SECTION 27 51 16 – PUBLIC ADDRESS AND VOICE EVACUATION SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Provide all labor, materials, and equipment for the complete installation of Work called for in the Contract Documents.

B. This section includes the minimum requirements for the Public Address/Voice Evacuation (PA/VE) System. The associated Drawing Set, including the General Notes, further specifies the system and is part of the technical specifications.

C. Scope of Work

1. PA/VE Systems Integrator and Contractor shall furnish and install all work shown on the plans and described in the specifications. All work and costs shall be performed under this Contract.
2. The PA/VE Systems Integrator authorized by the DFW Airport Board is Ford Audio-Video Systems Inc.
3. Demolition work is required for this system and includes deprogramming and carefully removing system components and devices.
4. The Contractor shall maintain the existing PA/VE systems in all operational and occupied areas throughout construction.
    a. The Contractor shall understand the existing paging zones and maintain circuit connectivity to speaker zones outside of the construction area.
    b. The Contractor shall coordinate programming of speaker zones prior to and after construction such that announcements and evacuation messages are routed and intelligible in the correct zones.

1.2 DEFINITIONS AND TERMS

A. Trade association names and communications terminology are frequently abbreviated. The following acronyms or abbreviations may be referenced within this Section:

1. ANSI American National Standards Institute
2. BICSI Building Industry Consulting Service International
3. CR Communications Room
4. DFW Dallas Fort Worth International Airport
5. IEEE Institute of Electrical and Electronics Engineers
6. LAN Local Area Network
7. NECA National Electrical Contractors Association
8. NEMA National Electric Manufacturers Association
9. NFPA National Fire Protection Association
10. RCDD Registered Communications Distribution Designer
11. STD Standard
12. TIA Telecommunications Industry Association
13. UL Underwriters Laboratories

1.3 QUALITY ASSURANCE

A. All cable and equipment shall be installed in a neat and workmanlike manner. All methods of construction that are not specifically described or indicated in the contract documents shall be subject to the control and approval of the Owner.

B. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified is based upon the acceptable manufacturers listed. Where “approved equal” is stated, or a substitution is requested, equipment shall be equivalent in every way to that of the equipment specified. All substitutions are subject to the control and approval of the Owner.

C. Strictly adhere to all NFPA, BICSI and TIA recommended installation practices when installing the products specified in this section.

D. Contractor’s Qualifications:

1. Firms regularly engaged in the installation of Life Safety systems and that have five (5) years of installation experience with systems similar to that required for this project.
2. Provide references to include client names, phone numbers and a summary of project details. These references will be checked, and the clients will be asked questions relative to the performance of your company.
3. Provide verification that installation personnel responsible have been properly trained to install the products described in this Section.
4. Provide a professional engineer, licensed in the State of Texas, for oversight on this project. This person does not have to be working on-site but must be accessible to answer questions and provide weekly status reports. The engineer shall be a full-time employee of the contractor.
5. Provide full time project manager with a minimum of ten (10) years field experience in installation of communications systems and infrastructures. Project manager shall be assigned for the duration of the project and shall not be replaced without written consent from the Owner.

E. Manufacturer’s Qualifications:

1. Firms regularly engaged in manufacture of products of the types, ratings and capacities required for this project; whose products have been in satisfactory use in similar service for not less than five (5) years, with production capabilities per applicable NEMA standards.

F. Material and Work specified herein shall comply with the applicable requirements of:

1. NECA 1 – Standard Practice of Good Workmanship in Electrical Construction, 2015
2. ANSI/NECA/BICSI-568 – Standard for Installing Commercial building Telecommunications Cabling, 2006
3. ANSI/TIA-568.0-E – Generic Telecommunications Cabling for Customer Premises, 2020
4. ANSI/TIA-568.1-E – Commercial Building Telecommunications Infrastructure Standard, 2020
5. ANSI/TIA-606-C – Administration Standard for the Telecommunications Infrastructure of Commercial Buildings, 2017
6. ANSI/TIA-607-D – Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises, 2019
7. ANSI/TIA-942-B – Telecommunications Infrastructure Standard for Data Centers, 2017
8. IEEE 802 – Local Area Network Standard
9. NFPA 70 – National Electric Code, 2017
10. NFPA 72, National Fire Alarm and Signaling Code, 2019
11. ADA - Americans with Disabilities Act

12. Sound System Engineering, 4th Edition, Davis, Patronis, Brown, 2013
13. Sound System Design and Optimization, 3rd Edition, McCarthy
14. Audio System Design and Installation, Giddings, 1990
15. International Fire Code (IFC) 2021
16. BICSI – Telecommunications Distribution Methods Manual, 14th Edition
17. DFW Airport Design Criteria Manual, Nov. 2015
18. Applicable codes and directives of authorities having jurisdiction

G. Work:

1. The Work shall be performed in compliance with the applicable manufacturer's installation instructions, Standards, and certifications listed herein, the Contract Documents, and governing codes and regulations of the authorities having jurisdiction.
2. The drawing and specification requirements govern where they exceed Code and Regulation requirements.
3. Where requirements between governing Codes and Regulations vary, the more restrictive provision applies.
4. Nothing in the Contract Documents grants authority or permission to disregard or violate any legal requirements.

