

1. PART ONE – GENERAL

1.1. SECTION INCLUDES

1. Sound masking systems

1.2. REFERENCES

1. UL6500 – Standard for Audio/Video and Musical Instrument Apparatus for Household, Commercial and Similar General Use
2. UL 2043 – Standard for Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces; 1996
3. ASTM E 1374-06 – Standard Guide for Open Office Acoustics and Applicable ASTM Standards
4. ASTM E 1573-09 – Standard Test Method for Evaluating Masking Sound in Open Office Using A-Weighted and One-Third Octave Band Sound Pressure Levels
5. ASTM E 1130-08 – Standard Test Method for Objective Measurement of Speech Privacy in Open Offices Using Articulation Index
6. ASTM E 2638-08 – Standard Test Method for Objective Measurement of the Speech Privacy Provided by a Closed Room
7. ANSI S1.13-05 Measurement of Sound Pressure Levels in Air
8. ANSI S12.2-08 Criteria for Evaluating Room Noise
9. CSA T-529 Telecommunications Cabling Systems in Commercial Buildings

1.3. DESIGN AND PERFORMANCE REQUIREMENTS

1. System Architecture
 1. The system shall be of a networked architecture with addressable masking devices distributed throughout the installation area.
 2. All speakers to be located above ceiling tile in the plenum.
2. Masking Sound Generation
 1. The system shall provide an independent sound masking generator for each masking control zone in Section C.7. A zone is comprised of an independently addressable electronic module capable of generation and control (level and spectrum) of a sound masking signal and one or more loudspeakers.
 2. The masking sound shall be random and provide no noticeable repetitive pattern. Pseudo-random generation cycles shall exceed 24 hours. One minute time-averaged sound pressure level of any 1/3 octave band of masking sound from 160 to 5,000 Hz remains constant in any space to within a standard deviation of 1 dB when measured over a 30-minute period .
 3. The masking system must include an automated spectrum and level calibration process.
 4. The system shall provide a function to allow a gradual ramp up of masking volume each time power is applied
 1. This functionality shall have a programmable ramp up rate, as well as enabled/disabled feature, controlled from central control device.

3. System Control & Grouping

1. The system must include a software control interface capable of making and displaying all sound masking and sound masking timer settings.
2. All system settings shall be digital and adjusted via the software control interface and control panel.
3. The software control interface shall be capable of monitoring and reporting on all system settings affecting masking performance.
4. Masking level controls shall be limited to a software control interface and/or control panel(s) located in a locked mechanical room, electrical room or IT room local to the area being controlled, accessible only by authorized personnel. Location of the control panel if supplied is to be confirmed with the client.
5. The system shall use digital signal processing (DSP) technology for masking sound generation and adjustment of masking signals.
6. The sound masking system shall be arranged into groups of zones and individual zones of loudspeakers based on common installation conditions and each zone shall not exceed two (2) loudspeakers in size as per attached layouts. Divide each group into zones of one or two loudspeakers.
 1. Each zone shall be individually addressable and controllable for both volume and spectrum in 1/3 octave bands for fine tuning of the system.
 2. Each group of zones shall be individually addressable and controllable for volume for fine tuning of the system.
7. Each zone shall be independently controllable through a network device with the following capabilities:
 1. A 1/3 octave band equalizer with adjustment capabilities for a minimum of 16 1/3 octave bands for the masking signal, capable of equalizing the masking signal output to the loudspeakers within the corresponding zone within plus or minus 1 dB in each 1/3 octave band.
 2. Equalizers shall provide a minimum adjustment range of 160 to 5,000 Hz.
 3. The masking volume shall be adjustable within each zone in 0.5 dBA increments over a range of 35 dBA to 85 dBA at a distance of 1m.
 4. All output adjustments shall be implemented via control panel or software control interface.
8. Each closed office, boardroom or meeting room shall be considered a separate zone.
9. For open office close to glazed areas align zones comprised of two speakers such that both speakers are the closest speakers to the glazing.
10. For acoustic privacy, locate individual zones in front of doors in the corridor/open areas for closed offices and meeting rooms.
11. Locate speakers within 500 mm of the location in the design drawing to insure optimum masking and speech privacy control.

