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SECTION 275119.11 - SOUND MASKING SYSTEMS

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PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Networked sound-masking system.
2. Wire and cable.

B. Related Requirements:

1. Section 095123 "Acoustical Tile Ceilings."
2. Section 270528 "Pathways for Communications Systems" for conduits, wireways, surface pathways, innerduct, boxes, enclosures, and cabinets serving communications systems.
3. Section 284621.11 "Addressable Fire-Alarm Systems" for mute sound masking in the event of a fire emergency.

4. Section 284621.13 "Conventional Fire-Alarm Systems" for mute sound masking in the event of a fire emergency.

1.2 REFERENCES

- A. ANSI S1.4, "Specification for Sound Level Meters."
- B. ANSI S1.6, "Preferred Frequencies and Filter Band Center Frequencies for Acoustical Measurements."
- C. ANSI S1.11, "Octave-Band and Fractional-Octave-Band Analog and Digital Filters."
- D. ANSI 709.1, "Control Network Protocol Specification" for standards related to open platforms.
- E. ASTM E1374, "Standard Guide for Open Office Acoustics and Applicable ASTM Standards."
- F. ASTM E1573, "Standard Test Method for Measurement and Reporting of Masking Sound Levels Using A-Weighted and One-Third-Octave-Band Sound Pressure Levels."
- G. ASTM E1130, "Standard Test Method for Objective Measurement of Speech Privacy in Open Plan Spaces Using Articulation Index."
- H. ASTM E2638, "Standard Test Method for Objective Measurement of the Speech Privacy Provided by a Closed Room."
- I. NFPA 72, "National Fire Alarm and Signaling Code."
- J. UL 1310, "Standard for Class 2 Power Units."
- K. UL 1480, "Standard for Speakers for Fire Alarm and Signaling Systems, Including Accessories."
- L. UL 2043, "Standard for Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces."
- M. UL 2572, "Standard for Mass Notification Systems."
- N. UL 60065, "Standard for Audio, Video and Similar Electronic Apparatus - Safety Requirements."
- O. UL 6500, "Standard for Audio/Video and Musical Instrument Apparatus for Household, Commercial, and Similar General Use."

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 1. Include construction details, material descriptions, dimensions, profiles and finishes of individual components.

2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
3. Include nationally recognized testing laboratory listing data for plenum-mounted and rack-mounted equipment.

B. Shop Drawings: For sound-masking systems.

1. Include plans, sections, and mounting details for all system components. Provide schematics of system design including floor plan indicating quantity, type, and location of components.
2. Include details of equipment assemblies and installation instructions. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data:

1. Provide as-built drawings of the system including schematics and floor plans indicating quantity, type, and location of components, cabling, and accessories.
2. Operation and maintenance manuals.
3. Provide warranty documentation, with start date(s) and service contract(s).

B. Software and Firmware Operational Documentation:

1. Inventory of system components, with model and serial numbers for each.
2. Software operating and upgrade manuals.
3. Program Software and System Settings Backup: On digital media complete with data files. Provide electronic backup file of all system settings.
4. Device address list.
5. Printout of software application and graphic screens.
6. Provide login ID and password(s) to access control functions on the graphical user interface, if applicable.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Factory qualified and certified to install products listed.

1. Responsible for system specified and single contact point for Architect, Consultant, Fire Protection Engineer, and/or Owner with respect to sound-masking work specified.
2. Experienced in design, fabrication, installation, checkout, and warranty contract management of sound-masking systems.

B. Obtain required permits.

C. Follow applicable codes, including regulatory testing and certifications.

- D. Equipment and associated hardware fabricated and installed in accordance with manufacturer's instructions.
- E. Configuration and commissioning by an authorized manufacturer representative, certified installer, with a commissioning specialist, or their approved agent.

1.6 COORDINATION

- A. Coordinate quantity and arrangement of sound-masking system components with ceiling space configuration and with components occupying ceiling space, including structural members, pipes, air-distribution components, raceways, cable trays, luminaires, and other items.
- B. Coordinate raceway system material, routing and locations with Division 26 Contractor, General Contractor, or Construction Manager.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Deliver in manufacturer's original unopened and undamaged packages with manufacturer's labels legible and intact.
- B. Store and handle in strict compliance with manufacturer's written instructions and recommendations. Protect from moisture during shipping, storage, and handling.
- C. Inspect manufacturer's packages upon receipt.

