**SECTION 27 51 19**

**SOUND MASKING SYSTEMS**

**REVISED 2023-07**

**N. B.** This model specification is in the (2004) CSI format. Certain paragraphs will require editing, deleting, or supplementing depending on the requirements of a specific project. Paragraphs are automatically formatted: specification items or pages may be deleted or added without manual reformatting. Project specific titling including headers and footers will require manual editing. Expect that the Owner or Architect may rewrite or reformat this information to fit specific job requirements. **Delete this note before transmitting to client.**

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**Client Name**

**Project Name Title**

**DIVISION 27 51 19**

**SOUND MASKING SYSTEMS**

**DATE**

**Note to Specifier: this note and Highlighted text below is hidden and does not print.**

# general

## Applicable provisions of the Conditions of the Contract and Division #1, General Requirements, govern work in this Section.

## SuMMAry

### This specification includes all components required for a fully functional sound masking system for the purpose of increased speech privacy, freedom from distraction, and/or sleep disturbance-reduction in the treated areas.

## Definitions:

#### Sound Masking System: The electronic equipment and emitters or speakers used to generate, distribute, and control masking sound throughout a treated area.

#### Loudspeaker, Speaker or Emitter: These terms are used interchangeably in this document to indicate a device in the sound masking system which emits masking sound and voice paging or music.

#### Direct Field Masking System: A masking system comprised of emitters or speakers that emit masking noise directly into a masking environment without permeating through an obstruction such as a ceiling or floor tile.

#### Indirect Field Masking System: A masking system comprised of speakers that emit masking noise into a space either above or below the masking environment and permeate into the masking environment through an obstruction such as a ceiling.

#### Hybrid Masking System: A masking system comprised of direct field and indirect field masking systems monitored and controlled by a common network interface.

#### Masking Controller: A networkable electronic device that provides audio feeds to masking emitters or speakers. Audio may include masking noise, background music or paging or a combination thereof.

#### Amplifier: An electronic device required to amplify audio levels from certain masking controllers to drive masking emitters or speakers to a usable sound pressure level.

#### Network: An Ethernet based IP transport to facilitate communications from a PC to the sound masking system or between controllers within a sound masking system. The network must support system configuration, system control and audio transport between devices.

#### Network Switch: A network device when connected to masking controllers allows controllers to share control and audio communications and, when connected to a computer, facilitates setup and control of an entire system from a single connection point.

#### Paging Microphone/Paging Station: When connected to a masking system controller or through a network switch, sends paging messages to one or more masking zones.

#### Zone: One or more emitters or speakers assigned to a masking controller and operating as a group.

#### Spatial Uniformity: A condition where the sound pressure levels throughout a defined space do not vary significantly from a specified sound pressure level.

#### Spectral Uniformity: A condition where the sound pressure in each one-third octave band does not vary significantly from the specified one-third octave sound pressure level.

#### Temporal Uniformity: At a given position, a condition where the average sound pressure level measured over a short time interval does not differ significantly from the average sound pressure level measured over a long time interval.

#### SPL: Sound pressure level in dB re 0.00002 Pa (0.0002 microbar).

#### Target Level Variation: The variation, in decibels, of the equalized overall level or 1/3 octave level used as a target in the masking system.

#### Max Level Variation: The maximum variation, in decibels, of the equalized overall level or one-third octave level allowed in the masking system.

#### Project Manager: The architect, owner’s representative, general contractor, or other project manager in charge of the construction and site.

#### Sound Masking System Designer: The person or team responsible for design of the sound masking system.

#### Manufacturer: The company that manufacturers the sound masking system products.

#### Contractor: The company chosen to install the sound masking system. The contractor must meet the qualifications described in Section 1.08.

#### Authorized Dealer: The company chosen to provide all sound masking system products described in Part 2. This dealer must be authorized by the manufacturer to provide, install, maintain, and warrant the products specified herein.

## References:

#### ASTM E1130-16 – Standard Test Method for Objective Measurement of Speech Privacy in Open Offices Using Articulation Index (Updated).

#### ASTM E1374-18e1 – Standard Guide for Open Office Acoustics and Applicable ASTM Standards (Updated).

#### ASTM E2638-10 – Standard test method for objective measurement of the speech privacy provided by a closed room.

#### ASTM E1573-22 – Standard Test Method for Evaluating Masking Sound in Open Offices Using “A”-Weighted and One-third Octave Band Sound Pressure Levels (Updated).

#### ANSI S1.6 – Preferred Frequencies, Frequency Levels, and Band Numbers for Acoustical Measurements.

#### ANSI S1.4 – Specification for Sound Level Meters. Calibrated Type 1 or Type 2.

#### ANSI S1.11 – Specification for Octave Band and Fractional Octave Band Analog and Digital Filters.

#### UL 2043 – Standard for Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air Handling Spaces.

#### ISO - International Standards Organization

#### NEC - National Electrical Code

#### CSA-Canadian Standards Association

#### CE Code – Canadian Electrical Code as Published by the Canadian Standards Association referencing 24th Edition / 2018.

## DESCRIPTION OF WORK

### The work of this Section consists of the provision of all plans, materials, labor and equipment and the like necessary and/or required for the complete execution of the sound masking system and related work for this project, as required by the schedules, and keynotes and drawings.

## Functional Requirements of Systems – the contractor shall:

### Distribute sound masking to all areas as indicated on the project drawings.

### Locate all active electronic components to be conveniently accessible for service.

### Supply all sound masking system components from a single manufacturer.

## System Design, Commissioning and Equipment Supply

### The Sound Masking System Designer shall be: **(pick one)**

#### The specifying consultant.

#### The sound masking system manufacturer’s design team.

#### An authorized dealer trained and certified by the manufacturer.

### Sound masking system commissioning shall be performed by: **(pick one)**

#### A qualified consultant.

#### The sound masking system manufacturer’s factory personnel.

#### An authorized dealer’s engineer trained and certified by the manufacturer.

### Equipment and accessories not supplied by the masking system manufacturer that are required for a functional masking system, including cabling and hardware where applicable, shall be supplied by a dealer authorized by the equipment manufacturer.

## Installing Contractor Qualifications

### The sound masking system shall be installed by a qualified contractor.

### To be considered qualified for this work, the contractor shall be experienced in the provision of low-voltage electronic systems similar in complexity to those required for this project, and shall meet the following criteria:

#### The contractor is an authorized dealer for the major product components and is certified by the manufacturer to perform installation, setup, maintenance and warranty.

#### The contractor has a verifiable history of successful installations of at least three projects of similar scope and size.

#### The contractor has all applicable business and regulatory licenses and certifications.

#### The contractor has verifiable financial capability to satisfy any bonding requirements for the project.

#### When directed by the sound masking system designer, the contractor must provide the necessary personnel experienced in operating the required test measurement equipment outlined herein to configure, test, and calibrate the sound masking system.

#### During the warranty period, the contractor shall maintain two or more technicians who are certified for the product(s) under warranty as stated in Section 1.13.

## BID SUBMITTALS

### The contractor shall refer to **Division 00** of this Article.

### Instructions to bidders: To be considered, bids shall be made in accordance with the architect's instructions to bidders and this article.

### Examinations: The contractor shall carefully examine the contract documents and, when possible, visit the construction site to obtain first-hand knowledge of existing conditions. Contractors will not be given extra payments for conditions that can be determined by examining documents or by making onsite examinations, and will not be relieved of any obligations with respect to bid.

