

**SECTION 27 51 19 – SELF-CONTAINED SOUND-MASKING EQUIPMENT****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to this section.

**1.2 SUMMARY**

- A. This section includes electronic noise generators, amplifiers, wiring, loudspeakers, controls and components to generate, amplify, distribute and reproduce digitally synthesized and stabilized background sound masking to improve speech privacy in zones of coverage. Components contained herein this paragraph may be collectively integrated in a printed circuit board as part of a speaker unit.

**1.3 DEFINITIONS AND REFERENCES**

- A. Test and Calibration Conditions: Spaces completely furnished but unoccupied, lights and HVAC systems on, HVAC system testing and balancing completed, ceiling components in place. Additional testing to be provided after space is occupied to adjust for variations in use.
- B. Covered spaces: Spaces above which masking speakers are installed.
- C. Pink Noise: Random noise signal with equal energy in each octave.
- D. Sound Masking: Sound that reduces the intelligibility of intruding speech and the distraction from activity noise. Sound that when measured falls inside the "preferred curve". The masking sound spectrum slopes downward with an increasing frequency. The rate of this slope of sound is 5 dB per octave, having a steeper roll-off above 2 KHz. The low frequency response is determined by the low frequency capabilities of the masking system loudspeakers.

**1.3.1 AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI):**

- a. ANSI S1.4 American National Standard Specification for Sound Level Meters
- b. ANSI S1.6 American National Standard Specification for Preferred Frequencies and Band Numbers for Acoustical Measurements
- c. ANSI S1.11 American National Standard Specification for Octave-Band and Fractional-Octave-Band Analog and Digital Filters

**1.3.2 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM):**

- a. ASTM E 1130-02 Standard Test Method for Objective Measurement of Speech Privacy in Open Offices Using Articulation Index.
- b. ASTM E1573-02 Standard Test Method for Evaluating Masking Sound in Open Offices Using A-Weighted and One-Third Octave Band Sound Pressure Levels.

**1.2 DESCRIPTION OF SYSTEM**

- A. All masking/paging units must be UL Listed for use in a ceiling plenum.
- B. The system must be manufactured in the USA.
- C. All equipment and associated hardware shall be fabricated and installed in accordance with the manufacturer's specified recommendations.
- D. All wiring shall be minimum 18 gauge.
- E. Location of grounding points shall be determined carefully to insure minimizing of system hum and elimination of ground loops. In addition, all connections of shields and conductors to equipment shall be in accordance with manufacturer's instructions and best

- professional practices.
- F. In open areas and larger enclosed spaces, the overall sound level produced should have spacial uniformity of no more than  $\pm\frac{1}{2}$  dB between any two sound generating units.
  - G. The sound generating units must have an adjustable sound spectrum shaping control in order to meet the varying spectral requirements of drywall ceilings; various types of ceiling tile, air return grills and openings around lighting fixtures, etc.
    - a. The spectrum shaping ability shall be variable within the accepted background sound masking range (acoustical preferred curve).
    - b. Units installed over drywall ceilings should be wired for spectrum control adjustment and remote sound level.
    - c. Sound-Power Level produced by system: Sound masking system must not exceed NC 40 contour between 400 and 2000Hz, and have smooth roll-off above and below those frequencies when measured 1 meter from speaker.
      - i. Final adjusted level: Determine final level for each space individually by measurement as specified.
      - ii. Measurements: Made under Calibration conditions.
  - H. Maximum Average range of sound power level: 1 dB in the 250, 500, 1000, 2000, 4000 and 6000Hz range for 75 percent of the locations covered.
  - I. Spatial Uniformity (Directional Effect :) People in masked space under normal operating conditions cannot determine source of masking sound.
  - J. Temporal Uniformity: One minute time-averaged sound pressure level of any octave band of masking sound from 250 to 8000 Hz remains constant in any space to within a standard deviation of 2 dB when measured over a 30-minute period.
  - K. Sound Quality: No audible hum or noise, other than masking noise, from this system in masked spaces should be detected.

### 1.3 PERFORMANCE

- A. The system shall be capable of producing masking frequencies in the preferred spectrum range.
  - 1. Each unit shall allow smooth and seamless adjustability of the sound spectrum within the preferred curve, to allow for a variety of ceiling conditions.
- B. Speaker housings/enclosures must be damped to avoid undesirable resonance.
- C. System shall be designed so that individual speaker or component failure will have no impact on the balance of the system.
- D. Design of system must be powered by low voltage.
  - 1. Use adequately rated step down transformers.
    - i. a. Primary: 120 Volt AC 60 Hz.
    - ii. b. Secondary: 16-18 Volt AC 60 Hz
  - 2. Power usage:
    - a. Power: Typical consumption, 100 Watts per 18,000 square feet for masking only.
    - b. Power: Typical consumption, 200 Watts per 18,000 square feet for masking and paging.