1.8 WARRANTY

- A. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace sound-masking loudspeaker control units and loudspeakers that fail in materials, workmanship, or performance within one year (warranty period) from date of installation.
 - 1. At Closeout, provide to Owner an executed copy of manufacturer's standard limited warranty against manufacturing defects, outlining terms, conditions, and exclusions from coverage.
- B. System components for sound masking must carry a minimum 10-year warranty. Warranty statements must be submitted prior to notice to proceed.
 - 1. Warranty Period: Ten (10) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Source Limitations: Obtain components for sound-masking system from a single source.

- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Compliance Standard: Fabricate and label electronic components to comply with UL 60065 or UL 1419.
- D. Compliance Standard: Fabricate and label components to comply with UL 2572, in order to interface with a Fire Alarm Control Unit (FACU).
- E. Wire, cable, devices, and assemblies installed in air-handling spaces to be plenum rated, complying with NFPA 70 requirements for rate of heat-release and smoke-release characteristics. Tests for these requirements to be in accordance with UL 2043.

2.2 NETWORKED SOUND-MASKING SYSTEMS

- A. Description: Networked decentralized architecture for sound-masking or sound-masking with paging and background music with digital control of addressable system devices. Digital network controls at control panel include adjustments and monitoring and display of current settings for sound-masking and paging of loudspeaker controls, associated network devices, and control panel components.
- B. Basis-of-Design Product: Subject to compliance with requirements, provide Lencore: i.Net System
- C. Network:
 - 1. Provide an Ethernet LAN to connect controller/gateways to a PC running a Microsoft Windows operating system, macOS, or iOS.
 - 2. Network controls to be available at the control panel, or using a PC connected to the control network, or via Ethernet to Local Area Network.
- D. Network Control Panel. Single system control for entire building or buildings by providing operation of multiple system components from a single, central location.
 - 1. Sound-Masking Performance: Digital signal processing (DSP) technology for masking sound generation and output adjustment of masking signals.
 - a. Masking Sound: Generated via a truly random, non-deterministic digital process with no repeat cycle within a 24-hour period.
 - b. System Requirements:
 - 1) Single Control Unit: Capable of addressing entire system. Multiple control units not acceptable.
 - 2) Integrated Sound-Masking Digital Signal Processors (DSPs): Utilize an open platform network technology, meeting open control standards with web appliances, browser interfaces, infrared remote controls, and internet access capable.
 - 3) Sound-Masking System Shutdown: Through interface with FACU as described in Section 283100 "Intrusion Detection."

- a) Compliance: UL 2572.
 - 4) Standards for Open Platform: Comply with ANSI/CEA 709.1.
 - 5) Multi-drop network system; point-to-point systems are unacceptable.
 - 6) Complete diagnostics capability of entire system functions including diagnostics of network, hubs, nodes, routers, DSP, relays, memory, circuitry, amplifiers, and power.
 - 7) Report entire settings for each zone, indicating at a minimum the volume, contour, equalization, diagnostics, and zones and channel groupings.
 - 8) Diagnostics and remote administration via a standard web browser.
 - 9) Capable of naming network nodes, channels, zones, and external audio sources via its integrated graphical user interface.
 - 10) Central Zoning Control: Capable of separately and independently configuring zones for sound masking via the network, zoned through its singular central control.
 - 11) System Tuning: Through network, hand-held remote or keypad.
 - 12) Equalizer: 30-Band one-third-octave compatible via DSP.
2. Sound-masking adjustment for each loudspeaker control unit:
- a. Masking Sound: 20 Hz to 20 kHz, with equalizers for adjusting the masking-sound spectrum at one-third-octave resolution.
 - b. Masking-Sound Volume Adjustment: Digital control, adjustable in 0.5-dBA increments over the range of 34 to 82.5 dBA or a continuous adjustment within that range.
 - c. Twenty-nine (29) preset contour options. Adjust contour from minus 14 to plus 14.
3. Paging Inputs: Provision for the devices listed below, with analog-to-digital conversion of audio signals.
- a. Telephone.
 - 1) Input Impedance: 600 ohm.
 - 2) Operating Loop Current: 13 to 120 mA.
 - 3) Dynamic Range: 82 dB.
 - 4) Receive THD: Minus 82 dB.
 - b. Auxiliary.
 - 1) Input Impedance: 10 kilohms.
 - 2) Input Level: 3.5 V(rms) maximum.
 - 3) Gain, Max: 6 dB.
 - c. Microphone.
 - 1) Input Impedance: 600 ohm.
 - 2) Input Level: 70 mV maximum.
 - 3) Gain, Max: 60 dB.

