**SECTION 27 51 19**

**SOUND MASKING SYSTEMS**

**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 loudspeakers used to generate, distribute, and control masking sound throughout a treated area.

#### Loudspeaker 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.

#### Zone: One or more Loudspeakers operating as a group and covering a specific, geographic area in a building.

#### 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).

#### 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: That company which produces the Sound Masking System products.

#### Contractor: That company chosen to install the Sound Masking System. Contractor must meet the qualifications described in Section 1.08.

#### Authorized Dealer: That company chosen to provide all Sound Masking System products described in Part 2. This dealer must be an authorized dealer of Manufacturer’s products.

## References:

#### ASTM E1130-08 – Standard Test Method for Objective Measurement of Speech Privacy in Open Offices Using Articulation Index.

#### ASTM E1374-11 – Standard Guide for Open Office Acoustics and Applicable ASTM Standards.

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

#### ASTM E1573-09 – Standard Test Method for Evaluating Masking Sound in Open Offices Using “A”-Weighted and One-third Octave Band Sound Pressure Levels.

#### 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 2014 Edition

#### 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 plant, 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:

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

### All active electronic components shall be conveniently accessible for service.

### All systems components shall be supplied from a single manufacturer.

## System Design, Commissioning and Equipment Supply

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

#### A Qualified 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 Trained and Certified by the Manufacturer.

### Equipment and accessories, including such things as cabling where applicable, shall be supplied by a dealer authorized by the equipment manufacturer.

## Installing Contractor Qualifications

### Sound Masking System shall be installed by a qualified Contractor.

### To be considered qualified for this work, the Contractor must be experienced in the provision of low-voltage electronic systems similar in complexity to those required for this project, and meet the following: **(pick one or more)**

#### The Contractor’s primary business is the provision, fabrication, and installation of integrated audio and video systems including distributed sound systems, structured cabling, and/or related systems in the commercial environment.

#### The Contractor is an authorized dealer for the major product components furnished.

#### The Contractor is an authorized dealer for the major product components and is certified by the manufacturer to perform their installation and setup.

#### 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 project and bonding requirements.

#### When so directed by the Sound Masking System Designer, the Contractor must have obtained the necessary personnel expertise and test measurement equipment outlined herein to configure, test, and calibrate the sound masking system.

## BID SUBMITTALS

### Contractor shall refer to Division 00 of this Article.

### Instructions to Bidders: To be considered, Bids must be made in accord with the Architect's Instructions to Bidders and this Article.

### Examinations: Carefully examine the contract documents and, when possible, 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 on-site examinations, and will not be relieved of any obligations with respect to bid.

### Questions: Submit all questions about the contract documents in writing. Replies requiring changes to the contract documents will be issued to all bidders as addenda and will become part of the Contract. The Project Manager may give, but will not be responsible for, oral clarifications. Questions received less than 10 days before bid date cannot be answered in writing.

### Basis of Consideration: shall consist of the following items in order: **(Optional paragraph)**

#### 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

#### Contractor shall adhere to Article 01 30 00 for these requirements.

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

#### CAD drawings will be in AutoCAD 2018 dwg format and portable document format (PDF). All other submissions unless otherwise stated will be provided as PDFs.

#### Submit a list of proposed major components along with manufacturer’s detailed technical data sheets.

#### Unless otherwise directed by contract, do not order equipment until the bill of materials has been reviewed and approved by the Project Manager.

#### Coordinate all submittals with requirements set forth in Section 01 30 00.

#### A floorplan and/or reflected ceiling drawing denoting at minimum device locations which has been prepared by the sound masking manufacturer.

## Installation and QUALITY ASSURANCE

### Required Permits: Installing Contractor or Project Manager shall obtain all necessary permits for installation work.

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

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

### All equipment, cabling, accessories and associated hardware shall be installed in accordance with 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, best commercial practice and shall be accomplished by qualified personnel.

## JOB CONDITIONS

### Contractor shall refer to and adhere to Division 02 of this Article.

### Sequencing and Scheduling:

#### Coordinate work with 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; otherwise, the Project Manager will require an increase in force or overtime work without additional expenses to the Owner.

#### Abide by the decision of the Project Manager in case of conflict or interference by other trades.

#### Refuse: Remove all refuse from the job site to the satisfaction of the Project Manager and Owner.

### Insurance on the work of this specialty trade shall be provided if specified in Section 00 81 00.

## INSPECTION

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

## WARRANTY

### Warrant the installation of all equipment, cabling, and labor for an initial period of one year from the date of final acceptance.