### 1.4 CODES AND PERMITS

- A. Install all work in full accordance with the requirements of all local and governmental departments having jurisdiction over these matters, as well as with any requirements of the NFPA, MEA, BSA, UL, and other applicable Codes.
- B. Secure and pay for necessary approvals, permits, inspections, carting, legal dumping, etc., and deliver the official records of the granting of permits to the Owner without additional cost.
- C. Provide signs as required by the municipal authorities.

## 1.5 QUALIFICATIONS

- A. Source Limitations: Obtain sound masking equipment components from a single source that assumes responsibility for compatibility of items used.
- B. Components, speakers and power transformers must be UL listed for their appropriate use or listed as an equal to UL through another competent agency.
- C. Green: Sound masking equipment must be comprised of at least 50% recycled content.
- D. Privacy: Perform a speech and privacy evaluation to provide an articulation index (AI) as per ASTM E1130-02. A report of the AI must be provided with each exclusive project.
- E. Manufacture Qualifications: Manufacturer must manufacture sound masking equipment and have a minimum of 10 years sound masking experience. Sound masking product provided must be in existence for a minimum of six years with proven performance criteria for providing speech privacy.
- F. Warranty: A 10 year full warranty from the manufacturer must be provided for all sound masking equipment.
- G. In-Plenum Speakers only.

## 1.6 SUBMITTALS

- A. Product Data: For each component including nationally recognized testing laboratory listing data.
- B. Submit manufacturer's data or shop drawings of the following apparatus, giving full information as to dimensions, materials, and all information pertinent to adequacy of submitted equipment:
  - i. Masking Sound Speakers
  - ii. Additional necessary masking equipment needed
  - iii. Wire
  - iv. Transformers
  - v. Paging Amplifiers (If needed)
  - vi. Paging Only Speakers (If needed)
  - vii. Programmable Timers (If needed)
- C. Shop Drawings: Prepare and submit detailed dimensioned shop drawings for conduit runs (if required) and other distribution services including elevations showing minimum clearances and installed features and devices for system components. Show types and locations of masking speakers and their wiring connections. Channel assignments, and axis orientations. Show ducts, beams. And other significant sound reflecting and absorbing elements in ceiling space and show locations of partitions below ceiling. Include a diagram showing interconnection of major system components for each zone and channel and indicating grounding connections
- D. Each shop drawing shall contain job title and reference(s) to the applicable drawing(s) and/or specification article(s).
- E. Product Certificates: Signed by manufacturers of sound masking equipment and components certifying that products furnished comply with requirements.
- F. Qualification Data: For firms and persons specified in "Quality Assurance" Article.
- G. Record of Final Field Tests and Measurements: Include final adjustment of system.
- H. Maintenance Data: For sound masking equipment and components (if needed) to include in maintenance manuals specified in Division 1. Include data for each type of product, including all features and operating sequences. Both automatic and manual.

## 1.7 COORDINATION

- A. Coordinate quantity and arrangement of speaker assemblies with ceiling space configuration and with components occupying ceiling space, including structural members, Pipes air distribution components, raceways, cable trays, recessed lighting

fixtures and other items.

## 1.8 OPERATING AND MAINTENANCE INSTRUCTIONS

- A. Furnish a minimum of four complete sets of operating instructions and service maintenance manuals for the equipment employed in the systems. This shall include wiring diagrams. The information in the manuals and on the drawings shall be sufficiently detailed to allow a technician of normal competence to understand, install, operate, maintain, calibrate and repair the equipment.
- B. The Owner's designated operating personnel shall be provided instruction. This shall include instruction in the operation, care and maintenance of the installation. Instruction shall be scheduled at the mutual convenience of the Owner and Subcontractor, after demonstrations and acceptance testing.

## 1.9 GUARANTEES AND CERTIFICATION

- A. System shall be warranted to be free from defects in materials, workmanship, and performance for a 10-year from date of installation.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements. Provide products by the following:
  - 1. Lencore Acoustics Corp.  
1 Crossways Park Drive W  
Woodbury, NY 11797  
PH: 516-682-9292  
FX: 516-682-4785  
Website: [www.lencore.com](http://www.lencore.com)  
Email: [drawings@lencore.com](mailto:drawings@lencore.com)

### 2.2 EQUIPMENT

- A. The enclosure for the sound masking speakers shall consist of aluminum or electroplated steel, cylindrical housing.
- B. Speakers: 5 1/4 inch units mounted on metal baffles and arranged for optimum, multi-directional, angular sound distribution. Arrange units for suspension from the building structure above the ceiling.
- C. The system must be capable of being zoned on both a global and local level for sound. Global zoning must accommodate a minimum of 50,000 square feet and local zoning will be designed in accordance with the space plan for those areas requiring special attention; i.e. patient rooms, exam rooms, reception areas, provider offices, clerical work areas, open areas, patient check in areas, special work areas, executive areas. All zoning must allow both volume and frequency adjustments within each zone measured at 48" A.F.F. within +/- 1/2 dBA.
- D. LOUDSPEAKER
  - 1. Size: 5 1/4 inch wide dispersion
  - 2. Power Rating: 10 Watts Root Mean Squared (RMS)
  - 3. Frequency Response: 50-12,000 Hz
  - 4. Pressure Sensitivity: SPL - at 1 Watt/m - 90 dB
  - 5. Impedance: 16 Ohms
  - 6. Magnet Weight: 10 oz. (283.5 grams)
- E. Noise generator: Octave bands from 50Hz to 8000Hz
  - 1. Voltage: 16 to 24 Volts AC, 60 Hz
  - 2. Contour Adjustments
  - 3. Spectrum adjustment shall meet acoustical preferred curve