1.4 CONFLICTS

A. This installation shall be made in strict accordance with the Specifications, Drawings, any applicable codes, referenced publications and standards. In case of conflicts between the aforementioned, notify the OAR in writing prior to commencement of affected work.

1.5 SCHEDULING

A. The Contractor shall comply with all scheduling requests established by OAR, both prior to commencing Work, and during construction. The Contractor shall provide a detailed schedule of work to be performed.

1.6 REQUIREMENTS

A. All references to manufacturers, model numbers and other pertinent information herein are intended to establish standards of performance and quality of construction. The OAR must approve material submittal and substitutions in writing.

B. Verification that all the components specified and installed meet the criteria specified by the respective component manufacturer, supplier and designer is the responsibility of the Contractor.

C. All installation tools, special equipment and testing apparatus required to accomplish field connections and related work as described herein shall be furnished by the Contractor at no additional cost.

D. The requirements as given in this document are to be adhered to unless revised by the OAR in writing.

E. The Owner reserves the right to waive these requirements at any time.

1.7 SUBMITTALS

A. Comply with provisions of Division 01.

B. Comply with provisions of Section 27 05 00.

C. Provide product data for the following:

1. Product data consisting of manufacturers specifications for each type of product to be installed, all applicable certifications and elevation/plan documents supporting compliance with stated Specifications.
2. Contractor Shop Drawings consisting of no less than arrangement drawings showing physical arrangement of all physical components, floor plans showing locations of components on plans, elevation drawings showing location of components on walls, functional block diagrams showing major interconnections between components and subsystems, and wiring diagrams showing all field installed interconnects. All components and interconnections shall be consistently identified and labeled for cross reference between the drawings.
3. Proposed format of as-built documentation.

1.8 CONTRACTOR CLOSE OUT SUBMITTALS

A. Submit Closeout documentation in accordance with Division 01 of the Project Manual and any applicable supplements. The number of submittal sets required is the greater of either the requirements of Division 01 of the Project Manual, or a minimum of four (4) sets.

1. Segregate documents into separate binders containing data relevant to operational, maintenance, and warranty issues.

B. Warranty and Maintenance:

1. Record Drawings

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials factory-packaged in containers or reels and handle in accordance with manufacturer's recommendations. Store in a clean, dry space and protect products from damaging fumes and traffic. Handle materials carefully to avoid damage.

B. Storage space on project site may be limited. Contractor shall coordinate delivery and arrange storage of materials and equipment with the OAR.

C. Components sensitive to damage in a harsh environment shall be stored off-site and delivered as needed.

D. Provide protective covering during construction to prevent damage or entrance of foreign matter.

E. Contractor is responsible for on-site security of tools, test equipment and materials.

F. Replace at no expense to Owner, product damaged during storage, handling or the course of construction.

1.10 PROJECT CONDITIONS

A. Verify conditions on the job site are applicable to this Work. Notify Architect in writing of discrepancies, conflicts, or omissions promptly upon discovery.

B. The Drawings diagrammatically show cabling and arrangements of equipment fitting the space available without interference. If conditions exist which make it impossible to install Work as shown, recommend solutions and/or submit drawings to the Architect for approval, showing how the Work may be installed.

1.11 MATERIAL PURCHASES

A. Latest Technology

1. Products and materials shall be purchased by the Contractor in a timely manner to meet construction schedules but shall not be purchased so far advanced of the date(s) of installation that they become technologically obsolete or replaced with newer technologies.
2. In the event the manufacturer(s) of submitted products and materials have upgraded or replaced their products and materials with newer or improved technologies at the time of purchase, the newer or improved products or materials shall be provided unless they are incompatible with the rest of the PA/VE System, or so directed by the Design Consultant.
3. Latest technology products and materials shall be operationally and functionally equivalent or superior to the submitted products and materials. These products shall be submitted to the Design Consultant for approval, before ordering.

1.12 WARRANTY

A. Warrant labor and product to be free of defects and deficiencies, and to conform to the drawings and specifications as to kind, quality, function, and characteristics, following Contractor Warranty requirements defined in Division 01. Should a failure occur within the Contractor's warranty period, the Contractor shall provide all labor and materials necessary to restore the system to the condition required for the Final Test and Acceptance for this Contract, at no cost to the DFW Airport Board.

B. During the Warranty period, new devices may be connected in the same manner as shown on the Drawings for this Contract and the existence of the new connections shall not void this guarantee.

C. At completion of this project, Contractor shall provide to Owner a written quote for extending the existing System Maintenance Agreement to cover components installed or removed by this project. Quote shall itemize added and removed components, and pricing shall be provided as a monthly rate.