### Owner requested services, including telephone support, shall be at no charge during the duration of the initial one year warranty period.

### During the initial warranty period, services shall include two semi-annual visits to the site for routine adjustment and maintenance of all equipment. Provide a preliminary schedule for the semi-annual visits.

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

## SERVICE CONTRACT

### At Owner’s Request - Provide an annual service and maintenance contract to commence after the one year warranty period has expired.

### Services to include two semi-annual visits to the site for routine adjustment and maintenance of all equipment.

## TRAINING

### 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

## MANUFACTURER

### The basis of design is Cambridge Sound Management DynasoundPro 70-Volt Sound Masking System. Product details available at <https://cambridgesound.com/>

### Alternate manufacturers shall be considered as the basis of design only when they meet the same form, function and performance and are accompanied by appropriate supporting documentation and approved by the Sound Masking System Designer.

## gENERAL

### Product requirements include all masking, signal generation, signal processing, amplification, and loudspeakers with associated wiring, software, and controls.

### Only complete, integrated Sound Masking Systems from a sole manufacturer shall be acceptable.

### As chosen by the Sound Masking System Designer, the Sound Masking System shall be one of the following:

#### A Single-Channel 70-Volt System with dedicated Sound Masking Generator

#### A Multi-Zone 70-Volt Sound Masking System with independent Sound Masking Generators

### When the space to be masked has areas with differing ceiling height, plenum depth, ceiling type or requires more than one loudspeaker type, the Sound Masking System must be a Multi-Zone 70-Volt Sound Masking System.

### Multi-Zone Sound Masking System shall be capable of multiple Zones as depicted on the project drawings in order to adjust for unique architectural spaces and facility uses.

### Multi-Zone Sound Masking System shall be capable of automatically scheduling system parameter adjustments, including initial acclimatization, on a per Zone basis.

### Means of control may be facilitated through front-panel adjustment or through Windows client-based software such as Cambridge Sound Management Privacy Manager via optional Touch Screen Controller.

### Multi-Zone Sound Masking System shall be capable of generating, amplifying, and distributing a minimum of four non-correlated sound masking signals.

### Sound Masking System shall be capable of accepting at minimum one external line level audio source from ancillary audio equipment with control on a per Zone basis.

### Multi-Zone 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 separate level control Zone for Multi-Zone Sound Masking Systems shall be required in instances where a change in loudspeaker mounting / ceiling height varies by more than 6” throughout a functional space.

## LoudspeakerS

### Three types of Loudspeakers shall be provided to meet the needs of different spaces within the facility to be masked. Systems offering only one or two types of Loudspeakers are not acceptable under this specification.

### Type 1 Loudspeaker: Type 1 Loudspeaker shall be designed for upwards-facing use in the plenum above a suspended ceiling with a height from ceiling tile to deck of at least 18 inches (457 mm). Type 1 Loudspeaker shall also be designed for upwards-facing use in open-ceiling structures and shall have an attractive yet unobtrusive appearance for such usage. Type 1 Loudspeaker shall include a manufacturer-supplied 70-volt transformer with taps at ⅛-watt, ¼-watt, ½-watt, 1-watt, 2-watts and 4-watts to allow level/volume adjustment in 3 dB steps.

### Type 2 Loudspeaker: Type 2 Loudspeaker shall be designed for use in the plenum above a suspended ceiling with a height from ceiling tile to deck of less than 18 inches (457 mm) utilizing manufacturer-supplied optional tile bridge. Masking sound shall exit to the side of Type 2 Loudspeaker. Type 2 Loudspeaker shall include a manufacturer-supplied 70-volt transformer with taps at ⅛-watt, ¼-watt, ½-watt, 1-watt, 2-watts and 4-watts to allow level/volume adjustment in 3 dB steps.

### Type 3 Loudspeaker: Type 3 Loudspeaker shall be a direct field Loudspeaker that is no more than 5” in diameter and designed for downward-facing installation in suspended acoustical tile or hard surface ceilings. Type 3 loudspeaker shall include a manufacturer-supplied 70-volt transformer with taps at ½-watt, 1-watt, 2-watts and 4-watts to allow level/volume adjustment in 3 dB steps.

### 25-volt loudspeakers are not allowed under this specification.

### Provide seismic rated mounting where required by jurisdiction.

### All Loudspeakers shall be UL (or ETL) 1480 and/or 2043 listed as appropriate for use in the spaces where they will be mounted.

### Place loudspeakers where indicated on project drawings. Space evenly 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.