### Basis of Consideration: shall consist of the following items: **(Include all that apply)**

#### Sound masking system Performance.

#### Sound masking system Functional Capabilities.

#### Contractor’s qualifications per 1.08

#### Sound masking system Ease of Use / Software Interface

#### Sound masking system Cost.

### Submittal Documents

#### The contractor shall adhere to **Article 01 30 00** for these requirements.

#### The contractor shall coordinate all submittals with requirements set forth in **Section 01 30 00**.

#### Unless otherwise directed by contract, the contractor shall not order equipment until the submittals have been reviewed and approved by the specifying consultant.

#### In keeping with the practices of LEED™, the contractor shall deliver all submittals in electronic format as combined PDF files via FTP posting, CD-ROM, DVD, or e-mail.

#### All CAD drawings shall be generated in DWG format and also in portable document format (PDF). All other submissions unless otherwise stated shall be provided as PDFs.

#### The contractor shall provide manufacturer’s detailed technical data sheets for all major components in portable document format (PDF).

#### The contractor shall provide complete floor plan and/or reflected ceiling plan drawing(s) denoting, at minimum, device locations which have been prepared by the sound masking system designer based on the sound masking system manufacturer guidelines.

## Installation and QUALITY ASSURANCE

### Required Permits: The installing contractor or project manager shall obtain all necessary permits for installation work.

### Project Management: The contractor shall assign a qualified person to manage the installation and maintain the same person in charge of work throughout installation.

### Contract Documents: The contractor shall maintain a complete set of system drawings and specifications on the job site.

### The contractor shall install all equipment, cabling, accessories and associated hardware in accordance with the manufacturer’s instructions and according to standards of good engineering practice and other conditions as specified by the project manager.

### Workmanship shall be of professional quality utilizing best commercial practices, and shall be accomplished by qualified personnel.

## JOB CONDITIONS – the contractor shall:

### Refer to and adhere to Division 02 of this Article.

### Sequencing and Scheduling:

#### Coordinate work with the project manager and other trades to facilitate construction and prevent conflicts.

#### Afford other trades reasonable opportunity for installation of work and for the storage of materials.

#### Staff the job to keep pace with the other trades. The project manager, at their discretion, may require an increase in the sound masking contractor’s staff or require overtime work from the sound masking contractor without additional expenses to the Owner.

#### Abide by the decision of the project manager in case of conflict or interference by other trades.

#### Remove all refuse from the job site daily or per project requirements to the satisfaction of the project manager and owner.

### Provide insurance on the work of this specialty trade if specified in **Section 00 81 00.**

## INSPECTION – the contractor shall:

### Notify the Project Manager of any defects in work by other trades affecting system installation, operation, or performance.

## WARRANTY – the contractor shall:

### Warrant all equipment to be free of faulty workmanship and defects for a minimum period of five years from date of final acceptance.

### Warrant the installation of all equipment, cabling, and labor for an initial period of one year from the date of final acceptance unless a longer term is specified elsewhere.

### Provide owner requested services, including telephone support, at no charge during the duration of the initial one-year warranty period.

### Provide two semi-annual visits to the site for routine adjustment and maintenance of all specified and installed systems during the initial warranty period and include a preliminary schedule for the semi-annual visits.

## SERVICE CONTRACT – the contractor shall:

### Provide an optional annual service and maintenance contract to commence after the one-year warranty period has expired.

### Include two semi-annual visits to the site for routine adjustment and maintenance of all specified and installed systems.

## TRAINING – the contractor shall:

### Provide sufficient training to personnel selected by the Owner on operation and basic maintenance of all systems, software, and equipment. Explain operation of control systems, set-up and operation of individual pieces of equipment, and functions of overall systems.

### Provide manufacturer’s operation manuals for all products used in the system.

### Provide an overall system operation manual for use by the owner’s maintenance personnel.

# products

## general requirements

### Product requirements shall include all masking, signal generation, signal processing, amplification, and emitters or speakers with associated wiring, software, and controls.

### Only complete, integrated sound masking systems procured from a single manufacturer shall be acceptable.

### The sound masking system shall be comprised of logical zones capable of configuration and naming by the sound masking contractor. More than one physical output, including those from multiple control processors may be configured and assigned as a single zone. Each output within the zone may be controlled independently as to masking spectrum and level.

### The sound masking system shall be capable of automatically scheduling system parameter adjustments, including initial acclimatization, on a per zone basis.

### Means of control for the sound masking system shall be facilitated through any combination of front panel hardware interface, manufacturer configuration software, and/or a web browser-based software interface.

### The sound masking system shall generate, amplify, and distribute a minimum of four non-correlated sound masking signals on adjacent emitters or speakers when their spacing is 12’ (3.65m) or less. In this situation, adjacent emitter or speaker devices shall not reproduce coherent sound masking signals.

### The sound masking system shall be capable of accepting at minimum two external analog microphone or line level audio sources from ancillary audio equipment with control on a per zone basis.

### The sound masking system zones shall be determined by the functional requirements of each area(s) with separate independent level control for each zone as indicated by the project documents.

### A new zone with separate level control shall be required in instances where a change in emitter or speaker mounting or ceiling height causes a greater than 0.5dB increase or drop in level or where emitter or speaker density changes from one area to another. This usually translates to a varying device level height of about 6” (152mm) in a typical ceiling environment.

## Control processor

### General Specifications:

#### The masking sound controller shall be DSP based.

#### The masking sound controller shall provide multi-zone processing that shall facilitate adjustment of the masking level on a per zone basis in 0.5 dB increments.

#### The masking sound controller shall provide per zone scheduling function via internal clock source and/or network NTP server, which is capable of adjusting the masking signal levels. Scheduling shall, at a minimum, adjust for separate weekday and weekend level settings.

#### The masking sound controller shall provide an automatic, incremental level adjustment feature, allowing a gradual, one-time change of masking levels to commence upon completion of system commissioning, acclimating occupants to a newly sound masked environment (initial acclimatization).

#### The masking sound controller shall be separately capable of one-third octave equalization adjustment of the sound masking spectrum for each output as defined in Table 1 - PART 3 of this document.

#### The masking sound controller shall have two configurable network ports. A single port configuration shall simultaneously support communications, control and audio, either AVB or Dante© (if applicable) with the second port being unused. A dual port configuration shall support audio on one network port and communications and control on the second network port. Separate MAC addresses shall be available for control, AVB and Dante© in either port configuration.

#### The masking sound controller shall have at least two mic/line level analog audio source inputs usable for paging or background music with phantom power available for microphones. The audio source inputs shall be routable to other controllers over the audio network. A separate one-octave band equalizer, independent from the sound masking equalizer, shall be provided for adjustment of each audio source separate from the masking equalization.

#### The masking sound controller shall accept six external audio channels via an eight channel audio network transport usable for background music or paging. The audio transport shall be based on industry standard 802.1X protocols. Dante© may be used as an acceptable alternate protocol for controllers that support Dante©. Routing of one or more audio channels to specific masking zones shall be configured via the controller software.

#### The masking sound controller shall have the capability to mute or otherwise disable the sound masking signal and any other audio signals using a dry contact closure from a third-party source such as a fire alarm control panel (FACP). In a multiple processor system, a single contact closure at one processor will mute audio at all other processors when network communication exists.

#### Means of control for the masking controller shall be facilitated through any combination of front panel hardware interface, manufacturer configuration software, and/or a web browser-based software interface.

#### Third party supervision and control of the masking system shall be facilitated via the industry standard RESTful API syntax. This feature shall be protected from unauthorized access via multi-role security credentials.

#### The masking controller shall be networkable over standard Ethernet with dual network ports and shall support a minimum of (90) controllers on a single network.