D. All surplus parts and pieces to the installation shall be maintained as a spare parts inventory at the building site. Parts replaced during the warranty period shall have a warranty matching that of the original part from date of replacement.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. The PA System shall expand the existing campus-wide public address paging system to collect, manage, and distribute high quality audible information to specific zones throughout the terminal buildings. The PA System shall be specifically designed and focused on intelligibly reproducing live, prerecorded, or assembled voice messages. The PA System shall be a fully network based digital system and analyze the ambient sound level in specified zones to adjust the zone's sound level accordingly.

B. Voice Evacuation: This project will establish the PA System as the audible portion of the Voice Evacuation (VE) System. Following the renovation of the Terminal building and successful testing, all occupied areas shall utilize the Public Address system for Voice Evacuation. Areas not renovated shall continue to utilize the Fire Alarm system for all notification. Refer to TI series drawings for the PA/VE system limits.

C. Mass Notification System: Based on the Emergency Response Plan (ERP) requirements and perceived risks, DFW has chosen to proactively address the need for an Emergency Communication System by including requirements in their building standards. Therefore use of the PA/VE System shall include In-Building Mass Notification functionality as required by code.

D. Fire Alarm (FA) System: The Work shall not alter or compromise in any way the integration with the existing Fire Alarm System listed below.

1. The FA System will initiate any general evacuation alarms; it will initiate FA system strobes and signal the PA/VE system to distribute a prerecorded Voice Evacuation message.
2. Any general evacuation alarms will be initiated manually by DPS from the FA System.
3. The PA/VE System shall initiate any evacuation alarms; it shall signal the FA System to initiate strobes and distribute a recorded or live voice announcement through the PA/VE System. The PA/VE system shall also mute speakers in areas of the terminal where the FA will distribute all audible/visual notifications.
4. The PA/VE System shall mute normal automatic messages and announcements made from microphone stations during a fire alarm, except for those made when Emergency Responder's ID is used to log into microphone station. Ambient analysis and control shall ensure audio quality is acceptable during evacuation alarms.
5. The PA/VE System provides voltage contact closure output interface for supervisory trouble signal to the Fire Alarm system.

E. Zoned System: The system is comprised of operational public announcement and voice evacuation zones. For system coverage, refer to Public Address zones shown on the drawings.

F. System Architecture: The system features distributed processing, with multiple Announcement Control System (ACS) software controllers. Failed or abnormal performance of any active system component generates a fault to the fault reporting system.

G. Ethernet Network: The entire system operates on a single Ethernet network. The network is designed using a hierarchical star configuration with a Gigabit backbone between all core, intermediate, and edge switches. The network is designed and installed using recognized industry practice and tested in accordance with the latest release of ANSI/TIA-568.1, ANSI/TIA-568.2, ANSI/TIA-568.3.

1. As such the microphone cabling is an extension of the DFW Airport premise distribution system. Thus, any CAT6A cabling required shall follow those requirements set forth in 27

15 00 'Communications Horizontal Cabling' specification in all manners including color of cable.

H. Software: All system software for every system component is integrated into a single enterprise-class application utilizing a common database.

I. Password Security: System access to setup workstations, servers, and remote access shall require an authenticated user name and password. Access to microphone communications stations may require an optional user ID and PIN. Each user ID and PIN shall allow for up to 8 characters. The password server shall allow assignment of users to employer user groups for restricted access to appropriate functions and areas.

J. Ambient Noise Analysis and Control: The systems shall include the capability to automatically adjust the volume levels in each zone based on changes in the ambient noise levels in those zones.

1. Each zone that includes a sensor within its boundaries shall have automatic control.
2. The system shall automatically null announcement or program material for that zone to prevent "run-away" or inaccurate volume tracking and shall provide smooth unobtrusive control.
3. Software shall allow for setup of the following parameters:

a. Automatic, slaved to an automatic channel, or fixed modes.
b. Configuration of one to four sensors for control of a zone and control of multiple zones from one or more grouped sensors.
c. Control of threshold, maximum gain allowed and scaling ratio.
d. Software shall provide for real time monitoring of sensor levels, program levels, output levels, and gain changes.
e. System shall provide for automatic setup of zones using the integrated system messaging.

K. System Equalization: The system provides for frequency response equalization for each speaker zone output.

1. Filter types shall allow notch, high pass, or low pass.
2. Filters shall have a Q range of 0.055 to 33.
3. Provide eight (8) filters for each zone output.

2.2 MANUFACTURERS

A. Atlas IED

2.3 EQUIPMENT, COMPONENTS, ACCESSORIES

A. Type A, loudspeaker shall be comprised of a 4.5-inch coaxial cone type driver. Enclosure shall be a steel enclosure design equipped with an access panel to facilitate connection in conduit systems. External wiring shall be accomplished via a removable lockable wiring connector with screw-down terminals. The system shall include a support backing plate to reinforce the ceiling material and tile support rails for use on either 2 ft. by 4 ft. or 2 ft. by 2ft. ceiling tiles. The assembly can be installed from beneath the ceiling tile. Loudspeaker grilles shall be press-fit, manufactured from 24-gauge perforated steel mesh and finished in white epoxy. The loudspeaker shall be listed to both UL1480 and UL2043.