4. Acoustical Performance Requirements

1. Prior to commissioning the system, with mechanical system operating at normal daytime levels and with all furnishings in place, 1/3 octave sound measurement samples from 160 Hz to 5,000 Hz shall be taken throughout the facility in each 100 m².
 - a. Special attention should be taken to identify any building noise which exceeds the preferred spectrum identified below in D.9.
 - b. Provide a report of these measurements to the acoustical consultant in advance of system verification (see section 3.10).

2. With the exception of those areas identified in D.1.a., all other areas shall conform to the masking sound levels defined in D.6 and the sound spectrum defined in table D.9 below. Speakers should still be installed in these areas.
3. Sound Quality: No audible hum or noise, other than masking noise, from this system in masked spaces should be detected
4. Uniformity in any 1/3 octave band shall vary no more than +/- 2 dB from the NRC Canada optimum spectrum in table D.9 when adjusted by the vendor
5. Variations of more than +/- 2 dB in any 1/3 octave band of measurements provided by the vendor shall be corrected by vendor at the vendor's expense. This may include that vendor modify system design to provide additional zones through software control, additional wiring and/or sound sources.
6. Masking sound level shall be 42 dBA in meeting rooms (S5, S6), 43 dBA in private offices & closed rooms (S4, S7), 47 dBA for acoustic privacy (S3 – beside doors) and 47 dBA in open plan areas (S1 & S2) verified and adjusted accordingly every zone. The target spectrum of 45 dBA in table D.9 shall be maintained for each defined volume by subtracting 3dB in each 1/3 octave band for meeting rooms, 2 dB for private offices and by adding 2dB for each 1/3 octave beside doors for acoustic privacy and in open office areas to obtain the specified dBA levels.
7. For any acoustic privacy group identified on the project drawings, tune all loudspeakers in those groups before turning on any other loudspeakers to ensure that the level and spectrum in the areas requiring acoustic privacy is determined from loudspeakers from that group rather than from any other group. Once the acoustic privacy group tuning is complete proceed to tuning for other groups.
8. After adjustment, the system shall provide spatial uniformity of +/-1dBA for the combined mechanical and sound masking sound level within each zone.
9. The system shall provide a 1/3 octave band equalizer for smooth and seamless adjustability of the sound spectrum within the preferred spectral curve, as shown below and in Acoustical Design of Conventional Open Plan Offices, Canadian Acoustics, vol. 27, no. 3, 2003 for each zone.

| 1/3 Octave Frequency | NRC Canada Optimum Spectrum |
|----------------------|-----------------------------|
| Nominal dBA | 45 |
| 160 | 41.5 |
| 200 | 41.5 |
| 250 | 41 |
| 315 | 40.5 |
| 400 | 39.5 |
| 500 | 38.5 |
| 630 | 37.5 |
| 800 | 37 |
| 1,000 | 35.5 |
| 1,250 | 33.5 |
| 1,600 | 31 |
| 2,000 | 28.5 |
| 2,500 | 26.5 |
| 3,150 | 23.5 |
| 4,000 | 21.5 |
| 5,000 | 19.5 |

Table D.9 – NRC Canada Optimum Sound Masking Spectrum

10. The measured spectrum should be verified and adjusted to match spectrum in Table D.9 for every zone.
11. For closed rooms an optional spectrum may be provided with lower mid-range 1/3 octave band levels for a more neutral sounding spectrum closer to a level decreasing by 5 dB per octave. The specific spectrum to be determined on test.

5. Optional Features

1. The masking system may include an option to allow music and paging through the system's speakers. Any additional cost for this feature shall be identified separately.

6. Timer Performance

1. The system shall provide a timer function allowing masking volume levels to be automatically adjusted according to a programmed schedule.
2. The system shall provide a calendar-based programmable timer function. Timer schedules shall be assigned to an individual or group of primary network devices.
3. The system shall provide automatic daylight saving time adjustments.
4. The system shall provide an acclimatization (level ramp-up) process that automatically increases the masking volume over a period of time according to a programmed schedule. The system should allow for independent acclimatization schedules for each timer zone.
5. The system shall allow for up to eight independent timer zones.
6. The system shall allow independent timer schedules for each day of the week.
7. The system shall allow variable rates of volume adjustment.

7. In-Room Occupant Control

1. The system shall allow for the option to include a specified number of wall-mounted, in-room controls giving the facility occupants manual control over the loudspeaker volume in designated rooms. These controls are to be as per the system drawings.
2. Coordination with the client required for the installation of the in-room controls. If electrical boxes and conduit required, they are to be provided and installed by client.

