SECTION 275116

PUBLIC ADDRESS AND VOICE ALARM SYSTEM

TABLE OF CONTENTS

1. GENERAL 3
   * + 1. SCOPE 3
       2. SYSTEM SUMMARY 3
       3. SUBMITTALS 4
       4. INFORMATIONAL SUBMITTALS 5
       5. CLOSEOUT SUBMITTALS 5
       6. QUALITY ASSURANCE 6
2. PRODUCTS 8
   * + 1. SYSTEM DESCRIPTION 8
       2. MATERIALS 8
3. EXECUTION 18
   * + 1. GENERAL 18
       2. INSTALLATION OF CABLES 18
       3. INSTALLATION 19
       4. GROUNDING 20
       5. FIELD QUALITY CONTROL 20
       6. STARTUP SERVICE 21
4. GENERAL
   * + 1. SCOPE
          1. In simple terms, this document contains the minimum technical specifications and requirements for the public address system that will be installed in the project. It emphasizes that this work is part of the overall project documentation and should be considered within that context.
          2. The contractor is responsible for completing any additional technical or construction drawings necessary for the project, as well as complying with manufacturer requirements. They are also responsible for achieving the design intent indicated in the design package, including drawings, specifications, and BOQs.
          3. The contractor is required to supply, install, test, commission, and put into operation a complete public address system that meets all the system requirements outlined in the plans, risers, BOQ, specifications, and other contract documents, including any necessary accessories for a fully functional system.
       2. SYSTEM SUMMARY

PAVA (Public Address and Voice Alarm) system cabinet and control shall be installed in the location as shown in the drawings. The zoning of each area shall be as required by the detailed design as indicated in the PAVA system schematic diagrams.

The installation shall be suitable for making complete site broadcast and it shall be possible to individually select each or all subsystems for site broadcasting purpose on selection of any area and before an announcement is made a scheme sound shall sound.

* + - * 1. The public address shall feature multiple number zones, each served by independent amplifiers. The use of amplifiers serving multiple zones shall not be acceptable.
        2. These zones shall be accessed from a fully monitored zoned emergency microphone, high quality pre-recorded alert, evacuation and test messages and a zoned paging microphone.
        3. A fully monitored, processor-driven, DSP based controller system shall route the signals as required and also monitor the connected amplifiers and loudspeaker circuits.
        4. Each zone should be powered by class D amplifiers which shall provide both class A and class A+B monitored circuits.
        5. Public Address rack shall contain at least one digital Signaling processor Audio unit (DSP), Automatic Gain controller, and Matrix.
        6. Remote Voice alarm and Public Address Controllers should be used depending on the size of the project.
        7. Loudspeaker circuits must undergo impedance monitoring to ensure detection of 100% open circuit, short circuit, and earth failure detection. The monitoring system should not be affected by audio presence and should work with standard loudspeakers. The amplifier load can be diagnosed by examining the impedance, with low impedance indicating an overloaded amplifier.
        8. In the event of mains AC failure, the system shall automatically switch to an integral fully monitored DC power supply. This is sized to support the system for 24 hours in standby conditions (quiescent) and for a further 30 minutes use at full load as per EN54-4 requirements.
        9. The central equipment will be housed in 19” equipment racks supplied complete with lockable glazed front doors. Cable access shall be via the back of the racks, with labeled DIN- rail mounted terminals fitted at the rear.
        10. Evacuation, alert and test messages shall be stored digitally in the units. Broadcast of these messages will be controlled automatically by the fire alarm system, or manually from the emergency microphone. When activated from the fire alarm system, the messages will again require an input from the PCI system to cease broadcasting. In accordance with EN54, messages activated in this manner cannot be muted from the emergency microphone.
        11. Volume Controller and Channel Selector should be installed where indicated on the layout drawings.
      1. SUBMITTALS
         1. Product Data: For each type of the product indicated Include dimensions and data on features, performance, electrical characteristics, rating and finishes.
         2. Shop Drawings:

Detail equipment assemblies and indicate dimensions, weight, loads, required clearances, method of field assembly, components and location & size of each field connection.

Functional Block diagram: Show single-Line interconnections between components for signal transmission and control provide cable types and sizes.

Dimensioned plan and elevation of equipment rack, control panel and consoles. Provide access and workspace requirement.