### Loudspeakers as driven by Sound Masking Generators or Amplifiers shall be capable of producing minimum sound pressure levels and frequency spectrum as required in Part 3 of this specification and as measured at an above finished floor height of 4ft (1.2 meters) regardless of ceiling type, height, or presence.

### Active (self-powered) loudspeakers are not allowed under this specification.

## Sound Masking Generator/Amplifier

### Two types of Sound Masking Generator/Amplifier shall be provided to meet the needs of Single Channel Sound Masking Systems.

### Type 1 Sound Masking Generator/Amplifier: Type 1 Sound Masking Generator/Amplifier shall provide a digital sound masking generator with adjustable volume, low-pass filter and 25-watt amplifier.

### Type 1 Sound Masking Generator/Amplifier shall be suitable for consistent ceiling height, ceiling type, plenum depth, loudspeaker type and areas requiring no more than 25 Loudspeakers.

### Type 2 Sound Masking Generator/Amplifier: Type 2 Sound Masking Generator/Amplifier shall provide a digital sound masking generator with adjustable volume, low-pass filter and 40-watt amplifier providing power for up to 40 Loudspeakers.

#### Type 2 Sound Masking Generator/Amplifier shall provide a voice paging input with separate volume control.

#### Type 2 Sound Masking Generator/Amplifier shall provide a telephone paging input with separate volume control.

#### Type 2 Sound Masking Generator/Amplifier shall provide a music input with separate volume control.

#### Type 2 Sound Masking Generator/Amplifier shall provide a treble and bass control to adjust voice paging, telephone paging and music sources.

### Type 2 Sound Masking Generator/Amplifier shall be suitable for consistent ceiling height, ceiling type, plenum depth, loudspeaker type and areas requiring no more than 40 Loudspeakers.

### Type 1 and Type 2 Sound Masking Generator/Amplifier shall provide a factory default sound masking spectrum with adjustable low-pass filter.

## Networked Sound Masking Processor

### Provide at least one Networked Sound Masking Processor for Multi-Zone 70-Volt Sound Masking Systems.

### Type 1 Networked Sound Masking Processor shall provide eight balanced, line-level analog outputs, four non-coherent sound masking generators and eight analog, line-level balanced inputs for paging and music signals with level controls, equalizers and compressors.

### Type 2 Networked Sound Masking Processor shall provide two balanced, line-level analog outputs, four non-coherent sound masking generators and two analog, line-level balanced inputs for paging and music signals with level controls, equalizers and compressors.

### Networked Paging and Music Processor shall include a DSP matrix mixer to mix any combination of sound masking, paging and music signals and route them to any analog output.

### A separate, non-coherent sound masking generator shall be assigned for each change in ceiling material, ceiling height, plenum height or loudspeaker type. Provide sufficient Networked Sound Masking Processors to achieve this requirement.

### Configuration and adjustment of level controls, compressors, equalizers, matrix mixer and other controls shall be accessible via Ethernet connection using Windows client software such as Cambridge Sound Management Privacy Manager.

### Networked Paging and Music Processor shall be UL or ETL listed to conform to UL60065.

## 70-Volt Power Amplifier

### Provide 70-Volt Power Amplifiers as needed for Multi-Zone 70-Volt Sound Masking systems.

### 70-Volt Power Amplifier shall be a dual-channel type with 70-volt, 100-watt output from each channel to drive up to 85 loudspeakers per channel.

### 70-Volt Power Amplifier shall include rear-panel selectable high-pass filter, switchable limiter and detented gain/level control for each input. The amplifier’s power switch shall be on the rear panel. Amplifiers with any such controls on the front panel shall not be acceptable under this specification.

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

### 70-Volt Power Amplifier shall be UL or ETL listed to conform to UL60065.

## Auto-Transformer Attenuator

### Provide Auto-Transformer Attenuators to facilitate level adjustment of loudspeaker zones.

### Provide at least one Auto-Transformer Attenuator for each loudspeaker type, area of adjustment or change in ceiling materials or height.

### Auto-Transformer Attenuator shall be rated for 100 watts of power capacity and designed for use with 70-volt loudspeaker lines.

### Each Auto-Transformer Attenuator shall include an 11-stage detented control adjustable in 1.5 dB increments with an off position.

### Auto-Transformer Attenuators shall be offered in a standard 19” rack-mount panel with from one to eight Auto-Transformer Attenuators per panel.

## Software and Control

### The Networked Sound Masking Processor shall be capable of software control via a TCP/IP local area network connection via Ethernet.

### Each Networked Sound Masking Processor shall be uniquely addressed at the factory to include IP addressing and MAC address.