#### The masking sound controller shall be capable of TCP/IP network connectivity via DHCP or Static IP address.

#### The masking sound controller shall support 802.1X port authentication for network security.

#### The masking sound controller shall support certificates. Users may select a Root or Client certificate based on the security requirements of the organization.

#### The masking sound controller shall support multirole user authentication passwords.

#### The masking sound controller shall support fault reporting of trouble conditions.

#### The masking sound controller shall feature a nonvolatile memory, capable of storing all system settings in the case of power disconnect.

#### The masking controller shall be CE marked, UL listed, and RoHS compliant.

#### The masking controller shall be TAA compliant and GSA eligible

#### The masking controller shall be covered by a manufacturer five-year warranty.

### Additional Specifications – High Impedance Non-70V Direct Field Solutions

#### The masking sound controller shall provide a minimum of four (4) non-correlated masking signal outputs per zone.

#### For passive direct field emitter solutions, the masking controller shall support a maximum of (60) emitters on each of (2) cable runs for each masking zone with a maximum cumulative cable distance of 1000’ (305m). Where this distance is exceeded, some emitters must be broken off into a separate cable run on that zone.

#### For active direct field emitter solutions, the masking controller shall support a maximum of (50) emitters on each of (2) cable runs. Each cable run shall be further divided by a power insertion device that injects DC power in each emitter line and has two outputs to power up to ½ the number of emitters allowed in a cable run (25). The maximum cumulative cable distance from the power inserter to the last emitter in each of the two legs of the cable run shall be 400’ (122m). Where this distance is exceeded, some emitters must be broken off into a separate cable run on that zone.

#### The masking sound controller shall provide a factory default sound masking spectrum as defined in Table 1 - Part 3 of this specification.

#### The masking sound controller shall include factory set equalization for each speaker output, with no in-field speaker equalization normally necessary.

#### The masking sound controller shall include a UL/CUL/CE -listed 120-240VAC 50/60Hz power supply.

#### A wall mount bracket shall be included with the masking controller.

### Additional Specifications – Low Impedance Direct Field Solution

#### The masking sound controller shall provide a minimum of (8) non-correlated masking signal outputs per controller. Each output shall be rated at 4Ω and shall be designed to power (1) direct field masking speaker.

#### The masking controller shall be rated for UL2043 and be designed for installation within a plenum ceiling space.

#### The masking controller shall be powered via standard PoE+ power injector or network switch.

#### The masking controller shall support a maximum of (8) speakers per controller.

#### The masking sound controller shall provide a factory default sound masking spectrum as defined in Table 1 - Part 3 of this specification.

#### The masking sound controller shall include factory-set equalization for each speaker zone, with no in-field speaker equalization normally necessary.

#### A ceiling grid mounting bracket shall be included with the masking controller.

### Additional Specifications – 70 Volt Direct Field Solution

#### The masking sound controller shall provide a minimum of (8) non-correlated masking signal outputs per controller.

#### The masking controller shall support a maximum of (8) masking zones per controller.

#### Each masking zone output shall be analog line level designed to drive a 70-volt amplifier. The number of speakers supported by a single controller shall be determined by the capabilities of the 70-volt amplifier(s) that are chosen.

#### The masking sound controller shall include a UL/CUL/CE -listed 120-240VAC 50/60Hz power supply.

#### A rack-mount bracket shall be included with the masking controller.

### Additional Specifications – Low Impedance Indirect Field Solution

#### The masking sound controller shall provide a minimum of (8) non-correlated masking signal outputs per controller. Each output shall be rated at 4Ω and shall be designed to power up to (2) indirect field masking speakers.

#### The masking controller shall be rated for UL2043 and be designed for installation within a plenum ceiling space.

#### The masking controller shall be powered via standard PoE+ power injector or network switch.

#### The masking controller shall support a maximum of (16) speakers per controller.

#### A ceiling grid mounting bracket shall be included with the masking controller.

### Additional Specifications – 70 Volt Indirect Field Solution

#### The masking sound controller shall provide a minimum of (8) non-correlated masking signal outputs per controller.

#### The masking controller shall support a maximum of (8) masking zones per controller.

#### Each masking zone output shall be analog line level designed to drive a 70-volt amplifier. The number of speakers supported by a single controller shall be determined by the capabilities of the 70-volt amplifier(s) that are chosen.

#### The masking sound controller shall include a UL/CUL/CE -listed 120-240VAC 50/60Hz power supply.

#### A rack-mount bracket shall be included with the masking controller.

## Emitter and speaker types

### 1.25” (32mm) passive emitter, direct field, daisy chainable, in-ceiling or surface mount supporting masking only.

#### The emitter shall be designed for direct field operation, radiating directly into the occupied space.

#### The emitter driver shall be a nominal 1.25” (32mm) diameter with an overall housing diameter of 3.25” (83mm).

#### The emitter shall be purpose built to interface with its associated controller and shall not be used with any other controlling device.

#### The nominal frequency response of the emitter shall be 200Hz to 5kHz.

#### The nominal dispersion of the emitter shall be at least 170° below 4.2kHz.

#### The emitter housing shall be capable of mounting directly into acoustic ceiling tile materials, surface mounted, pendant mounted, structural beam mounted, or hard surface ceiling mounted utilizing optional manufacturer supplied accessories. Seismic rated mounting shall be provided where required by jurisdiction.

#### The emitters shall be spaced evenly between 8’ (2.45m) to 12’ (3.65m) as recommended by the product manufacturer based on site conditions and ceiling heights and below finished ceiling obstructions to meet the performance requirements stated in Part 3 of this specification for direct field 1.25” (32mm) emitter installations.

#### The emitter shall be capable of producing minimum sound pressure levels and frequency spectrum as required in Part 3 of this specification for 1.25” (32mm) emitters and as measured at an above finished floor height of 4’ (1.2 meters) regardless of ceiling type, ceiling height, or presence of obstructions.

#### The emitter shall include DIP switches to provide 3dB decrements of level for up to 9dB of level reduction for easy micro-zoning.

#### The emitter shall include internal circuiting to support the routing of (4) non-correlated masking channels so that adjacent emitters do not emit the same noise source, minimizing phase effects between emitters.

#### The emitter and all mounting accessories shall be UL 2043 compliant.

#### The emitter shall require a single, multi-conductor, low-voltage cable meeting NEC Class 2 requirements for low-voltage distribution. The cabling shall be rated for use in plenum spaces.

#### The emitter shall be available in white (standard) or black finish. An optional emitter cap shall be available which can be painted to match a particular ceiling color if required.

#### The emitter shall include a manufacturer supported five-year warranty.

### 1.25” (32mm) active emitter, direct field, daisy chainable, in-ceiling or surface mount supporting masking, paging and background music.

#### The emitter shall be designed for direct field operation, radiating directly into the occupied space.

#### The emitter driver shall be a nominal 1.25” (32mm) diameter with an overall housing diameter of 3.25” (83mm).

#### The emitter shall be purpose built to interface with its associated controller and shall not be used with any other controlling device.

#### The nominal frequency response of the emitter shall be 105Hz to 12kHz.

#### The nominal dispersion of the emitter shall be at least 170° below 4.2kHz.

#### The emitter housing shall be capable of mounting directly into acoustic ceiling tile materials, surface mounted, pendant mounted, structural beam mounted, or hard surface ceiling mounted utilizing optional manufacturer supplied accessories. Provide seismic rated mounting where required by jurisdiction.

#### The emitters shall be spaced evenly between 8’ (2.45m) to 12’ (3.65m) as recommended by the product manufacturer based on site conditions and ceiling heights and below finished ceiling obstructions to meet the performance requirements stated in Part 3 of this specification for direct field 1.25” (32mm) emitter installations.