Provide wiring diagram for power, signal and control wiring.

* + - * 1. Provide materials, equipment and services, and perform operations required for the installation & commissioning of the complete and fully operational systems as generally specified herein.
        2. Design drawings, method statement, & bill of material shall be provided as part of a material submittal.
        3. All system devices must be allowed to be easily replaced or upgraded. The solution should allow to connect at least 127 extension units to a single controller for a total of 1024 zones.
        4. The vendor shall describe what methods are available to detect and repair system malfunctions.
        5. Equipment List: provide every piece of equipment by Model number, Manufacture, serial number, location and date of original installation. Provide pre-testing record of each piece of equipment, listing name of person testing, date of test, set point of adjustments, name and descriptions of the view of preset positions, descriptions of alarms and description of unit output response to an alarm.
        6. Calculations

Sound Pressure Level (SPL)

Power distribution lines

* + - 1. INFORMATIONAL SUBMITTALS
         1. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings are shown and coordinated with each other, using input from installers of the items involved.
         2. Qualification Data: for installer and certification agency.
         3. Seismic Qualification Certificates: For control consoles, equipment cabinets and racks, accessories, and components, from manufacturer.

Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation. Include qualification data for testing agency.

Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

* + - * 1. Field quality-control reports.
      1. CLOSEOUT SUBMITTALS

As-Built Drawings: Prior to contract close-out, submit one copy of the system As-Built 'drawings and documents to the Consultant for review. Submit two copies to the Project Managers.

Cutover and Training: The subcontractor shall provide support during and immediately after system start-up. This will ensure quick response time to any issues that may arise. Training shall be provided to ensure knowledge transfer regarding documentation, moves, adds and changes and related activity. The subcontractor shall conduct a training session explain and orient the staff.

Operation and Maintenance Manuals:

Prior to system acceptance and commissioning, submit three copies of the operation and maintenance manuals to the Consultant for review.

This manual shall describe how to operate and maintain the systems.

This manual shall be targeted to be technically competent engineers to describe in full detail these specific systems.

The manuals shall be bound. At acceptance testing, turn over soft copies of the manual to the owner.

It is expected that user training shall be based on these manuals.

List of spare part and replacement components recommended to be stored at the site for ready access.

* + - 1. QUALITY ASSURANCE
         1. Manufactures Qualifications

Manufacturing firms of public address system shall be regularly engaged in manufacturing of the systems of type, size and characteristics similar to those required by the Contract for this project and whose products have been in satisfactory service in similar projects for not less than five (5) years.

* + - * 1. Installer Qualifications

Engage an experienced contractor who is a factory-authorized sales and service representative to perform the work of this section. The contractor firm shall have at least five (5) years of successful installation experience of related systems similar to that required for this project.

* + - * 1. Approved vendor / Manufacturer List

Contractor is required to comply with the approved vendor list. Any deviation must be documented and approved by the design engineer through the official approval procedure updated at the time of the project.

The Supplier/Installer/Manufacturer must be registered with the consultant through the official procedure prior to submitting the technical material submittal.

The Contractor must follow the approved vendor list for the project. Approved equal manufacturers must be submitted to the Design Engineer for Approval through the official registration procedure.

Supplier /Installer must submit Official letter from the manufacturer indicating the level of partnership and support level given to the system supplier/installer.

Supplier/Installer must submit detailed reference list indicating similar projects installations indicating location P/N and quantities of installed items.

* + - * 1. Training

A technician authorized by the manufacturer shall be able to provide training to the contractor at the time the contractor needs it.

* + - * 1. Warranty

The manufacturer must guarantee two (2) year after the handing over date to the End User that the products referenced within the specific Warranty Modules when correctly installed in accordance with installation guidelines.

All components must be produced by the same system manufacturer, unless by written approval from the consultant.

* + - * 1. Licenses

The systems shall be provided with all necessary licenses and allow for any future upgrade software /firmware. Online notifications should be included to allow for any software versions upgrades according to service level agreement with project operator.