1. Sensitivity: 90 dB at 1m with 1W input power.

2. Frequency Response: 90 Hz to 20 kHz (+/- 5 dB)
3. Vertical Coverage: 110 degrees, 800 Hz – 4 kHz.
4. Horizontal Coverage: 110 degrees, 800 Hz – 4 kHz.
5. Rated Power: 50 watts continuous.
6. Transformer
    a. Primary Voltage: 70.7V
    b. Primary taps at: 32W, 16W, 8W, 4W.
7. Acceptable product:
    a. Atlas Sound FAP43T- (B or W).
    b. Or approved equal.

B. Type B, compact two-way loudspeaker system. The system shall consist of two-way woofer and tweeter within environment-resistant housing. Each system shall include a stamped powder coated aluminum grille and removable C-shaped mounting bracket.

1. Sensitivity: 90 dB at 1m with 1W input power.
2. Frequency Response: 85 Hz to 20 kHz (+/- 5 dB)
3. Dispersion: 90 by 90 degrees.
4. Rated Power: 100 watts
5. Transformer
    a. Primary Voltage: 70.7V
    b. Primary taps at: 30W, 15W, 7.5W, 3.7W, 2W.
6. Acceptable product:
    a. Atlas Sound SM52T- (B or WH).
    b. Or approved equal.

C. Type C, indoor/outdoor two-way loudspeaker system. The system shall consist of two-way woofer and tweeter within environment-resistant housing. Each system shall include a stamped powder coated aluminum grille and removable C-shaped mounting bracket.

1. Sensitivity: 88 dB at 1m with 1W input power.
2. Frequency Response: 118 Hz to 20 kHz (+/- 5 dB)
3. Dispersion: 120 degrees conical.
4. Rated Power: 75 watts continuous
5. Transformer
    a. Primary Voltage: 70.7V
    b. Primary taps at: 32W, 16W, 8W, 4W.
6. Acceptable product:
    a. Atlas Sound SM63T- (B or W).
    b. Or approved equal.

D. Type D, indoor/outdoor two-way loudspeaker system. The system shall consist of two-way woofer and tweeter within environment-resistant housing. Each system shall include a stamped powder coated aluminum grille and removable C-shaped mounting bracket.

1. Sensitivity: 88 dB at 1m with 1W input power.
2. Frequency Response: 118 Hz to 20 kHz (+/- 3 dB)
3. Dispersion: 120 degrees conical.
4. Rated Power: 75 watts continuous
5. Transformer
    a. Primary Voltage: 70.7V

b. Primary taps at: 32W, 16W, 8W, 4W.

6. Acceptable product:

a. Atlas Sound SM63T- (B or W).
b. Or approved equal.

E. Type E, Line-Array loudspeaker system. The system shall consist of a two way, full range column array system with ten 3" LF transducers and four 22mm dome tweeter HF transducers.

1. Sensitivity: 96 dB at 1m with 1W input power.
2. Frequency Response: 160 Hz to 20 kHz (+/- 5 dB)
3. Dispersion: 40 degrees vertical; 135 degrees horizontal.
4. Rated Power: 75 watts continuous
5. Transformer

a. Primary Voltage: 70.7V
b. Primary taps at: 75W, 30W, 16W, 7.5W.

6. Acceptable product:

a. Atlas Sound ALA10T
b. Or approved equal.

F. Announcement Control System: The IP100-D Series Announcement Control System (ACS) shall manage announcements and messages using dynamically routed data on a standard Ethernet Network.

1. The ACS shall include an integral multi-channel message server providing simultaneous record and playback capability for up to 16 play and 16 record channels.
2. The ACS shall manage AtlasIED GLOBALCOM® Series peripherals including Digital Communications Stations, Network Power Amplifier Systems, Input/Output Devices, Zone Controllers and IP End Points.
3. The ACS shall include internal support for (8) logic inputs, (8) relay outputs, and (2) balanced audio inputs.
4. The ACS shall manage dynamic requests for live and delayed announcements, pre-recorded and assembled messages, actions, defined events, and two-way full duplex intercom connections.
5. The ACS shall support Dante Audio-over-Ethernet protocol.
6. The message server stores up to 250 hours of pre-recorded message files.
7. The ACS shall include GLOBALCOM IP system configuration and management software.
8. The ACS shall include internally hosted web page for configuration and monitoring the System Management Console.
9. Acceptable product:

a. AtlasIED IP216-D Primary.
b. AtlasIED IP216-D Lifeline.
c. Keyboard, Mouse, and Video Monitor.
d. Or approved equal.