#### The emitter shall be capable of producing minimum sound pressure levels and frequency spectrum as required in Part 3 of this specification for 1.25” (32mm) emitters and as measured at an above finished floor height of 4’ (1.2 meters) regardless of ceiling type, ceiling height, or presence of obstructions.

#### The emitter shall include DIP switches to provide 1.5dB decrements of level for up to 4.5dB of level reduction for easy micro-zoning.

#### The emitter shall include internal circuiting to support the routing of (4) non-correlated masking channels so that adjacent emitters do not emit the same noise source, minimizing phase effects between emitters.

#### The emitter and all mounting accessories shall be UL 2043 compliant.

#### The emitter shall require a single, multi-conductor, low-voltage cable meeting NEC Class 2 requirements for low-voltage distribution. The cabling shall be rated for use in plenum spaces.

#### The emitter shall be available in white or black finish. The emitter is not paintable.

#### The emitter shall include a manufacturer supported five-year warranty.

### 1.25” (32mm) emitter, direct field, individually controlled, in-ceiling or surface mount supporting masking, paging and background music.

#### The emitter shall be designed for direct field operation, radiating directly into the occupied space.

#### The emitter driver shall be a nominal 1.25” (32mm) diameter with an overall housing diameter of 3.25” (83mm).

#### The emitter shall be purpose built to interface with its associated controller and shall not be used with any other controlling device.

#### The nominal frequency response of the emitter shall be 125Hz to 12kHz.

#### The nominal dispersion of the emitter shall be at least 170° below 4.2kHz.

#### The emitter housing shall be capable of mounting directly into acoustic ceiling tile materials, surface mounted, pendant mounted, structural beam mounted, or hard surface ceiling mounted utilizing optional manufacturer supplied accessories. Provide seismic rated mounting where required by jurisdiction.

#### The emitters shall be spaced evenly between 8’ (2.45m) to 12’ (3.65m) as recommended by the product manufacturer based on site conditions and ceiling heights and below finished ceiling obstructions to meet the performance requirements stated in Part 3 of this specification for direct field 1.25” (32mm) emitter installations.

#### The emitter shall be capable of producing minimum sound pressure levels and frequency spectrum as required in Part 3 of this specification for 1.25” (32mm) emitters and as measured at an above finished floor height of 4’ (1.2 meters) regardless of ceiling type, ceiling height, or presence of obstructions.

#### The emitter and all mounting accessories shall be UL 2043 compliant.

#### The emitter shall require a single, two-conductor 18 gauge unshielded, low-voltage cable meeting NEC Class 2 requirements for low-voltage distribution. The cabling shall be rated for use in plenum spaces.

#### The emitter shall be available in white or black finish. The emitter is not paintable.

#### The emitter shall include a manufacturer supported five-year warranty.

### 3” (76mm) driver, 70-volt, direct field surface mount speaker supporting masking, paging and background music.

#### The speaker shall be direct field, radiating directly into the occupied space.

#### The speaker driver shall be full range with a nominal 3” (76mm) diameter.

#### The speaker shall be optimized to interface with the associated controller and shall not be used with any other controlling device.

#### The speaker shall be capable of surface mounting via the included U-bracket. Pendant mounting can be attained by utilizing threaded rod attached to the U-bracket. Provide an additional safety rated cable where required by code.

#### The speakers shall be spaced evenly between 6’ (1.8m) to 10’ (3.1m) as recommended by the product manufacturer based on site conditions and ceiling heights and below finished ceiling obstructions to meet the performance requirements stated in Part 3 of this specification for 3” (76mm) direct field speaker installations.

#### The speaker shall be capable of producing minimum sound pressure levels and frequency spectrum as required in Part 3 of this specification for 3” (76mm) drivers and as measured at an above finished floor height of 4’ (1.2 meters) regardless of ceiling type, ceiling height, or presence of obstructions.

#### The speaker shall require a single, two-conductor 18 gauge or greater unshielded, low-voltage cable meeting NEC Class 2 requirements for low-voltage distribution. The cabling shall be rated for use in plenum spaces.

#### The speaker shall be available in white or black finish. The speakers are not paintable.

#### The speaker shall include a manufacturer supported five-year warranty.

### 5.25” (134mm) driver, 8Ω, indirect field above ceiling speaker for masking.

#### The speaker shall be mounted above a finished acoustic ceiling tile ceiling, radiating into the plenum space. The plenum space shall be at least 18” (460mm) deep from finished ceiling to deck.

#### The speaker driver shall be full range with a nominal 5.25” (134mm) in diameter.

#### The speaker enclosure shall be ported and formed from a seamless 1mm cold rolled steel plate material with a powder coated finish. The enclosure shall measure 8.5” (216mm) in diameter X 5” (127mm) high. The enclosure shall be internally acoustically dampened.

#### The speaker impedance shall be a nominal 8Ω.

#### The speaker frequency response shall be a nominal 125Hz to 10kHz.

#### The speaker sensitivity shall be a nominal 91.9dB 1W/1M.

#### The speaker shall be optimized to interface with the associated controller and shall not be used with any other controlling device.

#### The speaker shall include a four-point suspension system with hanging chain for ease of installation and leveling.

#### The speakers shall be spaced as recommended by the product manufacturer based on plenum depth and type of acoustic ceiling tile. Final spacing shall meet the performance requirements stated in Part 3 of this specification for indirect field speaker installations.

#### The speaker shall be capable of producing minimum sound pressure levels and frequency spectrum as required in Part 3 of this specification for indirect field speaker installations and as measured at an above finished floor height of 4’ (1.2 meters) regardless of ceiling type, ceiling height, or presence of obstructions.

#### The speaker and all mounting accessories shall be UL2043 listed as appropriate for use in the plenum spaces where it will be mounted.

#### The speaker shall require a single, two-conductor 18 gauge unshielded, low-voltage cable meeting NEC Class 2 requirements for low-voltage distribution. The cabling shall be rated for use in plenum spaces.

#### The speaker shall be available in white or black finish.

#### The speaker shall include a manufacturer supported five-year warranty.

### 5.25” (134mm) driver, 70-volt, indirect field above ceiling speaker for masking.

#### The speaker shall be mounted above a finished acoustic ceiling tile ceiling, radiating into the plenum space. The plenum space shall be at least 18” (460mm) deep from finished ceiling to deck.

#### The speaker driver shall be full range with a nominal 5.25” (134mm) in diameter.

#### The speaker enclosure shall be ported and formed from a seamless 1mm cold rolled steel plate material with a powder coated finish. The enclosure shall measure 8.5” (216mm) in diameter X 5” (127mm) high. The enclosure shall be internally acoustically dampened.

#### The speaker shall include an internal transformer with 1/8W, 1/4W, 1/2W, 1W, 2W and 4W taps at 70 volts and an external wattage selector to choose the preferred wattage.

#### The speaker frequency response shall be a nominal 125Hz to 10kHz.

#### The speaker sensitivity shall be a nominal 91.9dB 1W/1M.

#### The speaker shall be optimized to interface with the associated controller and shall not be used with any other controlling device.

#### The speaker shall include a four-point suspension system with hanging chain for ease of installation and leveling.

#### The speakers shall be spaced as recommended by the product manufacturer based on plenum depth and type of acoustic ceiling tile. Final spacing shall meet the performance requirements stated in Part 3 of this specification for indirect field speaker installations.