1. PRODUCTS
   * + 1. SYSTEM DESCRIPTION
          1. Compatibility of Components: Coordinate component features to form an integrated system. Match components and interconnections for optimum performance of specified functions.
          2. Equipment: Comply with EN54. Equipment shall be modular, using solid-state components, and fully rated for continuous duty unless otherwise indicated.
          3. The materials described below must have at least a 2-year warranty. In addition, a support team must be available to assist in the repair of these components, whether under warranty or not.
       2. MATERIALS
          1. PA/VA MAIN CONTROLLER

The public address, background music and voice alarm system’s main controller shall be a compact EN 5416 certified PA/VA system that ensures a fast, safe and controlled emergency evacuation.

1. Must be EN 5416 and EN60849 certified.
2. 5 audio inputs
3. Up to 8 class D amplifiers with two configurations for 100V/70V lines
4. Audio Matrix 8x8 (digital up to 40x1024)
5. 8 preamp outputs for external PA amplifiers connection
6. Up to 8 multi-zone microphones or voice alarm panels connected with CAT5 UTP cable
7. DSP must contain: 7-band input/output parametric equaliser, loudness, sound enhancer, independent volume control per each I/0 channel and audio filters
8. Triple Ethernet port: for digital audio, remote control and supervision, and for escalating the system with extension controllers (up to 1024 zones).
9. Up to 4GB of internal memory for pre-recorded messages
10. Must have integrated emergency microphone.
11. Programmable delay available on all outputs
12. Control for up to 32 attenuators.
13. At least 22 GPIO ports (8 supervised for integration with fire alarm control panel).
14. Detection and indication of failure in all emergency functions.
15. Integration with fire alarm control panels.
16. TCP / IP connectivity
17. Manual control of emergency states with access control.
18. Recording output in emergency state.
19. Provide loudspeaker line supervision.
20. A+B connection (16 lines) and Class A connection should be provided by the processor
21. Back up amplifier connection: 7+1 (120W channels)

The main controller must have the ability to be scalable to support higher power. This can be achieved by implementing extensions that provide greater coverage and thus cover larger enclosures.

To improve this feature, the following aspects should be considered:

1. Modular design: the main controller should have an architecture that allows the incorporation of additional power modules easily and quickly. This will ensure greater flexibility and scalability in case coverage needs to be expanded.

2. Compatibility: The additional extensions must be compatible with the main controller, both in terms of communication and control protocols. This will allow for seamless integration and ensure proper operation of the extended system.

3. Power capability: The extensions must have their own power supply, either independent or coming from the main controller. This will ensure that the system has sufficient power to cover the desired area. In addition, protective measures such as fuses or safety switches should be considered to prevent overloads and damage to the devices.

4. Simplicity of installation: Extensions should be easy to install and configure. This will help reduce the time and resources required to perform the extension of the main controller. Clear instructions should also be provided and detailed instructions to guide the user through the installation process.

* + - * 1. AMPLIFIERS

1. The system shall include high quality 100V /70V line amplification: All amplifiers shall be Class D type and shall be monitored for proper operation and correct gain settings to ensure that the correct settings are maintained.
2. Gain control shall normally be through the routing equipment; however, each amplifier shall include a preset gain control on the rear panel.
3. Each amplifier shall include an independent AC power supply system and a DC backup power supply to minimize the effect of any faults. The system shall be capable of indicating a failure of the DC power supply to an amplifier (including the DC fuse) when the amplifier is powered from the AC mains.
4. Front panel indicators shall include a yellow bridge-mode indicator (one per channel) that illuminates when the channel is set in emergency state or alarm state.
5. The amplifier shall be fully compatible with and shall provide appropriate input cables and connectors.
6. The amplifier chasis shall be constructed of steel with durable black finish and shall be designed for continuously variable-speed forced-air ventilation from the front panel to the back panel.
7. The dimensions of the amplifier shall allow for 483mm EIA standard (19” rack mounting).
8. Power or control switches on the front of the amplifier shall not be acceptable according to the requirements of EN54 Part 16.

Amplifiers shall have the following functions:

* Stackable type
* Quarter, Eighth 250 watts/500 watts
* Power rating
* 80Hz - 20kHz Frequency response
* <0.5% Distortion factor according to IEC 62368-3
* >93 dB Signal to noise ratio
* 100V / 70 V Line output
* LED indication
* Forced air cooling
* Integral power supply 230Vac - 24Vdc
* 2U rack mounting

Each circuit shall have its own amplifier, a backup amplifier should be considered to switch automatically in case of any failure of the service amplifier.

