 70V, 15W @ 70V (30W @ 100V), 7.5W @ 70V (15W @ 100V), and 3.7W @ 70V (7.5W @ 100V). Install new:

JBL MODEL CONTROL 24CT.WITH OPTIONAL MTC-NC19 NEW CONSTRUCTION BRACKET OR MTC-19MR PLASTER RING CONSTRUCTION AS REQUIRED.

- S2 LOUDSPEAKER TYPE S2:** The loudspeaker shall be a self-powered, full-range system. The transducers shall consist of two 5-inch diameter cone drivers and a 1-inch metal dome tweeter. The loudspeaker system shall incorporate internal processing electronics and a two-channel amplifier. Processing functions shall include equalization, phase correction and signal division and driver protection for the high- and low-frequency sections. The crossover point shall be 1.3 kHz. Each amplifier channel shall be class AB/bridged with complementary MOSFET output stages. Burst capability shall be 350 watts total with nominal 4 ohms low channel and 8 ohms

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high channel resistive load. Distortion (THD, IM, TIM) shall not exceed 0.02%. Performance specifications for a typical production unit shall be as follows, measured at 1/3 octave resolution at 4 meters. Operating frequency range shall be 75 Hz to 20 kHz. Phase response shall be $\pm 60^\circ$ from 300 Hz to 18 kHz. Maximum SPL Notes: shall be 123 dB at 1 meter. Horizontal coverage and vertical coverage shall both be 100 degrees. The audio input shall be electronically balanced with a 10 kOhm impedance and accept a nominal 0 dBV (1 V rms, 1.4 V pk) signal. Connector shall be XLR (A-3) type female with parallel looping male. RF filtering shall be provided, and CMRR shall be greater than 50 dB from 50 Hz to 500 kHz. Two input module options shall be offered: one with loop-through output and another with an attenuator and polarity reversal switch in addition to the loop-through output. Two versions shall be available: a switchable 115/230 V and a non-switchable 100 V-only version. The voltage selection needs to be manually selected. The internal power supply shall perform EMI filtering, soft current turn-on and surge suppression. The speaker powering requirements shall be nominal 100VAC or 230 VAC. (115/230 version) with a line current at 50 or 60 Hz. UL operating voltage range shall be 115 V AC - 240 V AC. Ultimate short-term peak current draw shall be 2.9 A at 115 V AC, 2 A at 230 V AC and 3.3 A at 100 V AC. Current inrush during turn-on shall not exceed 18 A at 115 V AC. AC power connectors shall be PowerCon with looping output. The loudspeaker system shall provide facilities for installing a remote monitoring system. All loudspeaker components shall be mounted in an acoustically vented trapezoidal enclosure constructed of premium birch plywood with a black textured finish. The front protective grille shall be hex-stamped steel covered by charcoal gray foam. Dimensions shall be 6.85" wide x 18" high x 7.70" deep (174 mm x 457 mm x 196 mm). Weight shall be 21 lbs (9.53 kg). Rigging shall be three 3/8"-16 or M10 nut plates. This speaker shall include the remote monitoring system module, Loop-Through Power Module, and "U" mounting bracket. Note: The loudspeaker shall be painted to match the ceiling beam per the architect. Install new:

MEYER SOUND UPM-1P WITH RMS MODULE OR APPROVED EQUAL

MEYER "U" BRACKET OR APPROVED EQUAL

- S3 LOUDSPEAKER TYPE S3:** The loudspeaker shall be a self-powered, full-range system. The high-frequency section shall consist of a 1-inch metal dome tweeter on a symmetrical constant-directivity high-frequency horn with 45-degree beamwidth. The low-frequency section shall consist of two 5-inch low-frequency cone drivers that shall be driven in parallel at low frequencies to take advantage of their combined acoustic output. To prevent destructive interference and comb filtering effects in the mid-band frequencies close to the crossover area, one of the drivers shall roll off above 320 Hz. Two channels of power amplification shall be provided, along with an active crossover, driver protection voltage limiters, and frequency and phase response alignment circuitry. Mounting shall be via three 3/8"-16 or metric M10 threaded recessed nut plates. The loudspeaker shall have dimensions 6.85" w x 18.00" h x 7.70" d (174 mm x 457 mm x 196 mm) and weigh 21 lbs (9.53 kg). Note: The loudspeaker shall be painted to match the ceiling beam per the architect. The loudspeaker shall be provided with the weatherproof option, RMS module and "U" mounting bracket. Install new:

MEYER SOUND UPM-2P, RMS MODULE, AND MEYER "U" BRACKET

- S4 LOUDSPEAKER TYPE S4:** The loudspeaker shall be self-powered and include a single 4-inch (102 mm) diameter cone transducer with a 100 watt (AES), 4-ohm, long-excursion voice coil. The loudspeaker shall incorporate a Class D power amplifier with a burst capability of 220-W