#### The speaker shall be capable of producing minimum sound pressure levels and frequency spectrum as required in Part 3 of this specification for indirect field speaker installations and as measured at an above finished floor height of 4’ (1.2 meters) regardless of ceiling type, ceiling height, or presence of obstructions.

#### The speaker and all mounting accessories shall be UL2043 listed as appropriate for use in the plenum spaces where it will be mounted.

#### The speaker shall require a single, two-conductor 18 gauge or greater unshielded, low-voltage cable meeting NEC Class 2 requirements for low-voltage distribution. The cabling shall be rated for use in plenum spaces.

#### The speaker shall be available in white or black finish.

#### The speaker shall include a manufacturer supported five-year warranty.

### Dual 4” (102mm) X 1.5” (38mm) driver, 8Ω, indirect field above ceiling speaker for masking.

#### The speaker shall be mounted above a finished acoustic ceiling tile ceiling, radiating into the plenum space. The speaker is designed for use in ceilings where plenum space is less than 18” or where the plenum space is severely restricted due to HVAC or other obstructions.

#### The dual opposed speaker drivers shall each be full range with a nominal 4” (102mm) X 1.5” (38mm) dimension.

#### The speaker enclosure shall be formed from a 1mm cold rolled steel plate material with a powder coated finish. The enclosure dimensions shall be a nominal 5.25” (135mm) X 6.25” (160mm) X 1.8” (45mm) high. The enclosure shall include tuned ports.

#### The speaker impedance shall be a nominal 4Ω.

#### The speaker frequency response shall be a nominal 160Hz to 6.3kHz.

#### The speaker sensitivity shall be a nominal 80.7dB 1W/1M.

#### The speaker is optimized to interface with the associated controller and shall not be used with any other controlling device.

#### The speaker shall accommodate an optional ceiling tile bridge for ceiling mounting.

#### The speakers shall be spaced as recommended by the product manufacturer based on plenum depth and type of acoustic ceiling tile. Final spacing shall meet the performance requirements stated in Part 3 of this specification for indirect field speaker installations.

#### The speaker shall be capable of producing minimum sound pressure levels and frequency spectrum as required in Part 3 of this specification for indirect field speaker installations and as measured at an above finished floor height of 4’ (1.2 meters) regardless of ceiling type, ceiling height, or presence of obstructions.

#### The speaker and all mounting accessories shall be rated to UL2043 and CSA C22.2 No. 205-12 as appropriate for use in the spaces where it will be mounted.

#### The speaker shall require a single, two-conductor 18 gauge unshielded, low-voltage cable meeting NEC Class 2 requirements for low-voltage distribution. The cabling shall be rated for use in plenum spaces.

#### The speaker shall be available in white finish.

#### The speaker shall include a manufacturer supported five-year warranty.

### Dual 4” (102mm) X 1.5” (38mm) driver, 70-volt, indirect field above ceiling speaker for masking.

#### The speaker shall be mounted above a finished acoustic ceiling tile ceiling, radiating into the plenum space. The speaker is designed for use in ceilings where plenum space is less than 18” or where the plenum space is severely restricted due to HVAC or other obstructions.

#### The dual opposed speaker drivers shall each be full range with a nominal 4” (102mm) X 1.5” (38mm) dimension.

#### The speaker enclosure shall be formed from a 1mm cold rolled steel plate material with a powder coated finish. The enclosure dimensions shall be a nominal 5.25” (135mm) X 6.25” (160mm) X 1.8” (45mm) high. The enclosure shall include tuned ports.

#### The speaker shall include an internal transformer with 1/8W, 1/4W, 1/2W, 1W, 2W and 4W taps at 70 volts and an external wattage selector to choose the preferred wattage.

#### The speaker frequency response shall be a nominal 160Hz to 6.3kHz.

#### The speaker sensitivity shall be a nominal 80.7dB 1W/1M.

#### The speaker is optimized to interface with the associated controller and shall not be used with any other controlling device.

#### The speaker shall accommodate an optional ceiling tile bridge for ceiling mounting.

#### The speakers shall be spaced as recommended by the product manufacturer based on plenum depth and type of acoustic ceiling tile. Final spacing shall meet the performance requirements stated in Part 3 of this specification for indirect field speaker installations.

#### The speaker shall be capable of producing minimum sound pressure levels and frequency spectrum as required in Part 3 of this specification for indirect field speaker installations and as measured at an above finished floor height of 4’ (1.2 meters) regardless of ceiling type, ceiling height, or presence of obstructions.

#### The speaker and all mounting accessories shall be rated to UL2043 and CSA C22.2 No. 205-12 as appropriate for use in the spaces where it will be mounted.

#### The speaker shall require a single, two-conductor 18 gauge or greater unshielded, low-voltage cable meeting NEC Class 2 requirements for low-voltage distribution. The cabling shall be rated for use in plenum spaces.

#### The speaker shall be available in white finish.

#### The speaker shall include a manufacturer supported five-year warranty.

## network switch

#### The network switch shall utilize a managed architecture.

#### The network switch shall support Layer 2 and Layer 3 switching.

#### The network switch shall include an active AVB license.

#### The network switch shall handle control, AVB and Dante© protocols within the same switch.

#### The network switch shall have a minimum of (8) 10/100/1000 PoE+ enabled ports, (2) non-PoE 10/100/1000 ports and (2) SFP+ 1G/10G ports. All ports shall be auto sensing.

#### The network switch shall have a PoE power budget to support a minimum of (8) PoE+ devices simultaneously on a single switch.

#### The network switch shall have a switching fabric of 60Gbps or greater.

#### The network switch shall support Link Aggregation Groups to allow multiple switches to act as a single link.

#### The network switch shall have a dedicated web-based GUI interface to support sound masking installations.

#### The network switch shall have a selectable fan mode to minimize fan noise based on ambient temperature and power requirements.

#### The network switch shall be rack mountable.

#### The network switch shall be TAA compliant.

#### The network switch shall have a manufacturer lifetime warranty.

## 70 Volt Amplifiers

#### 70-Volt power amplifiers shall be chosen to support the masking system.

#### Individual amplifier channels shall be required for each zone where masking equalization needs adjustment due to ceiling material variations or structural variations above or below the ceiling.

#### Unless specifically stated in the amplifier manufacturer specifications for masking systems, each amplifier channel shall not be loaded to more than 42% of their rated RMS power.

#### Level controls shall be located on the back of the amplifier. No level controls shall be allowed on the front of the amplifier.

#### The input impedance shall be 8kΩ or greater per channel.

#### The input sensitivity shall be nominal +4dBu (1.23 Vrms).

#### The maximum input level per channel shall be +24dBu.

#### The THD+N (1kHz, 1dB below clip) shall be <0.008 percent.

#### Channel separation at 1kHz shall be >75dB.

#### The input gain for 70-volt operation shall be 35.2dB.

#### Power output per channel shall be at least 75-watts, all channels driven.

#### The amplifier shall include a built-in limiter for each output.

#### The amplifier shall include a switchable high pass filter rated at 70Hz, 12dB/octave for each channel.

#### The amplifier shall include front panel LEDs to indicate:

##### Temperature status

##### Limiter status

##### Signal status

##### Power status

#### The contractor shall provide the necessary quantity of amplifiers/amplifier-channels to correspond with the project zoning/sound-masking-generator requirements.

#### The power amplifier shall be ETL listed to conform to UL62368-1 and CSA C22.2 No. 62368-1.

#### The amplifier shall include a manufacturer-supported five-year warranty.

## software and control

### The sound masking system shall be capable of software control via a TCP/IP local area network connection to the Owner’s local area network (LAN Infrastructure). Communication shall be via industry standard Ethernet protocols. No communication via serial or proprietary bus architectures shall be acceptable in this standard.