* + - * 1. POWER SUPPLY AND STANDARD BATTERIES

The power supply needs to have the ability to recharge batteries, distribute battery current during an alarm, test the battery grid, indicate operating states, and provide at least 30 minutes of endurance during an alarm. A standby supply should be included to ensure continuous operation in case of a mains AC supply failure.

The changeover to the standby supply should be automatic and silent, with batteries being charged when mains power is present. Each amplifier's power feed should be protected against short circuit faults separately. The surveillance system should be able to detect individual battery failures, so solutions using paralleled batteries are not acceptable.

Power feeds to each amplifier shall be separately protected against short circuit faults. The surveillance system shall be capable of detecting individual battery failures therefore solutions employing paralleled batteries are not acceptable.

* + - * 1. MICROPHONES

High performance desktop microphone for professional PA installations. Indicator lights to show active status, busy line or permission to speak granted.

It is able to work under different systems and with different operating modes: on/off button, push-to-talk button and warning tone to start/cut communication. The following microphones has to provide the features below.

Paging Microphone:

High performance dynamic capsule.

Local power supply 5V DC, 200mA.

Audio Output: 750 mV 600 balanced.

Frequency Response: 200 – 15kHz.

Configurable contact relay for auxiliary system.

S/N ratio 100dB (A-weighting).

Busy line and conceded-word indicators.

Lighting indicator placed in the goose-neck.

Multi-zone Paging Microphone

8-zone programmable buttons.

System event activator.

Recall function.

Auto-lock function.

LED indications for zone selection.

LED indicators of the system's state (EMG, FLT or LINK).

LED Indicators of busy and conceded word.

Power directly from system through the UTP cable.

High performance durable microphone capsule.

It should be scalable to more zones.

* + - * 1. VOICE ALARM PANEL

Voice alarm panel to provide EN54 public address/surveillance systems with evacuation system controls for different zones.

It should allow to know the status of the system and to issue both live and pre-recorded alarm and evacuation announcements through up to 56 evacuation zone selection memories.

It must have at least 7 expansion keypads with 8 zone memories each. In addition, the available expansion keypads can be adjusted to the special characteristics of each system.

The equipment must also offer a choice of power supply between local or supplied via the ACSI bus. The ACSI bus allows a maximum total wiring of 1000 m and offers priority levels for devices connected in bus mode.

Features such as volume control, dynamic sound adjustment and programmable buttons enable other system functions such as pre-recorded message broadcasting.

The characteristics of these Voice Alarm Panel must be as follows:

General Features

1. Up to 56 group memories of up to 8 zones per memory (448 zones of the system).
2. Prior notice tone.
3. Volume adjustment.
4. Power supply indicator.
5. Emergency condition general indicator.
6. Fault condition general indicator.
7. Link with system fault indicator.
8. Power supply fault indicator.
9. Emergency microphone fault indicator.
10. Broadcasting of voice evacuation message indicator.
11. Broadcasting of voice evacuation recorded message indicator.
12. Broadcasting of voice alarm message indicator.
13. Remote control indicator.
14. Emergency controls, Reset, Acknowledge, Test, Alarm message, Evacuation message.
15. Side port to connect up to 7 expansion keyboards.
16. Priority configuration and operating parameters.
17. Local or peripheral power supply.
18. Wall or 19” rack installation.
    * + - 1. LOUDSPEAKERS

In this section, the speakers recommended by the manufacturer have several notable features. First, they are designed to provide high-quality sound reproduction, ensuring an immersive audio experience for users.

In addition, the recommended speakers feature a wide frequency response range, allowing them to reproduce both low and high frequencies.

Celling Loudspeakers:

EN54-24 ceiling speaker with metal housing for 70/100V lines of high quality for speech and background music.