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total (440-W peak) into a nominal load of 4 ohms. Distortion (THD, IM, TIM) shall not exceed .02%. Performance specifications for a typical production unit shall be as follows; measured at 1/3-octave resolution: operating frequency range, 120 Hz to 18 kHz; phase response, 400 Hz to 20 kHz $\pm 45^\circ$; maximum peak SPL, 113 dB at 1 meter. Coverage shall be 80° horizontal and 80° vertical at 3 kHz to 14 kHz $\pm 10^\circ$. Notes: The loudspeaker shall be equipped with a single 5-pin EN3 connector (three pins for balanced audio and two pins for DC power). The audio input shall be electronically balanced with a 10-kOhm impedance and accept a nominal -2.5 dBV (0.75 V rms, 1.00 V peak) input signal. DC blocking and RF filtering shall be provided, and CMRR shall be less than -60 dB and typically less than -72 dB (200 Hz to 3 kHz). The power requirements for the loudspeaker shall be a Meyer Sound MPS power supply — either the MPS-481 or MPS-488 — capable of delivering 48 V DC. Current draw for the loudspeaker during burst (<1 sec) shall be 2.2 A at 48 V. Current inrush during turn-on shall not exceed 7.0 A at 48 V. Loudspeaker components shall be housed in a sealed, extruded aluminum enclosure with a **paint finish that will be selected by HAS**. Dimensions shall be 4.02" (102.50 mm) wide by 4.02" (102.50 mm) high by 5.72" (145.38 mm) deep (including the grille). Weight shall be 4.2 lbs (1.91 kg). 3/8"-16 inserts on each side of the enclosure shall accommodate mounting and rigging options. The loudspeaker shall be supplied with a factory "U" bracket and painted in accordance with architectural or HAS instructions. Install new:

MEYER MM4XP LOUDSPEAKER, MEYER "U" BRACKET OR APPROVED EQUAL

S4PSU LOUDSPEAKER TYPE S4 POWER SUPPLY: Provide an external DC power supply that delivers DC power and balanced audio to up to eight S4 loudspeakers. The single-space 19-inch rack PSU shall have eight channels of balanced audio from its XLR female input connectors and routes the audio, along with 48 V of DC power, to its eight output connectors. Input channels feature toggle switches that route inputs to corresponding channel outputs only, or to adjacent, contiguous channel outputs. For example, channel input 1 could be routed to channel outputs 1 and 2 and channel input 3 could be routed to channel outputs 3 and 4. Another example would be to route channel input 1 to channel outputs 1–4 and channel input 5 to channel outputs 5–8. The power supply's eight channel outputs are available as either 5-pin Phoenix connectors, or 5-pin EN3 connectors. Outputs can deliver DC power to the S4 loudspeakers at cable lengths of up to 300 feet with just 1 dB of loss in peak SPL using 18 AWG wire. The use of composite multiconductor cables (such as Belden® 1502) allows a single cable to carry both audio and DC power from the unit to the loudspeakers. Longer cable lengths are possible for moderate applications that do not drive the loudspeakers to maximum output, as well as for installations with heavier wire gauges. The unit front panel shall have two LED's per output channel that provide useful feedback on the status of the system. The voltage LED indicates when voltage is present for each output channel. The load current LED's indicate when a loudspeaker is connected to an output channel and glow brighter as the signal level increases. Amplifier and signal processing circuits for the S4 are designed to tolerate voltage drops of up to 30 percent, thereby accommodating light-gauge cables and long cable runs. Internal energy storage circuits for the S4 minimize the system's peak-to-average current demands, ensuring efficient use of the unit's 48 V DC output. Note: An Alternate mounting location that is close to the S4 speaker locations may be used. Verify the device location prior to mounting the S4P in the ACRS equipment racks. Install new:

MEYER MPS488E OR APPROVED EQUAL

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S5 LOUDSPEAKER TYPE S5: The loudspeaker shall be self-powered and include eight (8) 4-inch (102 mm) diameter cone transducers and twenty-four (24) tweeters with a maximum SPL of 100 dB at 30 meters. Distortion (THD, IM, TIM) shall not exceed .02%. Performance specifications for a typical production unit shall be as follows; measured at 1/3-octave resolution: operating frequency range, 150 Hz to 10 kHz. Each driver shall be powered by a multichannel Class D amplifier. The loudspeaker shall be equipped with a single 5-pin EN3 connector (three pins for balanced audio and two pins for DC power). The audio input shall be electronically balanced with a 10-kOhm impedance and accept a nominal -2.5 dBV (0.75 V rms, 1.00 V peak) input signal. DC blocking and RF filtering shall be provided, and CMRR shall be less than -60 dB and typically less than -72 dB (200 Hz to 3 kHz). Loudspeaker components shall be housed in a sealed, extruded aluminum enclosure with an anodized paint finish. The mounting bracket shall also have an anodized paint finish. Custom colors shall also be available. Dimensions shall be 7.5" wide by 45" high by 7" deep (including the grille). 3/8"-16 inserts on each side of the enclosure shall accommodate mounting and rigging options. The loudspeaker shall be supplied with a factory "U" bracket painted in accordance with the Architect and HAS. Install new:

MEYER CAL 32 LOUDSPEAKER OR APPROVED EQUAL

MEYER "U" MOUNTING BRACKET OR APPROVED EQUAL

S6 LOUDSPEAKER TYPE S6: Provide a loudspeaker that shall be a self-powered, full-range system; the transducers shall consist of a 15-inch diameter cone driver and a 4-inch diaphragm compression driver on an 80-degree horizontal x 50-degree vertical horn. The loudspeaker system shall incorporate internal processing electronics and a two channel amplifier, one channel for each driver. Processing functions shall include equalization, phase correction, signal division, and protection for the high- and low-frequency sections. The crossover point shall be 770 Hz. Each amplifier channel shall be class AB/H with complementary MOSFET output stages. Burst capability for the low-frequency channel shall be 1000 watts total with nominal 2-ohm resistive load and 275 watts for the high-frequency channel with nominal 8-ohm resistive load. Peak power shall be 2550 watts. Distortion (THD, IM, TIM) shall not exceed 0.02%. Performance specifications for a typical production unit shall be as follows, measured at 1/3-octave resolution: Operating frequency range shall be 55 Hz to 18 kHz. Phase response shall be $\pm 45^\circ$ from 470 Hz to 16 kHz. Maximum peak SPL shall be 136 dB at 1 meter, free field. Coverage shall be 80-degree horizontal x 50-degree vertical horn at the -6 dB points and 100-degree horizontal x 60-degree vertical horn at the -10 dB points. The audio input shall be electronically balanced with a 10 kOhm impedance and accept a nominal 0 dBV (1 V rms, 1.4 V pk) signal. Connector shall be XLR (A-3) type female with parallel looping male or VEAM all-in-one multipin connector. An additional input module shall be offered with an attenuator and polarity reversal switch including one with loop-through output. RF filtering shall be provided, and CMRR shall be greater than 80 dB from 50 Hz to 500 Hz. The internal power supply shall perform automatic voltage selection, EMI filtering, soft current turn-on and surge suppression. Powering requirements shall be nominal 100, 110 or 230 V AC line at 50 or 60 Hz. UL and CE operating voltage range shall be 100 to 240 V AC. Maximum peak current draw during burst shall be 7.0 A at 115 V AC, 3.9 A at 230 V AC, and 8.2 A at 100 V AC. Current inrush during soft turn-on shall not exceed 6.0 A at 115 V AC or 8.4 A at 230 V AC. AC power connectors shall be PowerCon with looping capabilities or VEAM all-in-one multipin connector. The loudspeaker system shall provide facilities for installing Meyer Sound's optional RMS remote monitoring system. All components shall be mounted in an acoustically vented trapezoidal

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enclosure constructed of premium birch plywood with a hard black textured finish. The enclosure shall include an integral pole mount receptacle and versatile rigging end plates made of high-strength, 6061-T6 aluminum with threaded M10 metric holes for basic eyebolt rigging and shall also accommodate Meyer Sound proprietary rigging hardware. The front protective grille shall be powder-coated hex stamped steel with black mesh screen. Dimensions shall be 19.00" wide x 28.27" high x 18.18" deep (483 mm x 718 mm x 462 mm). Weight shall be 108 lbs (49 kg). The loudspeaker shall be provided with the weatherproof option. Install new:

MEYER UPQ-1P OR APPROVED EQUAL

MEYER MYA-UPQ MOUNTING YOKE OR APPROVED EQUAL

S7 LOUSPEAKER TYPE S7: Provide a loudspeaker that shall be a self-powered, full-range system; the transducers shall consist of a 15-inch diameter cone driver and a 4-inch diaphragm compression driver on an 50-degree horizontal x 50-degree vertical horn. The loudspeaker system shall incorporate internal processing electronics and a two channel amplifier, one channel for each driver. Processing functions shall include equalization, phase correction, signal division, and protection for the high- and low-frequency sections. The crossover point shall be 690 Hz. Each amplifier channel shall be class AB/H with complementary MOSFET output stages. Burst capability for the low-frequency channel shall be 1200 watts total with nominal 2-ohm resistive load and 250 watts for the high-frequency channel with nominal 8-ohm resistive load. Peak power shall be 2550 watts. Distortion (THD, IM, TIM) shall not exceed 0.02%. Performance specifications for a typical production unit shall be as follows, measured at 1/3-octave resolution: Operating frequency range shall be 55 Hz to 18 kHz. Phase response shall be $\pm 45^\circ$ from 490 Hz to 16 kHz. Maximum peak SPL shall be 136 dB at 1 meter, free field. Coverage shall be 50-degree horizontal x 50-degree vertical horn at the -6 dB points and 60-degree horizontal x 60-degree vertical horn at the -10 dB points. The audio input shall be electronically balanced with a 10 kOhm impedance and accept a nominal 0 dBV (1 V rms, 1.4 V pk) signal. Connector shall be XLR (A-3) type female with parallel looping male or VEAM all-in-one multipin connector. An additional input module shall be offered with an attenuator and polarity reversal switch including one with loop-through output. RF filtering shall be provided, and CMRR shall be greater than 50 dB from 50 Hz to 500 Hz. The internal power supply shall perform automatic voltage selection, EMI filtering, soft current turn-on and surge suppression. Powering requirements shall be nominal 100, 110 or 230 V AC line at 50 or 60 Hz. UL and CE operating voltage range shall be 100 to 240 V AC. Maximum peak current draw during burst shall be 7.0 A at 115 V AC, 3.9 A at 230 V AC, and 8.2 A at 100 V AC. Current inrush during soft turn-on shall not exceed 6.0 A at 115 V AC or 8.4 A at 230 V AC. AC power connectors shall be PowerCon with looping capabilities or VEAM all-in-one multipin connector. The loudspeaker system shall provide facilities for installing Meyer Sound's optional RMS remote monitoring system. All components shall be mounted in an acoustically vented trapezoidal enclosure constructed of premium birch plywood with a hard black textured finish. The enclosure shall include an integral pole mount receptacle and versatile rigging end plates made of high-strength, 6061-T6 aluminum with threaded M10 metric holes for basic eyebolt rigging and shall also accommodate Meyer Sound proprietary rigging hardware. The front protective grille shall be powder-coated hex stamped steel with black mesh screen. Dimensions shall be 19.00" w x 28.27" h x 18.18" d (483 mm x 718 mm x 462 mm) and weight shall be 108 lbs (49 kg). The loudspeaker shall be provided with the weatherproof option. Install new:

MEYER UPQ-2P OR APPROVED EQUAL

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MEYER MYA-UPQ MOUNTING YOKE OR APPROVED EQUAL

- S8 LOUDSPEAKER TYPE S8:** The loudspeaker shall be self-powered and include a single 4-inch (102 mm) diameter cone transducer with a 100 watt (AES), 4-ohm, long-excursion voice coil. The loudspeaker shall incorporate a Class D power amplifier with a burst capability of 220-W total (440-W peak) into a nominal load of 4 ohms. The loudspeaker shall have a directional hypercardioid pattern. Distortion (THD, IM, TIM) shall not exceed .02%. Performance specifications for a typical production unit shall be as follows; measured at 1/3-octave resolution: operating frequency range, 120 Hz to 18 kHz; maximum peak SPL, 113 dB at 1 meter. The loudspeaker shall be equipped with a single Switchcraft 5-pin EN3 connector (three pins for balanced audio and two pins for DC power). The audio input shall be electronically balanced with a 10-kOhm impedance and accept a nominal -2.5 dBV (0.75 V rms, 1.00 V peak) input signal. DC blocking and RF filtering shall be provided, and CMRR shall be less than -60 dB and typically less than -72 dB (200 Hz to 3 kHz). The power requirements for the loudspeaker shall be a Meyer Sound MPS power supply — either the MPS-481 or MPS-488 — capable of delivering 48 V DC. Current draw for the loudspeaker during burst (<1 sec) shall be 2.2 A at 48 V. Current inrush during turn-on shall not exceed 7.0 A at 48 V. Loudspeaker components shall be housed in a sealed, extruded aluminum enclosure with a white anodized paint finish. The mounting bracket shall also have white anodized paint finish. Custom colors shall also be available. Dimensions shall be 4.02" (102.50 mm) wide by 4.02" (102.50 mm) high by 5.72" (145.38 mm) deep (including the grille). Weight shall be 4.2 lbs (1.91 kg). 3/8"-16 inserts on each side of the enclosure shall accommodate Meyer Sound mounting and rigging options. The loudspeaker shall be supplied with a factory "U" bracket painted white as shown in the drawings. The loudspeaker shall be provided with the weatherproof option. Install new:

MEYER MM4-XPD OR APPROVED EQUAL

MEYER MUB-XPD "U" MOUNTING BRACKET OR APPROVED EQUAL

- S9 LOUDSPEAKER TYPE S9:** Provide a self-powered, ceiling mount installation loudspeaker. The loudspeaker shall be housed in an aluminum die cast enclosure with a heat sink on the back. The loudspeaker shall have an 8-inch coaxial cone and a 0.75-inch tweeter transducer and shall be able to produce a maximum peak SPL of 117 dB at one meter with a frequency range of 100 Hz to 22kHz. The loudspeaker shall have a coverage angle of 100 degrees. The loudspeaker shall accept balanced audio and DC power over a 5-pin Phoenix connector on its rear panel. The unit shall be powered with 12 to 18 V DC from an external power source. Dimensions of the loudspeaker shall be 11.66" front x 5.47" depth without grille (296.16 mm x 138.86 mm). Weight shall be 9.0 lbs (4.1 kg) without back box. The loudspeaker shall be provided with the weatherproof option. Install new:

MEYER STELLA-8 OR APPROVED EQUAL

- S10 LOUDSPEAKER TYPE S10:** The loudspeaker shall be a self-powered ceiling mount installation loudspeaker. The loudspeaker shall mount in a standard back box for 8-inch drivers (with a minimum depth of 6.5 inches). The loudspeaker shall be housed in an aluminum die cast enclosure with a heat sink on the back. The loudspeaker shall have a 4-inch cone transducer is capable of producing a maximum peak SPL of 108 dB at one meter over a

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frequency range of 100 Hz to 22 kHz. The loudspeaker shall contain amplification and signal processing onboard. The unit shall receive balanced audio and DC power from a 5-pin Phoenix connector on its rear panel. The loudspeaker shall have a transformer-isolated differential input circuit that shall yield a high common mode signal rejection ratio (CMRR). The unit shall receive balanced audio and DC power from the SPSU10 external power supply. The loudspeaker shall be provided with the weatherproof option. Install new:

MEYER STELLA-4C OR APPROVED EQUAL

SPSU10 LOUDSPEAKER TYPE SPSU10: Provide a 1 RU, 19-inch rack power supply that can power up to eight (8) S7 loudspeakers. The unit shall receive eight channels of balanced audio over its 25-pin D-sub connector and shall route audio along with 18 V DC power to its 5-in Phoenix output connectors. The unit shall deliver DC power over cable lengths of up to 150 feet with 1 dB of SPL loss over 18 AWG wire. The front panel of the unit shall have a voltage LED to indicate when voltage is present for each output channel. The unit shall have load current LED's to indicate when a loudspeaker is connected to an output channel and the LED shall grow in brightness as the signal level increases. Weight shall be 13.0 lbs (5.9 kg). Install new:

MEYER STELLA-188 OR APPROVED EQUAL

S11 LOUDSPEAKER TYPE S11: The loudspeaker shall be a self-powered installation loudspeaker. The loudspeaker shall be housed in an aluminum die cast enclosure with a heat sink on the back. The loudspeaker shall have a 4-inch cone transducer is capable of producing a maximum peak SPL of 108 dB at one meter over a frequency range of 100 Hz to 22 kHz. The loudspeaker shall contain amplification and signal processing onboard. The unit shall receive balanced audio and DC power from a 5-pin Phoenix connector on its rear panel. The loudspeaker shall have a transformer-isolated differential input circuit that shall yield a high common mode signal rejection ratio (CMRR). The unit shall receive balanced audio and DC power from the SPSU10 external power supply. The loudspeaker shall be provided with the weatherproof option. Install new:

MEYER STELLA-4 OR APPROVED EQUAL

S12 LOUDSPEAKER TYPE S12: The loudspeaker shall have twenty-eight 4-inch cone drivers, a 2-inch throat (4-inch diaphragm) compression driver, and an integral complementary MOSFET power amplifier with 1240 Watt burst capability, and optimized signal processing circuitry. The loudspeaker shall have a coverage pattern of 20° symmetrical from 1 kHz to 16 kHz at -6 dB. The loudspeaker shall produce a maximum SPL of 143 dB. The unit shall have a frequency response of 150 Hz - 13 kHz \pm 4 dB. The loudspeaker shall crossover at 1.5 kHz. The loudspeaker shall accept a 10 kOhm impedance, electronically balanced audio signal over XLR. Powering requirements shall be nominal 100, 110 or 230 V AC line at 50 or 60 Hz. UL and CE operating voltage range shall be 100 to 240 V AC. Maximum peak current draw during burst shall be 22 A at 115 V AC, 11 A at 230 V AC, and 25 A at 100 V AC. Current inrush during soft turn-on shall not exceed 12 A at 115 V AC. The loudspeaker shall have dimensions 46.5" W x 43.75" H x 31.22" D (1023mm x 962.5mm x 793mm) and weigh 300 lbs (137 kg). The loudspeaker shall be provided with the weatherproof option. Install new:

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MEYER SB-2 OR APPROVED EQUAL

- S13 LOUDSPEAKER TYPE S13:** The loudspeaker shall have a single 2-inch cone driver with a 16-ohm voice coil mounted in a sealed enclosure. The loudspeaker shall draw 20 watts from the line. Install new:

JBL C62P OR APPROVED EQUAL

- S14 LOUDSPEAKER TYPE S14:** The loudspeaker shall have a 5.25" (130 mm) low-frequency driver with silk-dome tweeter. The loudspeaker shall operate on 75 Watts, 8 ohms and 60W multi-tap transformer. The unit shall have 120 degree conical coverage. Install new:

JBL C65P/T OR APPROVED EQUAL

- S15 LOUDSPEAKER TYPE S15:** The loudspeaker shall have a 6.5" (165 mm) low-frequency driver with silk-dome tweeter. The loudspeaker shall supply 75 Watts at 8 ohms and 60W multi-tap transformer. The unit shall have 120 degree conical coverage. Install new:

JBL C67P/T OR APPROVED EQUAL

- S16 LOUDSPEAKER TYPE S16:** The loudspeaker shall have a 6.5" (165 mm) low-frequency driver with silk-dome tweeter. The loudspeaker shall supply 75 Watts at 8 ohms and 60W multi-tap transformer. The unit shall have 75 degree coverage. The loudspeaker shall have a sensitivity of 93 dB. Install new:

JBL C67HC/T OR APPROVED EQUAL

- S17 LOUDSPEAKER TYPE S17:** The loudspeaker shall have a 4" full-range driver. The loudspeaker shall have a frequency range of 60 Hz – 18 kHz at -10 dB. The loudspeaker shall supply 25 Watts at 6W, 3W and 1.5W multi-tap transformer. The unit shall have 130 degree conical coverage. The loudspeaker shall have a sensitivity of 97 dB. The loudspeaker shall have dimensions 206 mm (8.1 in) diameter round baffle x 89 mm (3.75 in) depth from back of baffle and weigh 1.2 kg (2.5 lb). Install new:

JBL 8124 OR APPROVED EQUAL

- S18 LOUDSPEAKER TYPE S18:** The loudspeaker shall have a 8" full-range driver. The loudspeaker shall have a frequency range of 95 Hz – 18 kHz at -10 dB. The loudspeaker shall supply 20 Watts at 8 ohms and 6W, 3W and 1.5W multi-tap transformer. The unit shall have 90 degree conical coverage. The loudspeaker shall have a sensitivity of 93 dB. The loudspeaker shall have dimensions 327 mm (12.9") diameter baffle x 84 mm (3.3") depth from back of baffle and an overall depth of 99 mm (3.9") and weigh 1.4 kg (3 lb). Install new:

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JBL 8138 OR APPROVED EQUAL

- S19 LOUDSPEAKER TYPE S19:** Provide a pre-install in-ceiling back can. The unit shall be compatible with ceiling speakers having a 286 mm (11¼ in) mounting circle diameter. The unit shall have dimensions 178 mm (7 in) height x 300 mm (11.75 in) width and depth and weigh 1.1 kg (2.5 lbs). Install new:

JBL 81BB8 OR APPROVED EQUAL

- S20 LOUDSPEAKER TYPE S20:** Provide a pre-install in-ceiling tile bridge for a pre-install back box. The unit shall be compatible with ceiling speakers having a 286 mm (11¼ in) mounting circle diameter. The unit shall have dimensions 600 mm (23.6 in) length x 359 mm (14.0 in) width and weigh 0.9 kg (2.0 lbs). Install new:

JBL 81TB8 OR APPROVED EQUAL

- S21 LOUDSPEAKER TYPE S21:** The loudspeaker(s) shall be an integral driver and constant directivity horn utilizing a rugged phenolic diaphragm and high-temperature-rated, 1.5-inch diameter voice coil. The axial frequency response will extend from 400 to 6,500 Hz, and the horn shall exhibit a low-frequency cutoff of 350 Hz. Sound pressure level will be 107 dB (1 W/1 m) with a 500 to 5,000 Hz pink-noise signal applied, and the horn will produce a horizontal beamwidth of 60° and a vertical beamwidth of 40° from 1 kHz to 10 kHz. The loudspeaker(s) shall be capable of handling a 30 watt, 500 to 5,000 Hz pink-noise signal with a 6 dB crest factor for a period of 8 hours. The horn shall be molded, high-impact acrylic-styrene-acrylonitrile (ASA) capable of satisfactory mechanical performance in the temperature range from -4°C (-40°F) to 71°C (160°F) and not subject to sunlight embrittlement. Other major external speaker parts shall be molded nylon, finished in mesa tan to match the horn. All components shall be resistant to damage from weather, moisture and fungus. A positive-lock swivel bracket shall provide orientation adjustment in all three places. Adjustments are made by loosening one or both of the locking nuts on the mounting hoop. The loudspeaker(s) shall be 22.6 cm (8.9 in.) high, 30.7 cm (12.1 in.) wide and 31.0 cm (12.2 in.) deep. Install new:

EV PA430 OR APPROVED EQUAL

- S21 LOUDSPEAKER TYPE S21:** The loudspeaker shall be of the integrated driver and horn style, utilizing two coaxial horns coupled to opposite sides of the driver diaphragm and a larger horn compression molded from fiberglass, a zinc die-cast front horn with phenolic-constructed inner horns. The driver uses a high-temperature rated 1.5-inch diameter voice coil. The axial frequency response will extend from 260-10,000 Hz and the horn shall exhibit a low-frequency cutoff of 200 Hz. Sound pressure level will be 105 dB (1 W/1 M) with a 500-5,000-Hz pink noise signal applied, and the horn will produce a horizontal beamwidth of 150° and a vertical beamwidth of 110° at 2 kHz. The horizontal coverage shall be constant over the frequency range of 3 kHz to 10 kHz. The loudspeaker shall be compression-molded fiberglass capable of satisfactory mechanical performance in the temperature range from -40°C to +40°C and not subject to sunlight embrittlement. Other major external speaker parts shall be die-cast zinc and

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finished in gray polyester paint to match the molded horn parts. All components shall be resistant to damage from weather, moisture and fungus. A steel swivel bracket capable of providing either vertical or horizontal installation or a variety of adjustments shall be provided. The loudspeaker shall be 52.0 cm (20.5 in.) high, 26.5 cm (10.5 in.) wide and 54.6 cm (21.5 in.) long. Install new:

EV 848AT OR APPROVED EQUAL

S22 LOUDSPEAKER TYPE S22: The horn shall be of the folded sectoral type featuring two separate air columns within the single assembly. It shall produce a horizontal beamwidth of 100 degrees and a vertical beamwidth of 60 degrees at 2.0 kHz. In addition, it shall provide useful acoustic loading at all frequencies above 250 Hz. The horn shall be constructed from a non-resonant glass fiber reinforced polyester and self-finished in an ultraviolet-inhibiting gray. A serrated, positive-lock "U" mounting bracket shall be affixed to the bell by self-locking nuts and shall provide orientation adjustment in all three planes. The horn shall possess a throat of 2.54-cm (1.00 in.) diameter and shall be provided with a 1 3/8"-18 thread for the mounting of a compression driver. The horn shall be 36.8 cm (14.5 in.) high, 69.9 cm (27.5 in.) wide and 38.1 cm (15.0 in.) deep. It shall weight no more than 3.2 kg (7.0 lb).