### Means of control may be facilitated through Windows client-based software such as Cambridge Privacy Manager.

### End-user Zone control may be facilitated using Auto-Transformer Attenuators.

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

#### Sound masking levels

#### Audio input levels

#### Equalization adjustment

#### Time of day scheduling

## Touch Screen Controller (Optional)

### Optional Touch Screen Controller shall be a Windows based tablet PC equipped with Privacy Manager Software and a network connection. Optional second network interface card shall enable connection to a second network.

### Touch Screen Controller shall include a wall-mounting bracket and a 19” rack-mount kit.

### Operation of the Sound Masking System may be facilitated from an owner-provided PC or other network device utilizing a remote desktop connection to the optional Touch Screen Controller equipped with optional second network interface card. For security purposes, this “bridging” connection shall be the single point at which the Sound Masking and owner networks make physical connection. Device and network security policies must maintained by the owner. Sound Masking Systems requiring more than one IP address from the owner’s computer network will not be permitted under this specification.

## 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.

#### Loudspeaker Cabling shall be a single jacket - 2 Conductor, stranded 18 to 16 AWG loudspeaker cabling.

#### Ethernet cabling shall be a single jacket UTP Category 5e, Category 6, or Category 7.

#### Each Ethernet cable shall be verified by the Installing Contractor to 10/100 MB/sec standards.

#### Line Level analog audio shall be a single jacket - 2 conductor 22 AWG stranded, twisted pair shielded cable designed for analog audio connectivity.

### 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.

#### Field terminations shall be permitted in cases only where approved by the product manufacturer.

### Ethernet network category cabling shall not exceed 100 meters (330 feet) in length.

## 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.

## 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

#### Provide seismic rated mounting for each Loudspeaker where required by jurisdiction.

### Fire Safety

#### The Sound Masking System shall have the capability to mute or otherwise disable the sound masking signal and any voice paging or music signal using a dry contact closure from a third party source such as a fire alarm panel.

#### The Sound Masking System shall not be used as a primary means of emergency communications system or ECS. For this reason, UL2572 compliance is not required under this specification.

## Environmental Certification

### Sound Masking System shall be LEED compliant when project requirements dictate.

# EXECUTION

## Examination

### Prior to installation, ensure 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 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

### 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

### General

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

#### Install Sound Masking System in compliance with manufacturer’s recommendations and published documentation.

#### All equipment shall be installed by competent workers 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.

#### All equipment shall be firmly held in place including loudspeakers, enclosures, amplifiers, processors, cables, etc. Fastenings and supports shall be adequate to support their loads with a safety factor of at least six unless otherwise stated.

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

#### User controllable devices shall be mounted at a location and height which allows for normal adjustment and operation.

#### Electronics shall be conveniently accessible for service.

#### Above-ceiling inline power injector equipment shall be UL2043 rated for air handling environments.

#### Systems using above-ceiling sound masking generators are not permitted under this specification.

### Loudspeakers

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

#### Loudspeakers must be installed no more than 30 feet (9.1 meters) above the floor.

#### Ensure loudspeaker 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 loudspeaker and structure/obstacles are maintained to allow adequate clearance of cabling and connectors.

#### When mounted in other substrates, ceiling types and or building structures, loudspeakers shall be installed using manufacturer supplied accessories. Mount loudspeaker assemblies to structure in an approved method as required by local codes and jurisdiction, and indicated by the project submittals.

#### Follow manufacturer recommendations for individual loudspeaker level controls/taps. Adjust as necessary.

### Cabling

#### All cable installation shall be done in professional workmanlike manner with adequate service loops where applicable. Dress cabling 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 loudspeakers. Never exceed manufacturer’s cable distance limitations and quantity of devices per cable run.

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

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

#### Cabling to be installed/supported in a manner and frequency utilizing approved methods and materials as required by the local AHJ (authority having jurisdiction).

#### Cabling shall be installed in metallic rigid or flex conduit only as indicated on the associate project drawings/ specification and using manufacturer approved accessories.

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

## Site Quality Control

### Ensure that loudspeaker spacing is correct, consistent, and follows design guidelines set forth by the product manufacturer.

### Securely terminate all cables.

## System Startup

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

### Perform the entire product manufacture’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 – Single-Channel 70-Volt Systems

### 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 (i.e. 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:

#### Loudspeaker Operation: Near field output of each loudspeaker shall match the Zone average within +/- 1.5 dB. Listen directly below each installed loudspeaker to confirm it is operating. For any loudspeakers 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 directly below and equal distance from each loudspeaker. Measure the variation between a minimum of 3 adjacent Loudspeakers of the same zone and tap setting.