1. Provide consisten 120º broadband pattern control for consistent coverage of listening area.
2. Provide integrated back box for blind-mount install with grille and tile rails included.
3. Provide 70Volts / 100 Volts operation.
4. Power nominal capacity: 6Watts (9Watts as max power)
5. Frequency Response (-10dB): 100Hz - 20kHz
6. Transformer Taps (100V): 6Watts, 3Watts, 1’5Watts, 0’75Watts
7. Transformer Taps (70V): 3Watts, 1’5Watts, 0’75Watts, 0’375Watts
8. Sensitivity - 89dB (1Watts / 1m) - 97dB full power octave band with
9. Termal fuse has to support 150º at least
10. Dimensions: Φ 200 mm x 90 mm
11. Color: White (RAL 9016) / Red (RAL 3000)
12. Provide IP44 protection grade (Type A according to EN54-24)

High Power Celling Loudspeaker:

1. Provide consisten 120º broadband pattern control for consistent coverage of listening area.
2. Provide integrated back box for blind-mount install with grille and tile rails included.
3. Provide 70Volts / 100 Volts operation.
4. Power nominal capacity: 30Watts (45Watts as max power)
5. Frequency Response (-10dB): 100Hz - 20kHz
6. Transformer Taps (100V): 30Watts, 15Watts, 7’5Watts, 3’75Watts
7. Transformer Taps (70V): 15Watts, 7’5Watts, 3’75Watts, 1’8Watts
8. Sensitivity - 93dB (1Watts / 1m) - 106dB full power octave band with
9. Termal fuse has to support 115º at least
10. Dimensions: Φ 224 mm x 129 mm
11. Color: White (RAL 9016) / Red (RAL 3000)
12. Provide IP44 protection grade (Type A according to EN54-24)

Surface Loudspeaker:

Surface mount speaker EN 54-24 for 70/100V lines both for music and high-quality voice applications. It is designed for surface installation, both for ceilings and walls.

1. Frequency response (-10dB): 300Hz - 15kHz
2. Power capacity: 6Watts
3. Transformer tappings: 6Watts, 3Watts, 1’5Watts, 0’75Watts (100V)
4. Sensitivity: 87dB (1Watts / 1m)
5. Maximun SPL: 95 dB
6. 180º Dispersion 1kHz; 90ºH 100ºV Dispersion 2kHz
7. Nominal impedance: 1’7k ohm
8. Provide ceramic terminal connection
9. Provide IP21C protection
10. Dimensions: 170x170x63 mm;
11. Speaker diameter 5”

Wall Mounted Column Loudspeakers:

Directive column loudspeakers of high quality certified according to EN 54-24 fire alarm.

Low-Power Column speaker (system requirements):

1. Frequency response (-10dB): 130Hz - 15kHz
2. Power capacity: 15Watts
3. Transformer tappings: 15Watts, 7’5Watts, 3’75Watts (100V)
4. Sensitivity: 84’5dB (1Watts / 1m)
5. Maximun SPL: 94’5 dB
6. Nominal impedance: 666 ohm
7. Provide IP54 protection (type B according to EN54-24)
8. Dimensions: 96x98x180 mm; Speaker diameter 2x2’5”

Medium-Power Column speaker:

1. Frequency response (-10dB): 130Hz - 15kHz
2. Power capacity: 60Watts
3. Transformer tappings: 60Watts, 30Watts, 15Watts (100V)
4. Sensitivity: 87dB (1Watts / 1m)
5. Maximun SPL: 103 dB
6. Nominal impedance: 166 ohm
7. Provide IP54 protection (type B according to EN54-24)
8. Dimensions: 96x98x680 mm; Speaker diameter 8 x 2’5”

High-Power Column speaker:

1. Frequency response (-10dB): 130Hz - 15kHz
2. Power capacity: 90Watts
3. Transformer tappings: 90Watts, 60Watts, 30Watts (100V)
4. Sensitivity: 91dB (1Watts / 1m)
5. Maximun SPL: 108 dB
6. Nominal impedance: 111 ohm
7. Provide IP54 protection (type B according to EN54-24)
8. Dimensions: 96x98x980 mm; Speaker diameter 12 x 2’5”

Horn Loudspeakers:

High performance voice alarm horn loudspeaker certified according EN54-24 standard. It shall have a broad frequency range, low distortion, and high sound pressure level ensure the delivery of intelligible voice and high quality sound. It is made of ABS.

1. Frequency response (-10dB): 350Hz - 12kHz
2. Power capacity: 15Watts
3. Transformer tappings: 15Watts, 10Watts, 5Watts (100V)
4. Sensitivity: 105dB (1Watts / 1m)
5. Nominal impedance: 1’7k ohm
6. Provide ceramic terminal connection
7. Provide IP66 protection (according to EN54-24)
8. Relative humidity: Up to 95%
9. Dimensions: Φ213mm x 265 mm;
10. Connection must be with fire resistant cable.