8. Diagnostic Performance

1. The system shall be capable of identifying electronic components that are not functioning via a diagnostics function and reporting the result of the diagnostics.

9. Reporting Performance

1. The software shall be capable of reading and displaying the current settings for all masking and timer zones.
2. The system shall be capable of generating detailed reports of all system settings down to the level of each masking and timer zone.

10. Security Performance

1. Below-ceiling electronic components shall be contained in a locked metal enclosure or cabinet.

2. Access to the control functions shall be password protected.
3. The system shall allow for all settings to be backed up on an electronic storage medium.

1.4. SUBMITTALS

1. Product Data: Manufacturer's specifications, cut-sheets and installation instructions
2. System Design: Shop Drawings including schematics of the system showing quantity and location of components and related cabling and accessories, clearly identifying the groups and zones and speaker locations matching the requirements of section 1.4.C.
3. Warranty Documents: Warranty documents covering the system components.

1.5. QUALITY ASSURANCE

1. Manufacturer Qualifications: Minimum of 5 years manufacturing sound masking systems.
2. System Design – Performed by an approved manufacturer representative.
3. Installer Qualifications – Approved by manufacturer representative and are trained with the specified products or have demonstrated experience with the installation of similar products to those specified.
4. System Adjustment – Done by an approved manufacturer representative or trained contractor.
5. Single Source Responsibility – Source electronic masking components, loudspeakers, wall controls and cables from a single manufacturer.

1.6. REGULATORY TESTING AND CERTIFICATIONS

1. The system components shall conform to:
 1. Safety and Electrical
 1. IEC 60065 – Standard for Audio, Video and Similar Electronic Apparatus - Safety Requirements. Products shall be labelled accordingly.
 2. Electromagnetic Interference (EMI)
 1. ICES-003 (Industry Canada) – Interference-Causing Equipment Standard.
 3. Cabling
 1. UL CL3P/CMP 75C. Products shall be labelled accordingly.
 4. Heavy Metals [Spec Note – Voluntary, but best practice]
 1. RoHS – Restriction of Hazardous Substances (voluntary).
 5. Low Voltage Power Supplies
 1. UL1310, Standard for Class 2 Power Units. Products shall be labelled accordingly.

1.7. DELIVERY, STORAGE AND HANDLING

1. Protect from moisture during shipping, storage and handling.
2. Deliver in manufacturer's original unopened and undamaged packages with manufacturer's labels legible and intact.
3. Inspect manufacturer's packages upon receipt.
4. Handle packages carefully

1.8. WARRANTY AND MAINTENANCE

1. Provide a written warranty that products installed shall be free from defects in parts or assembly for a 5-year period from date of first use.

2. PART TWO – PRODUCTS

2.1. MANUFACTURERS

1. Acceptable Manufacturers, those able to meet all these specifications.

2.2. SYSTEM COMPONENTS

1. General System Overview: The sound masking system shall be a networked system with complete digital control down to individually addressable networked masking devices. The system shall be comprised of a selection of a) distributed networked masking devices; b) loudspeakers; c) computer software; d) optional control panels; e) cable assemblies; f) power supplies.

3. PART THREE - EXECUTION

3.1. SYSTEM DESIGN

1. Design system according to manufacturer's specifications and match layout and group plan as per supplied drawings.
2. Conform to the speaker layout as per the project drawing AK01.

3.2. EXAMINATION

1. Ensure that facility build out is at a stage suitable for the system installation.
2. Ensure that facility is constructed according to plans including wall and door locations, ceiling types and plenum barriers.
3. Ensure that the plenum height is appropriate as per manufacturer's recommendations and as per plan.
4. Ensure power requirements have been provided as per plan.
5. Ensure sufficient space for centrally located components is available as per plan and manufacturer's specifications.
6. Ensure any third-party components required to be interfaced with the system have been provided.

3.3. PERMITS

1. Obtain necessary permits for installation work.

3.4. INSTALLATION

1. Follow all applicable codes for the area
2. Follow manufacturer's recommendations regarding installation as found in the manufacturer's installation manual.