4. Paging Performance:
 - a. Paging Volume Control: 34 to 83 dB in 1 dB steps with mute setting.
 - b. One-octave signal equalizer, with 10 bands, 31.25 Hz to 16 kHz.
 5. Enclosure: 1 RU rack enclosure for mounting in a rack unit or on a wall.
- E. Control Network Software: Microsoft, Windows, macOS, or iOS based.
1. Description of Functions:
 - a. Communicate with network control panel(s) to assign device addresses and to configure network hardware.
 - b. Security: 128-bit AES encryption and user passwords.
 - c. Setup data to be saved in electronic and printed formats.
- F. Sound-Masking Loudspeaker Control Unit: Addressable, connected to the sound-masking system control network. Unit has no physical controls; all settings to be from the network control panel.
1. Masking-Sound Generator: Digital, solid-state, random sequence noise generator, stable in sound spectrum and output level, and containing the following:
 - a. Electronic sound amplifier and equalizers for shaping the masking-sound spectrum.
 - b. Masking Sound: 20 Hz to 20 kHz, with equalizers for adjusting the masking-sound spectrum at one-third-octave resolution.
 - c. Masking-Sound Volume Adjustment: At least 10 steps at 0.5 dB each, or a continuous adjustment within that range.
 - d. Independent zoning of sound masking, paging, and background audio.
 2. Masking-Sound Generator Outputs: Four distinct channels per Operating Platform (OP)
 - a. Capable of specifying multiple Operating Platforms (in groups of 4 channels)
 - b. Capable of digitally assigning selected channels to any group of masking zones
 3. Paging Performance:
 - a. Music-Page Interface (MPI): Device with direct microphone, second line-level microphone, or analog phone input.
 4. Diagnostic functions specified at the network control panel.
 5. Enclosure: One RU high, rack mounted, metal enclosure.
- G. Sound-Masking Loudspeakers: Connected to a loudspeaker control unit.
1. Cone Type: 4 inches (102 mm) in diameter with 1-inch (25-mm) voice coil and minimum 10-oz. (283-g) ceramic magnet, mounted in an acoustic enclosure ensuring delivery of a broad frequency spectrum.
 2. Rated Output Level: 10 W.
 3. Dispersion Angle: 120 degrees.
 4. Sensitivity: 88-dB sound-pressure level (SPL) at 1 W/m on the reference axis.

5. Audio Output: 83 dB, maximum for both masking sound and paging/music.
6. Frequency Response: Plus or minus 3 dB from 85 to 13,000 Hz.
7. Enclosure: Metal acoustic enclosure, housing the loudspeaker, its connections, and controls.
8. Inline Speakers: Speakers with independent potentiometer allowing individual speaker adjustment control outside of networked zoned controls.
9. Mounting:
 - a. For plenum mounting, arrange units for upward or downward dispersion, suspended from the building structure above the ceiling; adjustable, not less than 20 inches (510 mm) from finished ceiling.
 - b. For flush-with-ceiling mounting, arrange units for downward dispersion and equip with a perforated grill and accessories required for mounting in the suspended ceiling system.
 - c. Power Supplies: Comply with UL 1310, Class 2