G. Digital Audio Bridge (DAB): Provide a method to bridge CobraNet audio across local networks or VLANS. The DAB is added to the system and configured through GLOBALCOM System Management Center on the ACS that manages the network. Coordinate deployment of DAB unit(s) with network manager and system manufacturer.

1. Acceptable product:

a. AtlasIED 1100DAB.
b. Or approved equal.

H. Smart Mainframe Power Amplifier System: AtlasIED TitanONE T112 shall house, supply power to, and control up to seven (7) TitanONE Series amplifier cards and a DSP/CPU card. In addition, the Smart Mainframe Power Amplifier shall have a provision to provide digital audio utilizing Dante type network audio distribution.

1. The integrated NIC (Network Interface Card) shall include dual ports for redundant network connections.
2. The Smart Mainframe Power Amplifier shall house six (6) active single or dual channel amplifier cards and a seventh (7th) active spare that is automatically engaged in a failure condition.
3. The integrated digital signal processor (DSP) shall provide up to 12 channels of processing to include level control of individual circuits, up to 8 bands of parametric equalization, high pass filter, signal delay, compression (on analog inputs) and ambient analysis control. All setup, monitoring, configuration, testing and control shall be under software control.
4. Ambient Analysis and Control shall be accomplished via an adjustment of signal levels via external noise sensing and/or computer commands. Connections for 24 ambient sensors shall be incorporated via rear panel connections and allow for single or dual sensor control of desired zones.
5. Power Amplifier Cards: The T112 Mainframe with DSP can provide up to twelve (12) main channels of amplification and two (2) backup channels for redundancy. Six of the amplifier cards function as primary cards to drive connected loudspeaker circuits.
6. Automatic Backup Amplifier Switching: The seventh card functions as a redundant backup that is automatically switched to in the event of a card failure.
7. Internal Monitoring: The Smart Mainframe Power Amplifier shall include internal audio bus monitoring and provide for visual as well as audio monitoring of the internal signal chain.
8. Automatic Testing: Testing of the Smart Mainframe Power Amplifier shall be automatic or manually on demand and allow selection of the monitor points in the signal chain internal to the amplifier and current level to the loudspeaker lines and report with a resolution of 0.5dB.
9. Local Inputs: Twelve (12) balanced audio inputs.
10. Input Power: 120VAC (T9160L) utilizing (2) Belden/Volex 17250
    a. No power to amplifiers, quiescent: 75W
    b. 6 power amplifier cards, quiescent: 387W
    c. 6 power amplifier cards (1/8 power): 875W
    d. 6 power amplifier cards (Full Power): 4080W.
11. Audio Distribution: Dante based network audio
12. Maximum Number of Cards: Shall support up to 7 digital amplifier cards
13. Maximum Number of Paging Zones Assignable to Frame: 12 Zones
14. Maximum Number of Amplifier/Loudspeaker Outputs: 12 total zones.
15. Maximum Number of Local Program/BGM Inputs: 12 balanced audio inputs.
16. Rack Units: 4 RUs, 7” vertical space in a 19” wide equipment cabinet.
17. Network Audio: (2) 100 Base-T modular-8 RJ-45, one primary and one redundant.
18. Control: (1) 100 Base-T modular-8 RJ-45.
19. Operating Temperature Range: +32 degrees F to 104 degrees F.

I. Digital Amplifier Cards: The TitanONE dual channel power amplifier modules are Class D, switch mode. Switch mode operation combined with high voltage MOSFET devices make it possible to eliminate transformers. The amplifier card contains no onboard attenuation controls. Attenuation is handled by the TitanONET112 Smart Mainframe.

1. Acceptable products:
    a. AtlasIED T602-120V-T1, 2 channels, 300W, 70V.

b. Or approved equal.

J. Titan Line Driver: Provide line output modules as necessary to interface Titan IED to Dante™ loudspeaker system.

1. Acceptable products:

a. IED T2LD-120V Line Driver.
b. Approved Equal

K. Ambient Noise Sensor Collector: The T112 has connectors on the rear of the chassis for up to twenty-four (24) IED540S ambient analysis sensors. One or two sensors can be used per main amplifier channel. Each ambient sensor intelligently reports the noise level at its location.

L. Ambient Analysis Sensors: IED Model 540S. Provide omni-directional condenser microphone capable of monitoring the ambient sound level of a space using an A-weighted curve, allowing the system to adjust the speaker output level. The sensor shall contain a preamplifier and analog conversion module to convert the signal for input to the ambient analysis system.

1. Mounting: 2-gang junction box
2. Finish: Stainless Steel

M. Paging Microphone: Programmable touchscreen interface with a 7" diagonal LCD screen. The communication station shall be powered via an IEEE 802.3af PoE connection. It shall include a secondary IEEE 803.af ethernet port for redundant network and power capability. It shall provide the ability to mount flush to a surface, on top of a surface, or on a desktop free standing configuration via mounting kit.