Projector Loudspeaker:

Acoustic projector for high quality 70 / 100V lines of music and voice reproduction with anti-vandal and weather protection features. Possibility of bidirectional model.

1. Frequency response (-10dB): 130Hz - 20kHz
2. Power capacity: 20Watts (30Watts peak)
3. Transformer tappings: 20Watts, 10Watts, 5Watts, 2’5Watts (100V)
4. Sensitivity: 89dB (1Watts / 1m)
5. SPL max: 99 dB (1m)
6. Nominal impedance: 500 ohm
7. 190ºH 180ºV Dispersion 1kHz
8. 100º Dispersion 2kHz
9. Provide ceramic terminal connection
10. Dimensions: Φ138mm x 205 mm;
11. Provide IP65 protection
12. Speaker diameter: 5”
    * + - 1. END OF LINES DEVICE

The end of line device provides an accurate measurement of the impedance of the speaker line (400 R/200 R configurable load), in order to test the line integrity between the speakers and the PA/VA system. This allows to supervise the line until the last speaker without return cable, even when the line has smaller loads with just 1 or 2 speakers.

Several devices shall be connected to the same speaker line. It should be compatible with all EN54 PA/VA systems with the latest firmware version.

General features

1. Supervision of 70 V or 100 V speaker lines.
2. Easy connection and installation, surface mountable.
3. Several devices can be connected to the same speaker line.
4. Small dimensions.
5. Low consumption.
6. Higher accuracy on impedance measurements.
7. Supervision until the last speaker, even in low load speaker lines.
8. No return cables.
9. 400 R/200 R configurable load for 19 kHz tone.
10. Compatible with EN54 PA/VA systems with the latest firmware version.
    * + - 1. VOLUME AND CHANNEL CONTROLLER

Volume and channel control device to be rack-mounted together with the main controller and extensions. This device shall have the following features:

1. Installation in local zone and connected via bus to the system.
2. Provide 99 programmable channels.
3. Volume control (0-9).
4. Bus RS-485.
5. 4 P terminal block.
6. DIP switch.
7. LCD Display of 2 x 8 character type.
8. EXECUTION
   * + 1. GENERAL

The installation of the public address system shall fully comply with EN-54 standard, which sets the requirements for fire detection and fire alarm systems. The complete Public Address shall be installed and commissioned by the equipment manufacturers approved licensed supplier.

By using approved suppliers, the installation process can be carried out by professionals with the necessary knowledge and expertise in handling the specific equipment. This ensures that the system is installed correctly and is ready to operate efficiently.

Public address & voice evacuation system cabling shall be installed over a GI cable trunking in open areas like the car parks, mechanical spaces & warehouse areas. Cabling will be open clipping in other areas above false ceiling with proper clipping as per the manufacturer recommend distance. All cable entries through external walls shall be made weatherproof.

* + - 1. INSTALLATION OF CABLES
         1. Comply with EN-54.
         2. General Cable Installation Requirements:

Install the system as indicated, in accordance with equipment manufacturer's written instructions (official installation manuals) and complying with applicable local Public Address System standards of installation. Installation of equipment and devices that pertain to other Works of the Contract shall be closely coordinated with the appropriate trades.

Pulling Cable: Do not exceed manufacturer's recommended pulling tensions. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between normal termination points. Remove and discard cable where damaged during installation and replace it with new cable.

Identify system components, wiring, cabling, boxes, panels and terminals. Comply with requirements for system identification according to project operator requirements.

System labeling scheme must be submitted to the End user project operator for approval. Operator teams labeling requirements should be considered.

Install framed operation instructions in visible locations as required.

As recommended by manufacturers & any specific Operator standards, unless more stringent requirements are indicated. Ground equipment and conductors to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments. Install Grounding system in complete accordance with system manufacturer's requirements and manual instructions.

Cables should be listed for the system specific application and installation requirements.

All wires and cables shall be listed and/or approved by a recognized testing agency.

All wiring shall be color coded and cabled. Junction boxes shall be color coded and include wiring identification numbering.

Wires and cables shall provide sufficient resistance to the spread of fire and generate no hazardous smoke to human life.