The loudspeaker shall be of the compression-driver type having a rugged phenolic diaphragm and a high-temperature rated one and one-half inch voice coil. The loudspeaker shall exhibit essentially flat power response from 400 to 3,000 Hz with a smoothly rolled-off response beyond. The sensitivity, when mounted on a **S22** horn, will be 105 dB (1 W/1 M) with a 500 to 5,000 Hz pink noise signal applied. The loudspeaker will be capable of handling a 30 watt, 500 to 5,000 Hz pink noise signal with a 6 dB crest factor for a period of eight hours. The unit shall have a height of 12.7 cm (5.0 in.), a width of 10.2 cm (4.0 in.), and a depth of 13.3 cm (5.2 in.). The unit shall have a throat opening of 2.54 cm (1.0 in.) with a 1-3/8"-18 thread for mounting. Install new:

EV COBRALEX III OR APPROVED EQUAL

EV 1828T OR APPROVED EQUAL

S23 LOUDSPEAKER TYPE S23: The horn shall be of the folded sectoral type featuring two separate air columns within the single assembly. It shall produce a horizontal beamwidth of 100 degrees and a vertical beamwidth of 60 degrees at 2.0 kHz. In addition, it shall provide useful acoustic loading at all frequencies above 250 Hz. The horn shall be constructed from a non-resonant glass fiber reinforced polyester and self-finished in an ultraviolet-inhibiting gray. A serrated, positive-lock "U" mounting bracket shall be affixed to the bell by self-locking nuts and shall provide orientation adjustment in all three planes. The horn shall possess a throat of 2.54-cm (1.00 in.) diameter and shall be provided with a 1 3/8"-18 thread for the mounting of a compression driver. The horn shall be 36.8 cm (14.5 in.) high, 69.9 cm (27.5 in.) wide and 38.1 cm (15.0 in.) deep. It shall weight no more than 3.2 kg (7.0 lb).

The loudspeaker shall be of the compression-driver type having a rugged phenolic diaphragm and a high-temperature rated 5.08 cm (2") voice coil. The loudspeaker shall exhibit essentially flat power response from 280 to 8000 Hz with a smoothly rolled off response beyond. The sensitivity, when mounted on a **S22** horn, will be 105 dB (1 W/1 m) with a 500 to 5000 Hz pink noise signal applied. The loudspeaker will be capable of handling a 60 watt 500 to 5000 Hz

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pink noise signal with a 6 dB crest factor for a period of eight hours. The loudspeaker shall have a diameter of 13.5 cm (5.3") and a length of 16.2 cm (6.4"). The unit shall have a throat opening of 3 cm (1.2") with a 1 3/8"-18 thread for mounting. The unit shall include a 70V line-matching transformer and weigh 3.2 kg (9.8 lb). Install new:

EV COBRAFLEX III OR APPROVED EQUAL

EV 1829BT OR APPROVED EQUAL

S24 LOUDSPEAKER TYPE S24: The loudspeaker shall be of the integrated driver and horn style, utilizing two coaxial horns coupled to opposite sides of the driver diaphragm and a larger horn compression molded from fiberglass, a zinc die-cast front horn and phenolic-constructed inner horns. The driver uses a high-temperature rated 5.2 cm (2.0-inch) diameter voice coil. The axial frequency response will extend from 280 to 8,000 Hz and the horn shall exhibit a low frequency cutoff of 180 Hz. Sound pressure level will be 105 dB (1 W/1 M) with a 500 to 5,000 Hz pink noise signal applied, and the horn will produce a horizontal beamwidth of 150° and a vertical beamwidth of 110° at 2 kHz. The horizontal coverage shall be constant over the frequency range of 3 kHz to 10 kHz. The loudspeaker shall be compression molded fiberglass capable of satisfactory mechanical performance in the temperature range from - 40°C to +40°C and not subject to sunlight embrittlement. Other major external speaker parts shall be diecast zinc finished in gray polyester paint to match the molded horn parts. All components shall be resistant to damage from weather, moisture and fungus. A swivel bracket capable of providing either vertical or horizontal installation or a variety of adjustments, is provided. The loudspeaker shall be 52.0 cm (20.5 in.) high, 26.5 cm (10.5 in.) wide and 51.0 cm (20.0 in.) long. The loudspeaker shall include a 70-V transformer and weigh no more than 8.4 kg (19.0 lb). Install new:

EV 850T OR APPROVED EQUAL

SS1 SYSTEM SERVER: The System Server shall support and provide redundancy for all required data files and programs for the Paging System. The server shall include Microsoft Server 2003 and Microsoft SQL Server 2005. Provide the most recent configuration as recommended by the system manufacturer with the following minimum specifications: **Note: Verify acceptable products with the HAS Staff prior to configuration.**

1. Rack mounted with sliding rack support
2. Quad Core 2.06 GHz Xeon Processor
3. 4Gb Memory
4. SAS/SATA Drive Controllers
5. RAID 1 Drive Redundancy with (3) 36 Gigabit Drives
6. Dual Gigabit Network Interfaces
7. Redundant Hot Swap Power Supplies
8. Locking Drawer Rack Mount 15" LCD Monitor with Keyboard.

**Audio Communication System
275113-49**

Revisions 8/13/2010

GUIDELINES

HAS/IT/Design Division
Houston, Texas

ProjectTitle
Proj./CIP No.