### The integrator shall coordinate connection to local area network with Owner’s network administrator to include IP Addressing, MAC address(s), switch port assignments, 802.1X and certificate configuration and multirole user authentication passwords.

### The software interface shall consist of one or more of the following types:

#### Client Based Configuration/Control software utilizing Windows 10 or higher.

#### Internal web server using browser client.

### Software control of the sound masking system shall include password-protected adjustment and configuration of the following minimum features:

#### Ability to import multiple floor plans to facilitate control of masking zones.

#### Choice of masking controller(s) in the system. The system may include multiple controller types.

#### Choice of emitters or speakers connected to each controller.

#### Pre-optimization of emitter or speaker equalization when applicable for direct field systems.

#### Muting/unmuting per zone.

#### Sound masking level control on a per zone basis.

#### Background music and paging audio input level control.

#### Choice of audio distribution to controller(s) via 802.1X or Dante©.

#### Routing of up to (8) audio sources via a network connection to one or more zones.

#### Equalization adjustment on a per output basis.

#### Emergency mute and push to talk for paging.

#### Zone naming on a per output basis.

#### Time of day scheduling on a per zone basis.

#### Network / clock management.

#### Audio routing of external network audio sources.

#### Error notification / monitoring.

### The hardware interface shall be capable of basic level adjustment on a per output basis using the front panel menu screen that allows, at minimum, operation of both sound masking and audio input levels.

### A third-party API shall be published by the sound masking product manufacturer using the RESTful API syntax to allow monitoring of the masking system by building wide / room control system providers.

## peripehrals

### Fire Alarm Control Panel

#### The system controller shall accept a contact closure from a Fire Alarm Control Panel (FACP)

#### The contact closure shall be configured in the system controller to mute all masking, background music and paging audio in the masking system.

#### The controller shall communicate with other masking system controllers on the network to also mute their audio when a contact closure is sensed.

#### The systems shall automatically be restored to normal operation when the contact closure is removed.

### Paging microphone – to be used only with masking systems designed to support convenience paging.

#### A balanced, low impedance paging microphone shall be connected to an audio input in the masking controller. 48V phantom power shall be provided by the controller to power the microphone if necessary.

#### A contact closure shall be accepted by the masking controller to permit the audio from the paging microphone to pass to the page zone(s) as configured from the controller setup software.

#### The controller shall communicate with other masking system controllers on the network to allow the page audio to be routed to page zones on those masking controllers as configured from the masking system controller setup software.

### Paging stations – to be used only with masking systems designed to support convenience paging.

#### The paging station shall be network based utilizing standard 802.1X or Dante© protocols.

#### The paging station shall be configured as a four- or ten-button keypad version with either a nominal 13.3” (338mm) gooseneck microphone or push-to-talk handheld microphone.

#### A multi-line LCD screen shall have language support for nine languages and shall indicate the status of the paging station and provide feedback for:

##### Unlocking the paging station.

##### Selecting and executing a page code.

##### Recording messages.

##### Message playback progress.

##### Status of a live paging microphone.

#### A security PIN shall be configurable at each page station to lock out unauthorized users.

#### The paging station shall have a push-to-talk button with status indication and shall be latchable to support hands-free or long pages.

#### The paging station shall include DSP to optimize audio playback for the page.

#### Paging audio shall be blocked from the network until a page is being made for enhanced privacy.

#### The masking system shall be able to support up to 16 paging stations on the same network.

#### Each page station shall have the ability to be assigned a priority paging level via software.

#### The paging station shall be capable of supporting up to (32) page zones. Each page zone shall be comprised of one or more masking zones.

#### Each page station shall have the capability to record, store and play back up to (10) messages. Message length can be variable, with a pool of 50 minutes of record time available. Recordings shall be made at the paging station or downloaded to the paging station through the network via a computer. Recordings may be locked to protect from accidental erasure.

#### A built-in event scheduler shall allow automated playback of any recorded message.

#### The paging station shall include default preannounce tones and shall also support customized preannounce tones.

#### The paging station shall support either desktop or wall mounting.

#### The four-button paging station shall support (4) user configurable page codes.

#### The ten-button paging station shall support (999) page codes.

#### The paging station shall be configured via the masking system controller software.

#### The paging station shall be NRTL listed to UL 62638-1, CSA C22.2 #62368-1, CE marked and shall be RoHS compliant.

#### The paging station shall be TAA compliant.

#### The paging station shall include the manufacturer’s five-year warranty.

## Cable Assemblies

### All cable assemblies shall consist of the proper number of conductors, wire gauge, and type, as approved by the system manufacturer based on the system design.

#### Cabling for 1.25” (32mm) diameter emitters shall be rated either Category 3, Category 5e or Category 6. Cables shall be terminated to TIA568A or TIA568B standards as a “straight-thru” cable.

#### Cabling for 3” (76mm) diameter or larger speakers shall be a jacketed UTP stranded 18 to 16 AWG cable.

#### Cabling for 70V speaker systems shall be a jacketed UTP stranded 18 to 16 AWG cable.

#### Cabling for emitter system power supplies shall be a jacketed UTP stranded 14 AWG cable.

#### Ethernet cabling shall be UTP Category 5e, Category 6, or Category 7 rated. Cables shall be terminated to TIA568A or TIA568B standards. Each Ethernet cable shall be verified by the Installing Contractor to 10/100 MB/sec standards.

#### Line Level analog audio cabling shall be a jacketed 2-conductor 22 AWG stranded, twisted pair shielded cable designed for analog audio signals.

### Cabling flammability rating shall meet the installation conditions as required by NFPA/NEC/CSA or local codes/ jurisdiction as follows;

#### Type CM – General Purpose for Commercial Installation. Meets UL-1581 requirements for smoke and flammability testing.

#### Type CMR/FT4 – Commercial Installation for vertical risers. Meets UL-1666 requirements for smoke and flammability testing.

#### Type CMP/FT6 – Commercial Installation for plenum airspaces. Meets UL-910 requirements for smoke and flammability testing.

### Terminations shall be completed utilizing the appropriate connector type, method, and tooling as recommended by the product manufacturer.

### All cabling shall be plenum rated when located in a plenum space.

## LABELS

### Except where otherwise specified, label each item of control equipment as shown on drawings.

### Identify all wires and cables at every connection point to controllers with reference number keyed to the as-built wiring diagrams.

### Room numbers appear on the contract documents for reference only. All labels shall reflect the Owner's final room designations.

### Cable Markers:

#### High-grade PVC clip-on or permanent-type cable markers with permanent markings, or printed vinyl tape protected by clear shrink tubing or adhesive wrap shall be used for labelling cabling.

## Safety Listings

### General

#### Products and system shall comply with all applicable local, regional and national safety codes.

### Electrical Safety

#### All electronics shall be UL Listed or listed by an equivalent body such as Intertek ETL. Outside the USA, the electronics shall be certified by an equivalent certification body to meet local and/or national safety standards.

### Seismic Safety

#### A ceiling device seismic support system shall be installed in a manner certified by the manufacturer. Alternate seismic support system(s) must be approved by authorities having jurisdiction and based on local code requirements.

### Fire Safety

#### The masking control processor shall have the capability to mute or otherwise disable the sound masking signal and any line-level audio input(s) of the entire sound masking system using a dry contact closure from a third party source such as a fire alarm control panel to one of the masking controllers.

#### The sound masking system shall not be a primary means of emergency voice evacuation or ECS. For this reason, UL2572 compliance is not required under this specification.