Wiring System shall include all indoor and outdoor cables necessary for complete system installations.

* + - * 1. Separation of Wires: Separate speaker-microphone, line-level, speaker-level, and power wiring runs. Install in separate pathways or, where exposed or in same enclosure, separate conductors apart for speaker microphones and adjacent parallel power and telephone wiring following the manufacture manual. Separate other communication equipment conductors as recommended by equipment manufacturer.
      1. INSTALLATION
         1. Coordinate layout and installation of system components and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.
         2. Match input and output impedances and signal levels at signal interfaces. Provide matching networks where required.
         3. Identification of Conductors and Cables: Color-code conductors and apply wire and cable marking tape to designate wires and cables so they identify media in coordination with system wiring diagrams.
         4. Installation of Racks:

Provide enclosed racks with front and rear doors where shown on drawings and secure to wall/floor/ceiling as equipped.

In locations where more than one rack is required, butt multiple racks together.

All wiring shall be run neatly bundled with wiring management channels.

Properly ground racks and equipment to room ground bus.

* + - * 1. Volume Limiter/Compressor: Whenever the project requires it, equip each zone with a volume limiter/compressor. Install in the central equipment cabinet. Set it up to provide constant input to the power amplifiers.
        2. End of line Devices: Each loudspeaker line must have an end-of-line terminator installed, this ensuring a current return to the equipment, where it can be verified that the closed circuit has no short circuits or shunts to ground.
        3. Floor-Mounted Outlets: Conceal in floor and install cable nozzles through outlet covers. Secure outlet covers in place. Trim with carpet in carpeted areas.
        4. Conductor Sizing: Unless otherwise indicated, size speaker circuit conductors from racks to loudspeaker outlets not smaller than No. 18 AWG.
        5. Weatherproof Equipment: For units that are mounted outdoors, in damp locations, or where exposed to weather, install consistent with requirements of weatherproof rating.
        6. Speaker-Line Matching Transformer Connections: Make initial connections using tap settings indicated on Drawings.
      1. GROUNDING
         1. Ground cable shields and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.
         2. Signal Ground Terminal: Locate at main equipment cabinet. Isolate from power system and equipment grounding.
         3. Grounding conductors should be sized appropriately to handle the maximum current that could flow through them.
         4. Separate grounding systems should be used for electrical and electronic equipment to prevent interference.
      2. FIELD QUALITY CONTROL
         1. The contractor is responsible for submitting the required testing and commissioning procedures based on the Manufacturer's requirements. This includes parameters and features that are factory tested. All relevant certificates from the manufacturers and third-party organizations must be provided by the contractor for approval by the End user Representative.
         2. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
         3. Visual inspection is an essential step that should be conducted prior to testing in any field service or maintenance operation. It involves carefully examining the components, assemblies, and equipment installations to identify any visible issues or damage that may affect their performance or reliability.

During the visual inspection, the factory-authorized service representative will visually inspect the components, assemblies, and equipment connections. They will look for signs of wear and tear, corrosion, loose or damaged parts, improper installations, and any other visible issues that could potentially impact the operation or safety of the equipment.

The visual inspection helps in detecting problems at an early stage, preventing any further damage or failures that may occur during testing or regular operation. It also ensures that the equipment is installed and connected correctly, avoiding any potential electrical, mechanical, or safety hazards.

* + - * 1. Tests and Inspections:

Schedule tests with at least seven days' advance notice of test performance.

After installing public address system and after electrical circuitry has been energized, test for compliance with requirements.

Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

The system will be considered defective if it does not pass tests and inspections.

* + - * 1. Inspection: Verify that units and controls are properly labeled and interconnecting wires and terminals are identified.
        2. Public address system will be considered defective if it does not pass tests and inspections.
        3. Prepare test and inspection reports. Provide an overview of the purpose and scope of the test and inspection reports.
      1. STARTUP SERVICE

The manufacturing company will be responsible for performing the system start-up service, either remotely or on-site, using specialized technicians who will be in charge of configuring the system and making sure it is working properly.

In the case of remote commissioning, the technician will use remote access tools to be able to perform the necessary configurations, without the need to physically travel to the system location.

Once commissioning has been completed, the supplier shall issue a certificate of completion of the installation, thus commencing the warranty period.