1. Acceptable products:

a. IED571D with Handheld Microphone.
b. Or approved equal

N. Paging Microphone RJ45 Lock-In Device: Concealed locking mechanism reduces potential tampering. Keys shall be provided directly to the Owner; keys shall NOT be left at the device locations.

1. Acceptable product:

a. Panduit PSL-DCPLE
b. Or approved equal

O. End of Line Filter Module: IED Model 596EOL. Provide module to monitor the integrity of a single continuous series-wired speaker circuit.

P. Loudspeaker Cable: Trunk loudspeaker cable to Zone Tie Box shall be 12 AWG, stranded, unshielded twisted pair.

1. Acceptable product:

a. West Penn 25227B
b. Or approved equal

Q. Branch loudspeaker cable shall be 14 AWG, stranded, unshielded twisted pair. Maximum distance for total load of 200 watts is 300 ft.

1. Acceptable product:

a. West Penn 25226B.
b. Or approved equal.

R. Ambient Noise Sensor Cable: Shielded twisted pair at 20 AWG tinned-copper conductors; color coded, low-loss polyethylene insulation; with 20 AWG stranded tinned copper drain wire shielded, or as recommended by the equipment manufacturer.

S. UTP Cable: Refer to Section 27 15 00.

T. Homerun Conduits: Speaker circuit home run conduits from the Zone Tie Box (ZTB) to the first speaker in each zone shall be sized to allow future installation of Circuit Integrity cable. These conduits shall be supported every five feet. When speaker circuit home runs for multiple zones are combined in the same conduit, the conduit shall be sized so that the same quantity of installed speaker cables could be replaced with a 0.42" outside diameter fire alarm speaker cable(s) without exceeding NFPA 70 fill ratios.

2.4 DESIGN CRITERIA

A. Programming: The Contractor shall coordinate all hardware and software requirements for Public Address and Voice Evacuation functionality with the DFW Board. This shall include, but is not limited to network connectivity, paging priorities, digital message assembly, system access, microphone paging, paging station button functionality and screens.

B. Levels and Intelligibility: The system shall meet all code requirements for a Voice Evacuation system including power, circuit monitoring and integrity, notification, and survivability. The Contractor shall optimize the system to maximize intelligibility as limited by the architectural acoustics of each space. This shall include adjustments to levels, equalization, timing, and other software tuning.

1. The audio distributed by the sound system shall be 15dB above the ambient background level in all zoned areas.
2. The audio distributed by the sound system shall not vary more than 3dB throughout a public address zone.
3. The following values were used for initial design: ambient sound level of 80dBA in bag make-up and mechanical spaces, and an ambient sound level of 60dBA in all other spaces including those occupied by the travelling public.

C. Digital Message Distribution Operation: The system shall be provided so all voice messages are intelligible at destination areas. Messages shall be coordinated such that dissimilar messages are not distributed within the same area at a given time. Messages shall not be lost due to coordination or priority preemption, unless they are no longer timely.

D. Background Music: Background music distributed over the PA/VE System shall be ducked or muted for any page message within the area affected by the page message. Priority shall be assigned such that emergency paging function shall immediately cancel all other audio announcements or messages in the affected zones. Local paging functions shall have a higher priority than background music, and recorded messages in the local paging zone. Recorded messages shall override background music in all zones.

E. Fault Tolerance and Degraded Mode Operations: The system design shall be based on distributed intelligence. All equipment shall be powered by a high-quality UPS as required by code. Failed or abnormal performance of any active system component shall generate a supervisory signal at the local paging interface, system workstation, and notify the FA System. The system shall be tied into the FA system for reporting of trouble alarms. Coordinate with the DFW Board to determine which PA/VE system faults send a code required trouble signal to the Fire Alarm System. Standby amplifier channels shall automatically take over for failed amplifier

channels. Amplifier outputs shall be protected so they can survive a shorted output line while reporting an off normal condition to the system workstations.

F. LAN Distribution: The system shall be capable of distributing data between PA/VE nodes and from microphone stations to PA/VE nodes utilizing TCP/IP protocol over the DFW Airport Board Ethernet LAN. LAN switches are provided by the DFW Board.

G. Multi-Zone Operation: The system shall perform simultaneous distribution of independent announcements or messages to different zones or groups of zones. The system shall be capable of distributing a minimum of 8 different concurrent messages from any given public address node.

H. Ambient Noise Analysis System: The Ambient Noise Analysis system shall adjust signal levels in response to either ambient noise levels or computer commands. Three (3) modes of operation shall be possible:

1. Automatic: Changes attenuation levels in response to noise levels reported by remote sensors.
2. Controlled: Changes attenuation levels based on remote sensors of automatic channel.
3. Fixed Attenuation: Fixed attenuation as set by the computer and User.

I. High-Quality Sound Reproduction: The system shall provide clean audio, free from noises such as pops, clicks, hiss/hum and access/disconnect tones at all loudspeakers at all times during operation including standby mode. Distortion shall be within specified limits.