2.3 WIRE AND CABLE

- A. Comply with Section 271513 "Communications Copper Horizontal Cabling" for balanced twisted pair cabling.
- B. Category 5e/6 Twisted Pair Cable: Four-pair, balanced-twisted pair cable, certified to comply with transmission characteristics of Category 5e/6 cable.
 1. 100-ohm, 24 AWG solid copper.
 2. Unshielded twisted pairs (UTP).
 3. Riser or plenum rated per building code.
- C. Loudspeaker Wire and Cables:
 1. Plenum-Rated Paired Cable: NFPA 70, Type CMP.
 - a. Four pair, twisted.
 - b. PVC insulation.
 - c. Unshielded.
 - d. PVC jacket.
 - e. Flame Resistance: Comply with NFPA 262.
 2. Lead Content: Less than 300 parts per million.
- D. Control-Circuit Conductors:
 1. Class 2 Control Circuits: Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Install in accordance with manufacturer's instructions based upon approved system design and submittals. Follow manufacturer's installation manual.
- C. General Contractor: Responsible for supplying any conduit, which may be required to complete system installation in accordance with specifications and local building codes.
- D. Loudspeaker Assemblies: Suspend with chains from building structure above ceilings, so bottom of assembly is 6 to 8 inches (150 to 200 mm) above upper plane of finished ceiling material. Use eyebolts on speaker assemblies for attachment. Suspend independently from structure, not to supports for components of other building systems. Retain "Loudspeaker Connections" Paragraph for zoned systems.
- E. Wiring Method: Install cables in raceways and cable trays, except within consoles, cabinets, desks, and counters and unless otherwise indicated.
 - 1. Except raceways are not required in accessible indoor ceiling spaces and attics.
 - 2. Except raceways are not required in hollow gypsum board partitions.
 - 3. Conceal raceways and wiring, except in unfinished spaces.
- F. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
 - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
 - 2. Comply with requirements for raceways and boxes specified in Section 260533 "Raceway and Boxes for Electrical Systems."
 - 3. Comply with requirements in Section 271513 "Communications Copper Horizontal Cabling."
- G. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.
- H. Exposed Cable: Install parallel to building lines, follow surface contours, and support as recommended by manufacturer.
- I. Grounding: As recommended by manufacturers 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 with a maximum of 5 ohms to ground at main equipment location.
- J. Impedance Matching: For system components, including connecting cable, provide end-to-end level and impedance-matched signal paths. Use matching networks and balancing devices at connections where necessary to avoid mismatches.

- K. Splices, Taps, and Terminations: Make splices, taps, and terminations on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.
- L. Final connection to FACU will be completed by fire alarm system installer.

3.2 IDENTIFICATION

- A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Label loudspeakers as to channel designation.

3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- D. Perform tests and inspections with the assistance of a factory-authorized service representative.
- E. Tests and Inspections:
 - 1. Inspection: Verify that units and controls are properly labeled, and interconnecting wires and terminals are identified.
 - 2. Operational Test: Start system to confirm proper operation..
 - 3. System Noise Test: With system on, adjust amplifiers to a working level 10 dB above ambient sound level. Check for hum, buzz, rattle, or other operating deficiencies. Remove and replace any malfunctioning units and retest.
 - 4. Frequency Response Adjustment and Test: Adjust one-third octave frequency bands and other unit filters to provide response. Correct deficiencies and retest until satisfactory performance and conditions are achieved. Measured values must not deviate from those listed by no more than ± 2 dB from 250 Hz to 4000 Hz frequency bands (unless condition cause overall volume to exceed tolerances). Sound masking frequency shall be adjusted to conform as closely as possible to the following spectral curve.

1/3 Octave Center Band	Spectrum Adjustments
200	+9.5
250	+9
315	+7.5
400	+6
500	+4.5
630	+3
800	+1.5
1000	0
1250	-2
1600	-5
2000	-7.5
2500	-10
3150	-12.5
4000	-15
5000	-17.5

5. Adjust Sound Masking System based on A-Weighted dBA level within ± 2 dB.

Area	Target dBA
Open Office	46
Enclosed Office	42
Corridors	45

6. Spatial uniformity shall be within ± 2 dB for the masking volume.
 7. Perform sound-masking evaluation tests in reference to ASTM E1130, ASTM 1573 and E2638.
 8. Tests and Calibration Conditions: Spaces to be completely furnished but unoccupied; HVAC systems to be tested and balanced; ceiling tiles to be fully installed; lights, electronic ballasts, lighting relay panels, and low-voltage transformers to be in place.
 9. Instrumentation: Use a professional-quality, sound-level meter with one-third octave-band filters and documentation of recent calibration against recognized standards.
 10. Record test observations, readings, and corrective actions.
 11. Report test results in accordance with the requirements in ASTM E1130 and ASTM 1573.
- F. Final Acceptance Testing: Provide a minimum of 10 days' notice of final test scheduling after initial testing and adjustments have been successfully completed, should a 3rd party be engaged.
1. Correct deficiencies identified by tests and observations, and retest until compliance with specified requirements is achieved.
- G. Demonstration and Acceptance
1. Demonstrate testing and measurements taken to owner or owner's consultant.
 2. Obtain system acceptance by owner or owner's consultant.
 3. Train owner's designated personnel of system operation and maintenance

END OF SECTION 275119.11