## Environmental Certification

### Sound masking system shall be Green Spec Listed.

### Sound masking system shall be LEED compliant when project requirements dictate.

# EXECUTION

## Examination – The contractor shall:

### Prior to installation, verify the site is suitable for system installation.

### Verify all locations where system components are to be installed are free of conflicts with other trades prior to installation.

### Verify that colors chosen (where applicable) have been coordinated with the architect, building manager, and/or building owner.

### Verify that site building conditions match the system design plans including ceiling finishes, wall locations, and obstructions. Immediately notify the project manager of any discrepancies prior to the commencement of work.

### Ensure system power requirements, network connectivity, and any other third party infrastructure requirements for the system have been provided and installed prior to installation.

## Delivery, Storage and Handling – the contractor shall:

### Protect all system components from moisture, dust and damage during shipping, storage and handling.

### Deliver in manufacturer’s original unopened and undamaged packages with manufacturer’s labels legible and intact.

### Inspect all system components upon receipt and upon unpacking.

## installation – the contractor shall:

### General

#### Comply with all applicable electrical and other safety codes.

#### Install the sound masking system in compliance with manufacturer’s recommendations and published documentation.

#### Utilize competent workers to install all equipment at locations shown on the drawings in strict accordance with approved shop drawings. Record any and all necessary changes to the system design in cases where different from the submittal documents and submit changes for approval prior to implementing the changes.

#### Ensure that all equipment shall be firmly held in place including emitters or speakers, enclosures, amplifiers, processors, cables, etc. Fastenings and supports shall be adequate to support their loads with a safety factor of at least five unless otherwise stated.

#### Ensure that all system components shall be mounted in a level and plumb fashion utilizing the dimensions indicated on the associated drawings.

#### Mount user controllable devices at a location and height which allows for normal adjustment and operation.

#### Locate all electronics to be conveniently accessible for service.

#### Ensure that all equipment located in the ceiling plenum shall be UL2043 rated for air handling environments.

### Ceiling Mounted Masking Emitters or Speakers

#### Locate masking emitter or speaker assemblies as indicated on project drawings and as required to meet the spatial uniformity requirements of this specification.

#### Ensure that design approval from the sound masking manufacturer is acquired for any direct field masking emitters or speakers scheduled to be installed greater than 20 feet (6.1 M) above the finished floor prior to installation.

#### Ensure that design approval from the sound masking manufacturer is acquired for any indirect field masking speakers scheduled to be installed greater than 30 feet (9.1 M) above the finished floor prior to installation.

#### Ensure that the emitter or speaker coverage pattern is not obstructed by building systems or structures which may impede performance of the sound masking system.

#### Ensure minimum distance between the top of an emitter or speaker and structure/obstacles is maintained to allow adequate clearance of cabling and connectors.

#### Ensure that the masking emitters and speakers are installed using manufacturer supplied accessories when mounted in other substrates, ceiling types and/or building structures. Sound masking emitter and speaker assemblies shall be mounted to structure in an approved method as required by local codes and jurisdiction, and indicated by the project submittals.

#### Follow manufacturer recommendations for individual emitter or speaker level controls/taps. Adjust as necessary.

### Cabling

#### Install all cabling in a professional, workmanlike manner with adequate service loops where applicable. Cabling shall be dressed in a neat and consistent fashion using appropriate methods and materials.

#### Test all field fabricated and manufacturer supplied cables, before installation, for open circuits, shorts, crossed pairs, reversed pairs, split pairs and proper pin-out.

#### Refer to manufacturer recommendations as to maximum cabling distances and types to support control processor unit(s), controls, and emitters or speakers. Manufacturer’s cable distance limitations and quantity of devices per cable run shall never exceed manufacturer guidelines.

#### Coordinate cabling pathways to prevent conflict with other building systems. Care shall be taken to minimize and eliminate all RFI and EMI interference sources.

#### Maintain appropriate separation between dissimilar signal types, voltages, and electrical devices.

#### Install and support cabling in a manner and frequency utilizing approved methods and materials as required by the local AHJ (authority having jurisdiction).

#### Install cabling in metallic rigid or flex conduit only as indicated on the associated project drawings/specification and using manufacturer approved accessories.

#### Support all cabling from structure. Cabling shall not contact ceiling tiles or inhibit their removal for access to the plenum.

## Site Quality Control – the contractor shall:

### Ensure that emitter and/or speaker spacing is correct, consistent, and follows design guidelines set forth by the product manufacturer.

### Securely terminate all cables.

## System Startup – the contractor shall:

### Coordinate with building network administrator to provide an Ethernet connection to the building LAN where required.

### Perform the entire product manufacturer’s recommended testing and startup procedure as outlined in the manufacturer’s product manual(s).

### Ensure functional operation of all ancillary devices to include front panel controls, audio inputs, contact closures, wall controls, software control and third party controllers. Test each setting and confirm expected results from actions taken. Correct all deficiencies in operation.

### Perform system startup at a time when each Zone / space is completely vacant and free of any noise contamination.

## System Tests and Adjustments

### Qualifications of Testing Party

#### Testing, calibration and setup shall be performed by a qualified manufacturer’s employee or an authorized dealer or consultant who has been trained by the manufacturer.

### Prior to test and adjustment: Ensure the site conditions are suitable for adjustment of the sound masking system. Adjustment can only be made when the following site conditions exist:

#### All ceiling assemblies are currently installed and completed.

#### All interior furnishings are assembled and in place.

#### Mechanical systems have been previously optimized to final operational conditions and are active in areas served by sound masking signals.

#### No occupants are present at the time of adjustment.

#### External noise sources (e.g. construction activities) are not present during testing.

#### Final testing shall be scheduled at least 30 days in advance of owner occupancy.

##### Notify the party listed under Section 1.07, Paragraph B of this document of the testing and adjustment schedule.

### Initial test and adjustments: Perform and record results of the following tests:

#### Masking emitter/speaker operation: Near field output of each masking emitter or speaker shall match the zone average within +/- 2.0 dB. Listen directly below each installed emitter or speaker to confirm it is operating. For any emitter or speakers found to be inoperative, or possibly operating at an incorrect level, use a calibrated sound level meter set to A-weighting and slow response to check the output. Place the microphone so as to contact each grille and measure the variation between a minimum of two adjacent emitters or speakers of the same zone.

#### Replace any defective emitters or speakers or cabling, or otherwise correct cause for any emitters or speakers found to be operating outside the range stated.

#### Buzzes, Rattles, and Distortion: With system operating at maximum level, listen for any buzzes, rattles, and objectionable distortion in all areas covered. Correct all causes of these defects.

### Final test and adjustment: Perform and record the results of the following tests:

#### Control settings: Adjust all masking spectrum levels and audio level controls for initial operation using manufacturer recommended procedures. Document setting for each user control.

#### Adjustment of sound masking Levels: With the masking system active, measure the A-weighted sound pressure level of each Zone independently. Use an ANSI S1.4 approved and calibrated Type 1 or 2 sound level meter and/or calibrated real time acoustic analyzer with one-third octave filters per ANSI S1.11. Perform all SPL measurements at a typical seated height of 4ft AFF (1.2 meters). Adjust the sound masking frequency spectrum in each zone to correspond with the A weighted average level and frequency levels (non-weighted) shown in Table 1. Document at minimum, one measurement per 1000sq ft. in open offices, one measurement in 50% of private offices, and one measurement in 50% of all other spaces where sound masking is present. **All documented measurements shall meet the maximum level variation column criteria of Table 1.** Correct any sound masking system deficiencies such as emitter or speaker placement or speaker tap settings to meet this performance criteria.