J. Capacity: At each equipment location, provide 20 percent spare system capacity including, but not limited to all amplifier card slots, inputs, outputs, patch ports, terminal strip positions, etc.

PART 3 - EXECUTION

3.1 INSTALLERS

A. The Contractor must currently be and have been in the business of selling, installing, and maintaining similar systems at large international Airport for a minimum of five (5) years. The Contractor must have been actively engaged in designing, installing, maintaining and operating similar systems and services as outlined in this document. The Contractor shall be an IED Master Certified Contractor.

B. The Contractor must be a Certified Installer of Innovative Electronic Designs, Inc. (IED) products, holding all current necessary certifications.

C. The Contractor must have a minimum of three (3) sites that are actively using the same or similar solutions, and each of those solutions must be currently in operation and have been in operation for at least the preceding twelve (12) months.

D. Code Certification: The Contractor shall be certified to install and maintain voice evacuation systems that are NFPA 72 certified. The Contractor shall hold a current State of Texas Fire Alarm Contractor License.

E. System Specific Certification: The Contractor shall have a working knowledge of the specified digital audio signal processing and amplification equipment. A current IED Titan Certification or equivalent is required.

F. The Contractor shall have a fully staffed service department capable of responding to system needs as specified. The minimum requirement is a fully staffed service department within 60 miles of the Dallas/Fort Worth International Airport.

3.2 EXAMINATION

A. Refer to Section 27 05 00.

3.3 INSTALLATION AND APPLICATION

A. Refer to Section 27 05 00.

B. Refer to Section 27 05 28 for pathway and raceway requirements.

1. Junction and outlet box sizes shall be in accordance with the NEC, Article 314.28. Minimum box size shall be 4-11/16-inches square.

C. Refer to Section 27 05 53 for conduit and junction box labeling requirements

D. Special Techniques

1. Arrange equipment within cabinets to provide adequate ventilation and access.
2. Properly ground system per applicable Sections.
3. Support backboards and cabinets under the provisions of Divisions 26 and 27, or as required by manufacturer's instructions if more restrictive.
4. Cable and Wiring

a. Installation of conductors shall comply with Division 27 Section 27 15 00 “Communications Copper Horizontal Cabling,” and meet all applicable manufacturer recommendations, local, state and national codes.
b. Grounding Cable Shields: All shields and pair shields shall be grounded at one (1) point only. Cables that originate from processing equipment and serve field devices shall be grounded to the signal ground terminal in the processing equipment.
c. Install PA/VE System wiring away from any surface that may become hot, including and not limited to, hot water piping and heating ducts.
d. Raceway for PA/VE System wiring shall not be shared by power or any other electrical wiring that is not part of the low-voltage public address systems.
e. Microphone cabling shall be isolated from power, speaker, and ambient sensor cabling.
f. Speaker cabling shall be isolated from power, microphone, and ambient sensor cabling.
g. Ambient Sensor cabling shall be isolated from power, microphone, and speaker cabling.
h. Speaker circuits shall be wired in a single circuit each without paralleled branches.
i. Connect speaker circuit shield to equipment ground only at amplifier.
j. Provide protection for exposed cables where subject to damage.
k. Use suitable cable fittings and connectors.
l. All cables shall be cut to the length dictated by the run. No splices shall be permitted in any pull boxes. For equipment mounted in drawers or on slides, the interconnecting cables shall be provided with a service loop of appropriate length.
m. Install all cables no closer than 12” from any horizontal or backbone cabling, power system cable/raceway, or fluorescent/ballasted light fixtures.

n. Leave a minimum of 12” excess cable at each termination at speaker and termination blocks.
o. Leave a minimum of 12’ excess cable at the central system equipment/rack.
p. Provide protection for exposed cables where subject to damage.
q. Cables shall not be installed with a bend radius less than that specified by the cable manufacturer.
r. Label cable at both ends indicating the originating and terminating location of each end with plain English language descriptor identifying the zone and/or function. This labeling/identification shall be fully documented in as-built drawings. Physical zone descriptions shall be posted at zone tie boxes and key to cable identification labels.
s. Test polarity of existing speaker circuits and for shorts prior to connecting wiring to new amplifier.
t. Final connections, balancing, adjustments, testing, etc. shall be by factory trained technicians. When system is complete, it shall be demonstrated to owner’s representative who shall be given complete instructions, part, manuals and maintenance information.

E. Interface with Other Work: Refer to “System Description” in Part 2 for interface requirements.

F. Systems Integration: Refer to “System Description” in Part 2 for integration requirements.

3.4 FIELD QUALITY CONTROL

A. Refer to Section 27 05 00.

B. Phases of Testing: Provide the phased testing in the sequence listed below.

1. Pre-Testing: Refer to testing requirements below.
2. Factory Acceptance Testing: Refer to testing requirements below.
3. Integration Testing: Refer to testing requirements below.
4. Final Test and Completion (FTC): Refer to testing requirements below.