3. Support all cabling and masking system components on their own dedicated suspension and mounting systems independent of the ceiling grid, and ensure the support system meets seismic requirements for the building.
4. Follow the system design for location of loudspeakers and control panels.
5. Record any necessary changes to the system design on the plan
6. Ensure that supplementary materials used meet applicable safety standards

3.5. FIELD QUALITY CONTROL

1. Ensure that plenum heights meet the minimum recommended by the manufacturer for the loudspeakers
2. Ensure that distance between the top of the loudspeaker and the slab or deck meets manufacturer's minimum specifications
3. Ensure that loudspeakers are suspended in a level manner
4. Ensure that loudspeakers are not obstructed as much as possible
5. Ensure cables are properly supported in the ceiling
6. Ensure cables are securely terminated

3.6. NETWORK CONFIGURATION AND ADJUSTMENT

1. Follow manufacturer's recommendations for system settings as found in the system's user manual.
2. Follow masking tuning requirements as per Section 1.4.D.

3.7. CLEANING

1. Ensure that empty packaging is removed.
2. Ensure that any material waste is removed.
3. Ensure the product is clean and presentable.

3.8. DEMONSTRATION AND TRAINING

1. Demonstrate operational system to customer by walking the space.
2. Demonstrate functionality of the system to the customer or customer's representative.
3. Train customer employee to maintain system as required.

3.9. COMMISSIONING

1. Commissioning Agency
 1. To be Sound Masking Vendor or qualified Acoustical Consultant hired by the vendor.
2. Timing
 1. Commissioning to begin after final tuning of system.
3. Procedures
 1. Acoustical performance shall be determined with the methods identified in this section to verify the conformance with section 1.4 of this specification.
 2. Provide separate readings for every zone at 1.2 m from floor using a moving microphone technique with a minimum 15 second Leq, keeping at least 1m away from

any reflecting surface. When it is not possible to be at least 1 m from any reflecting surface, measure as far away as possible from any sound reflecting surface.

3. The sound level meter itself must be a calibrated Type 1 with a microphone frequency response uniformity of plus or minus 1 dB from 160 to 5000 Hz, and must be mounted or held in such a way that there are no sound reflections from the operator or any part of the measuring instrument affecting its response per ANSI S1.13. It is recommended that the sound level meter be held away from the body of the operator (or other reflecting objects) to minimize the effects of reflections. A microphone mounted on a tripod or stand and connected via an extension cable to the sound level meter is the ideal approach.
4. Calibrate the sound level meter every two hours using a calibrated sound level calibrator. Microphone calibrator must have been calibrated within 2 calendar years and be within 0.5 dB of its stated calibration on its calibration certificate.
5. With masking off and mechanical system on, verify sound levels in all areas previously identified by vendor in 1.4.D.1.a., which exceed target volume and spectrum levels.
 1. Excessive mechanical noise, which exceeds the target limits identified in 1.4.D.6 and 1.4.D.9, shall be noted and included in the submission to the client.
 2. This does not preclude the responsibility of the vendor to ensure that the target levels are met outside of the immediate area affected by the mechanical noise.
6. Verify specified sound volume and spectrum with mechanical system on. Volume levels shall be as per section 1.4.D.6 and spectrum as per section 1.4.D.9.
7. Volume or 1/3 octave spectrum levels which cannot be fine-tuned by the vendor to meet the specified requirements, will be the basis for additional speakers and/or spectrum zones to be provided at the vendor's expense.
8. Calibration reports of the vendor's measuring equipment must be made available upon request.

4. Report

1. Provide a printed report as per Section 3.9.C identifying all system settings and measurement results to client. Acoustical performance shall be determined at a minimal in conformance with ASTM E1573 measurement procedures and section 1.4 of this specification.
2. The report must include in a spreadsheet format file the measured results with zone ID, the dBA and 1/3 octave band measured levels for each zone, the target dBA level for the zone, and individual and maximum deviations from the target dBA and spectrum levels for each 1/3 octave band. All deviations must be clearly identified for both dBA and individual 1/3 octave bands.
3. Vendor to provide as-built drawings showing the schematic of the system and the final loudspeaker and equipment locations, including the identification of all groups and zones after commissioning including any changes that were required during commissioning.

5. Commissioning During Warranty

1. Prior to occupancy and with all furnishings in place, and the HVAC system operating normally, a third party acoustical consultant may be retained at the client's expense to measure the performance of the masking system and submit a report. Vendor will be liable at their own expense to correct any non-compliant performance identified by third party acoustical consultant.

2. Acoustical consultant to provide a printed report detailing system settings and measurement results.
3. Testing must occur within 6 weeks after vendor commissioning. Vendor to supply report provided in section 3.9.D to acoustical consultant before testing.

END OF SECTION