#### When integrating the sound masking system in a space previously occupied by workers, configure the incremental level adjustment feature of the control processor. Following the initial adjustment of sound masking levels, adjust each Zone’s initial sound masking level to a level 1.5 dBA above the average ambient noise level of the space. Engage the incremental level adjustment feature to automatically increase the sound masking level until reaching the “Average A-Weighted Sound Pressure Level” shown in Table 1 for each type of space listed. Use a minimum time frame of five days for the incremental level adjustment to reach the final target levels.

#### Provide a final testing report which states that the performance requirements of the sound masking system have been met.

### Automatic real-time masking level adjustment: Automatic adjustment of masking level based on ambient noise conditions shall not be permitted under this specification. Only scheduled adjustment of sound masking levels may occur at times when each zone is vacant of occupants.

# Table 1 for all system types

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Frequency | Open Office | Private Office | Corridor / Conference Room | Max Level Variation -Direct Field &Target Level Variation -Indirect Field | Max Level Variation -Indirect Field |
| \*125 Hz | 48 dB | 43 dB | 46 dB | +/- 3dB | +/- 5 dB |
| \*160 Hz | 47 dB | 42 dB | 45 dB | +/- 3dB | +/- 4 dB |
| 200 Hz | 45 dB | 40 dB | 43 dB | +/- 3dB | +/- 3 dB |
| 250 Hz | 44 dB | 39 dB | 42 dB | +/- 2dB | +/- 3 dB |
| 315 Hz | 42 dB | 37 dB | 40 dB | +/- 1dB | +/- 3dB |
| 400 Hz | 41 dB | 36 dB | 39 dB | +/- 1dB | +/- 3dB |
| 500 Hz | 40 dB | 35 dB | 38 dB | +/- 1dB | +/- 2.5dB |
| 630 Hz | 39 dB | 34 dB | 37 dB | +/- 1dB | +/- 2.5dB |
| 800 Hz | 38 dB | 33 dB | 36 dB | +/- 1dB | +/- 2.5dB |
| 1000 Hz | 37 dB | 32 dB | 35 dB | +/- 1dB | +/- 2.5dB |
| 1250 Hz | 36 dB | 31 dB | 34 dB | +/- 1dB | +/- 2.5dB |
| 1600 Hz | 34 dB | 29 dB | 32 dB | +/- 1dB | +/- 2.5dB |
| \*\*2000 Hz | 32 dB | 27 dB | 30 dB | +/- 1dB | +/- 2dB |
| \*\*2500 Hz | 30 dB | 25 dB | 28 dB | +/- 1dB | +/- 2dB |
| \*\*3150 Hz | 27 dB | 22 dB | 25 dB | +/- 1dB | +/- 2dB |
| \*\*4000 Hz | 24 dB | 19 dB | 21 dB | +/- 1dB | +/- 2dB |
| \*\*5000 Hz | 19 dB | 14 dB | 17 dB | +/- 1dB | +/- 2dB |
| \*6300 Hz | 14 dB | 9 dB | 12 dB | +/- 1dB | Not Applicable |
| \*8000 Hz | 11 dB | 6 dB | 9 dB | +/- 1dB | Not Applicable |
| Average “A” Weighted Sound Pressure Level (dB A) | 47 dBA | 42 dBA | 45 dBA | +/- 2 dBA | +/- 3 dBA |

\* Denotes additional frequency bands to be used when commissioning systems designed for background music and paging applications.

\*\* For effective speech privacy, special attention must be especially given to these frequency bands to ensure evenness of coverage. If the variation is greater than what is specified above, it is likely that the emitters or speakers are spaced too far apart to meet the above requirements.

### ***[Specifier’s Note: The Proof of Performance Section below is optional and can be used in cases where Section 1.07 Paragraph B specifies commissioning by a qualified acoustic consultant. The following section should not be used for dealer / manufacturer commissioned systems.]***

### Proof of performance testing by a qualified Acoustic Consultant: The contractor shall employ the services of a qualified acoustic consultant at no additional cost to the owner documenting to the Owner’s Representative in written form that the system is fully operable and is installed in compliance with the terms of the performance specifications hereunder.

#### Test the system to demonstrate that the design goal of Privacy Index (PI) = 80% (Normal Privacy) or better is met between representative workstations separated by partitions of 66” or greater height. For this test, select adjacent workstation pairs without direct line of sight or significant sound reflecting ceiling or wall elements between, and with a ceiling material rated at NRC of 0.85 or higher. Tests shall be in accordance with ASTM Standard E1130 except that the octave band calculation method of ANSI Standard S3.5 may be used. Lower levels of PI are acceptable only if the ceiling or partition requirements described herein before are not met. Document the results of this test.

#### Test the system in each open plan area zone served to demonstrate that the design goal for spatial uniformity is met. Tests shall be carried out per ASTM Standard E1573 as measured in the 2,000 Hz octave band. At each location, the average sound pressure levels shall be measured over an interval of at least four seconds at four positions at 90° intervals around a circle of 0.3 m (1 ft.) radius centered on the location. The arithmetic mean sound pressure level shall be calculated from the four measured values. For at least 75% of the test locations, the arithmetic mean sound pressure level in the 2,000 Hz octave band shall not vary by more than +/-1 dB from the average of the arithmetic mean sound pressure levels measured at all locations. Document the results of this test.

#### Test the system to demonstrate that the Speech Privacy Class (SPC) is at least 75 (Standard Speech Privacy) between representative private (enclosed) offices served by the system. For this test, select adjacent offices with closed doors free of air gaps. Tests shall be in accordance with ASTM Standard E2638-10. Test 10% of all similar sized offices and meeting spaces utilizing the same basic construction methods. Lower levels of SPC are acceptable if the common walls between the offices are comprised of assemblies <=STC 40 and which do not extend to the deck above -or- in cases where the common wall <=STC40, does not extend to the deck, and the ceiling attenuation class of the ceiling material is less than 45 (<=CAC 45). If the SPC achieved is lower than 75 due to architectural factors, bring this to the attention of the Owner or General Contractor. Document the results of this test.

#### The sound masking contractor will make all necessary modifications to the system design, integration, and/or settings, as specified by the System Designer, to achieve the performance testing goals contained herein at no additional expense to the Owner.

## Cleaning and waste management – the contractor shall:

### Remove empty packaging and other material waste.

### Clean all debris created by installation of components.

### Clean system components where required.

## Final Closeout and As-Built Documentation – the contractor shall:

### Document, prepare and submit all final control processor settings, emitter or speaker zone maps, speaker tap settings, one line diagrams, operational instruction, and testing results in PDF format. Submit three copies to the system designer, the project manager and, if required, the Owner’s representative for final review and acceptance.

### Indicate the location of each sound pressure level measurement, privacy index measurement, and spatial uniformity measurement referenced within the final documents on the zone map.

### In cases where the sound masking system utilizes configuration software for adjustment and operation, provide a copy on media with each documentation set utilizing the same software version as currently installed and operating. The contractor shall also provide all configuration files created by the configuration software on the same media.

### With 30-day advance notice, train Owner’s designated representative on sound masking system maintenance and proper operation.

#### Provide user instruction on operation.

#### Discuss potential for mis-adjustment of sound masking levels and deterioration of both comfort / speech privacy performance.

#### Demonstrate all software features, controls, and configuration.

## ATTACHMENTS

### System design schematic: Schematic of the system design on a floor plan showing the quantity and location of system components indicating zoning requirements.

### Project drawing sheet(s): (insert drawing sheets here)

END OF SECTION