C. Pre-Testing: Prior to any work on the system, the Contractor shall complete pre-testing for any speakers to be reused. Pre-testing shall consist of feeding pink noise into the system using octaves centered at 4,000 and 500 Hz. Use a sound level meter with octave band filters to measure the level at each speaker measured at a distance of 36” (thirty-six inches) for each speaker. The Contractor shall record this measurement in the Shop Submittal Drawings in AutoCAD Format. The Owner shall be notified of any deficiencies observed in pre-testing. At the Owner’s Discretion the Contractor shall replace malfunctioning or damaged items with new, and retest until satisfactory performance and conditions are achieved. This test shall be performed in off hours and in the presence of a representative of the DFW Board. The pretesting shall also include an Acoustic Coverage Test.

D. Factory Acceptance Testing: Refer to Section 27 05 00.

E. Final Test and Completion (FTC)

1. Testing and completion shall comply with NFPA 72, 2019 Ed.
2. Operational Test: Perform an operational system test to verify conformance of system to these Specifications. Perform tests that include originating program material distribution, page material distribution, message distribution coordination, zone distribution selection, message assembly, system supervisory, alarm and monitoring functions, ambient noise control functionality, and paging operator workstation features. Observe sound

reproduction for proper volume levels and freedom from noise. All zones shall be included in the test.

3. Signal-To-Noise Ratio Test: Measure the ratio of signal to noise of the complete system at normal gain settings using the following procedure: Distortion Test: Measure distortion at normal gain settings and rated power. Feed signals at frequencies of 50, 200, 400, 1,000, 3,000, 8,000, and 12,000, Hz into each pre-amp channel and measure the distortion in the power amplifier output. The maximum distortion at any frequency is three percent (3%) total harmonics.
4. Acoustic Coverage Test: Feed pink noise into the system using octaves centered at 4,000 and 500 Hz. Use a sound level meter with octave band filters to measure the level at approximately 40-foot spacing intervals in each zone. For spaces with seated audiences, the maximum permissible variation in level is plus or minus 2 dB and the levels between locations in the same zone and between locations in adjacent zones must not vary more than plus or minus 3 dB.
5. Power Output Test: Measure the electrical power output of each power amplifier at normal gain setting at 50, 1,000, and 12,000 Hz. The maximum variation in power output at these frequencies must not exceed plus or minus 1 dB.
6. The documentation of tests, measurements and adjustments performed shall include a list of personnel and the list of certified test equipment used.
7. All information recorded from all testing shall be shown on the as-built documents.

F. Manufacturer: Provide manufacturer field quality control to assure that all systems and components adhere to the manufacturer's requirements.

G. System Startup: Pre-test: Once all system components are installed, perform pre-testing to ensure all components are correctly connected and installed. Adjust and balance the audio system to meet all requirements.

H. Adjustment: Adjust all system components as necessary to meet system requirements.

1. This includes but is not limited to balancing audio levels, adjusting speaker locations, adjusting speaker tap settings, etc. Tap settings shown on the drawing plans are minimums. The Contractor shall tap all speakers within a zone to the highest setting possible for the specified amplifier.
2. Replace all damage or malfunctioning equipment prior to closeout activities and perform additional field quality control and system startup testing as necessary.
3. All adjustments shall be at the Contractor's expense.

3.5 CLOSEOUT ACTIVITIES

A. Refer to Section 27 05 00.

B. Operational Conformity Test: Where existing speakers are reused, perform the operational conformity test verifying speakers operate in the same manner as they were previously installed based on the original Pretest measurements. The Contractor shall record this measurement in the Record Drawings in AutoCAD Format. Observe sound reproduction for proper volume levels and freedom from noise. This test shall be performed in off hours and in the presence of a representative of the DFW Board.

3.6 MAINTENANCE

A. System Certification: Upon successful completion of the installation and subsequent inspection, DFW shall be provided with a numbered certificate, from the manufacturing company, registering the installation (if applicable).

B. Support Availability: The Contractor shall commit to make available local support as noted in the Warranty section.

C. Provide the manufacturer's standard maintenance and support services for all hardware and software associated with this system at no additional charge for a period of not less than one (1) year.

D. It may be the responsibility of the DFW Board or the DFW Board operator's representative to provide the operational maintenance and support of the installed system after the warranty and maintenance period. Coordination through the DFW Board, or the DFW Board operator's representative shall be required by the installation Contractor to ensure that all documentation for the manufacturer's maintenance and support programs are in place.

E. Contractor shall provide a proposal for an Extended Warranty as noted in the Warranty section of this Specification. The proposal shall include all warranty items noted in this Section.

F. All lead technicians performing installation shall have a minimum of two (2) years' experience on the proposed system and be manufacturer certified on all hardware/software applications prior to work.

END OF SECTION 27 51 16

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