(NOTE TO DESIGNER/SPECIFIER: These Guidelines are basic minimum criteria to be met in preparing the final specifications for this section, which is the responsibility of the Designer.)

Install new:

**DELL 2950 CUSTOM CONFIGURATION OR APPROVED EQUAL
ATLAS SOUND MMK15-RM RACK MONITOR/KEYBOARD/MOUSE**

SW1 SOFTWARE: All software provided as part of an HAS ACS system shall be the latest version available supported by the ACS system manufacturer. Provide properly licensed versions and backup media for all software. The following software shall be provided as part of the ACS system:

Network Operating System: Microsoft Windows Server 2003

Workstation and DDC Operating System: Microsoft Windows XP Professional

Database Software: Microsoft SQL Server 2005

Announcement Control System Software: IED Enterprise

Flight Announcement Software: IED FAS Module

Courtesy Announcement Software: IED TCAS Module

TI1 TELEPHONE INTERFACE: Provide a telephone interface station to interface with and allow announcements and control functions from any tone type (DTMF) telephone. The interface shall accept a standard analog station drop and provide DTMF decoding for zone selection. The system shall be configured to drop paging routing after the station has been off hook for more than 50 seconds. Install new:

IED 508T-1 OR 508T-2 OR APPROVED EQUAL

UW1 USER WORKSTATIONS: The user workstation shall be a rack mount computer to provide the user interface and monitor/test reporting. **Note: Verify acceptable products with the HAS Staff prior to configuration.** Provide the most recent configuration as recommended by the system manufacturer with the following minimum specifications.

1. Rack mount with sliding rack supports
2. Quad Core 1.86 GHz Xeon Processor
3. 2Gb Memory
4. SAS/SATA Drive Controllers
5. 500 Gigabit Drive
6. Gigabit Network Interface
7. VMWARE
8. Locking Drawer Rack Mount 15" LCD Monitor with Keyboard and mouse.

Install new:

**Audio Communication System
275113-50**

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**DELL 1950 CUSTOM CONFIGURATION OR APPROVED EQUAL
DELL KEYBOARD/MOUSE/DRAWER BY APPROVED SUBMITTAL**

PART 3 EXECUTION (NOT APPLICABLE), SEE SECTION 275113D.

END OF SECTION 275113FE

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SECTION 275113F INFRASTRUCTURE

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and all City of Houston General Conditions of Contract 2010 Edition, including any and all Supplementary Conditions, and other conditions listed in Section 007000 of the Contract Documents apply to this Section.

PART 2 – SUMMARY

1.1 OVERVIEW

- A. This section contains a listing of the Governmental, Safety, and Technical standards that are to be followed for all work performed under Section 275113 for the **Error! Reference source not found.**

PART 3 – DESCRIPTION

3.1 INFRASTRUCTURE

- A. All Telecommunications Equipment Rooms shall be constructed and built in strict adherence to the HAS Standards listed in Specification 271100.
- B. All Equipment Room products shall follow the requirements set forth in the HAS Standards listed in Specification 271100 Part 2.
- C. Following installation, the ACS Contractor shall adhere to the HAS Standards listed in Specification 271100 Part 3.02.
- D. All Equipment Rooms shall be examined to verify the minimum criteria as described in the HAS Standards listed in Specification 271100 Part 3.01 has been followed.
- E. All Vertical Cabinets shall be installed in accordance with the HAS Standards listed in Specification 271500 3.03 F.
- F. All Communication Infrastructure shall be identified and labeled in accordance with the HAS Standards listed in Specification 270553.
- G. Furnish and / or verify the installation of the various infrastructural elements required for the systems specified in HAS **Error! Reference source not found.** specifications and drawings.
- H. All ACS cabling shall be installed in either conduit or cable trays. Cables shall be grouped by cable type and speaker cables shall be kept 12" away from all CAT6 cables.

Audio Communication System 275113-52

Revisions 08/13/2010

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- I. The electrical Infrastructure is a critical part of **Error! Reference source not found.** and as such, the ACS Contractor is responsible for coordinating the on-site installation of this section of work with the General Contractor, Electrical Contractor, and other trades as required.
- J. The General Contractor and / or Electrical Contractor shall provide and install all necessary EMT conduit, raceways, panelboards, high-voltage disconnects, isolation transformers, sequenced power panels, and high voltage components required to install a fully functioning electrical system to power the **Error! Reference source not found.** as shown in the drawings.
- K. The General Contractor and / or Electrical Contractor shall provide a pull-string or jet-line with a 6' service loop in all ACS Conduits.
- L. All Category-5, Category-6 cables required from the ACS equipment rack to all wall plates (WP), digital microphone stations, or devices for this project shall be provided, installed, and terminated by the ACS Contractor.
- M. The HAS IT department is responsible for providing a broadband network service drop into the main ACS equipment rack.
- N. For purposes of installation the ACS Contractor will purchase, receive, and deliver all specialty related devices to the General Contractor at **Error! Reference source not found.** job site for installation and / or mounting. The ACS Contractor will coordinate the installation of these devices under the same general and section specifications. Specialty ACS devices to be Installed by the General Contractor include:
 1. Specialty back boxes required for Digital Microphone Stations and Touch-Screens, devices to mount in millwork, or specialized connector plates.

END OF SECTION 275113F

END OF SECTION 257113