#### Replace any defective loudspeakers or cabling, or otherwise correct cause for any loudspeakers 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 Audio Input Levels: Adjust background music/paging levels for clarity above ambient noises with a minimum signal to noise ratio of 10 dBA above ambient sound levels. Adjust frequency spectrum of each input as necessary to achieve accurate reproduction of the intended signal source.

## System Tests and Adjustments –Multi-Zone 70-Volt Systems

### 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 (i.e. construction activities) are not present during testing.

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

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### Initial Test and Adjustments: Perform and record results of the following tests:

#### Loudspeaker Operation: Near field output of each loudspeaker shall match the Zone average within +/- 1.5 dB. Listen directly below each installed loudspeaker to confirm it is operating. For any loudspeakers 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 directly below and equal distance from each loudspeaker. Measure the variation between a minimum of 3 adjacent Loudspeakers of the same zone and tap setting.

#### Replace any defective loudspeakers or cabling, or otherwise correct cause for any loudspeakers 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 Audio Input Levels: Adjust background music/paging levels for clarity above ambient noises with a minimum signal to noise ratio of 10 dBA above ambient sound levels. Adjust frequency spectrum of each input as necessary to achieve accurate reproduction of the intended signal source.

#### 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 1/3 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 loudspeaker placement or loudspeaker tap settings to meet this performance criteria.

# Table 1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Frequency | ***Open Office*** | ***Private Office*** | ***Corridor/Conference Room*** | ***Max Variation*** |
| *125 Hz* | *45 dB* | *40.5 dB* | *42.5 dB* | *+/- 5 dB* |
| *160 Hz* | *45 dB* | *40.5 dB* | *42.5 dB* | +/- 4 dB |
| *200 Hz* | *45 dB* | *40.5 dB* | *42.5 dB* | +/- 3 dB |
| *250 Hz* | *44 dB* | *39.5 dB* | *41.5 dB* | *+/- 3 dB* |
| *315 Hz* | *43 dB* | *38.5 dB* | *40.5 dB* | *+/- 3dB* |
| *400 Hz* | *41 dB* | *36.5 dB* | *38.5 dB* | +/- 3dB |
| *500 Hz* | *40 dB* | *35.5 dB* | *37.5 dB* | +/- 2.5dB |
| *630 Hz* | *39 dB* | *34.5 dB* | *36.5 dB* | +/- 2.5dB |
| *800 Hz* | *37 dB* | *32.5 dB* | *34.5 dB* | +/- 2.5dB |
| *1000 Hz* | *36 dB* | *31.5 dB* | *33.5 dB* | +/- 2.5dB |
| *1250 Hz* | *35 dB* | *30.5 dB* | *32.5 dB* | +/- 2.5dB |
| *1600 Hz* | *33 dB* | *28.5 dB* | *30.5 dB* | +/- 2.5dB |
| *2000 Hz* | *32 dB* | *27.5 dB* | *29.5 dB* | +/- 2dB |
| *2500 Hz* | *30 dB* | *25.5 dB* | *27.5 dB* | +/- 2dB |
| *3150 Hz* | *28 dB* | *23.5 dB* | *25.5 dB* | +/- 2dB |
| *4000 Hz* | *26 dB* | *21.5 dB* | *23.5 dB* | +/- 2dB |
| *5000 Hz* | *23 dB* | *18.5 dB* | *20.5 dB* | +/- 2dB |
| **Average “A” Weighted Sound Pressure Level (dBA)** | **46.6 dBA** | **42.1 dBA** | **44.1 dBA** | **+/- 3 dBA** |

#### Configure time of day sound masking level adjustment following the final adjustment of sound masking levels. Coordinate with Owner to determine activity times and levels of occupancy. Adjust the Sound Masking System based on the target “Average A-Weighted Sound Pressure Level” in Table 1 as the final sound masking levels used for high activity/occupancy times. Adjust the Sound Masking System based on the targeted “Average A-Weighted Sound Pressure Level” in Table 1 with adjustment -3 to -9 dBA lower at times of inactivity/lower occupancy per product manufacturer’s recommendations.

#### 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.

### Sound Masking Equalization: On-site sound masking equalization shall be performed by those qualified personnel specified in Section 1.07B to meet the values specified in Table 1.

### ***[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: If requested, demonstrate to the Owner’s Representative that the system is fully operable and 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 4 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

### 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, loudspeaker Zone maps, loudspeaker 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 client control software for adjustment and operation, provide a copy on media with each documentation set utilizing the same software version as currently installed and operating.

### With thirty 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