4. OUTPUT ADJUSTMENTS
  - i. 10 Position step-volume control @ 1.5 dB per step
  - ii. Minimum 15 dB remote central volume control.
- F. Wire: The speaker wiring shall be minimum 18 gauge, stranded, non-shielded, UL Listed, Plenum Rated
- G. Step Down Transformer:
 

1. POWER REQUIREMENT	120v AC, 60 Hz
2. FUSE	6-Amp Reset Circuit Breaker
3. POWER RATING	95VA
4. SIZE	4 ¼ " X 4 ¼ " X 4"
5. TRANSFORMER SPECIFICATIONS	16V/95VA
- H. Remote Central Volume Control:
  1. The Remote Central Volume Control unit must operate as a central volume control from which universal volume adjustments can be made remotely for a minimum 50 main units (150 total speakers) and covering up to 33,000 square feet system-wide.
  2. The unit must consist of an individual self-contained noise generator, audio amplifier, loudspeaker in a damped aluminum enclosure, powered by 16/18 volts AC and is capable of driving one secondary model in addition to the aforementioned.
  3. The central volume remote control unit must allow adjustment to the volume of sound masking system remotely.
  4. Volume adjustment: A rotating switch accompanied by a wall mountable plate and is adjusted by rotating the dial from 0 to 10.
  5. Each remote central volume remote control unit is solid state and consists of a CMOS/MSI digital random sequence noise generator, electronic amplifier, and filter for active spectrum shaping and is equipped with a 10-step volume control, an additional continuous volume control, and the central volume remote adjustment control (as previously described above). Range of sound level: 41-86 dBA. Additionally contained is a continuous and completely separate volume control for paging/music.
- I. Programmable Audio-Level Control Unit:
  1. Automatic Sound Power Level Changes: Two system channel changes, capable of different time settings for each day of the week:
  2. ZONES
    - i. 2 independent zones (except for acclimate mode)
    - ii. Capacity: Minimum of 50,000 square feet per zone
  3. CLOCK ACCURACY+ / - 2 seconds per day (Leap year and DST updated automatically)
  4. BATTERY Rechargeable lead sealed, 12 volt, 2.2 Ah provides approximately 24 hours backup power
  5. PROGRAMMING
    - i. Programmable attenuation range: 0 to + 9 dB
    - ii. Slide control attenuation range: + 5 to - 5 dB
    - iii. Minutes per dB change: 1 to 5 minutes
    - iv. Acclimation attenuation range: - 1 to -9
    - v. Acclimate days per dB change: 1 to 5 days
    - vi. Acclimatization length: 1 to 54 days not counting Sat. & Sun.
    - vii. Maximum overall attenuation range: + 5 to - 18 dB
    - viii. Programmable events: 24 events per day for each zone
  6. Program Memory: Nonvolatile for one year, minimum, without power. When re-energized after a power outage, control starts at zero level and automatically advances system sound level at same rate used for programmed level changes.
- J. Paging Equipment (Only if Paging Option is Required)
  1. The paging amplifier shall perform to the following requirements:
 

i. TYPE	3-channel mixer power amplifier
ii. OUTPUT POWER	15 or 30 W RMS (as appropriate)
iii. FREQUENCY RESPONSE	50 - 20,000 Hz (+ / - 3 dB)
iv. TOTAL HARMONIC DISTORTION	

- v. 0.5% or less at 1kHz, rated output
- vi. 0.1% or less at 1kHz, 5 W output
- 2. PAGING INPUT
- 3. INPUTS
  - i. Mic/Telephone page input
  - ii. Program input
  - iii. Aux input
- 4. INPUT SENSITIVITY AND IMPEDANCE
  - i. Mic: 1mV (-60 dB), 600 ohms, balanced
  - ii. Telephone Page: 100mV (-20 dB), 10 kohms, balanced
  - iii. Program: 315 mV (-10 dB), 10 kohms, electrically balanced
  - iv. Aux: 315mV (-10 dB), 10 kohms, unbalanced
- 5. OUTPUTS (Transformer-isolated)                      Balanced 4 ohms, 25 & 70 volts
- 6. Music On Hold (MOH) OUTPUT                      Balanced 1 W (8 ohms)
- 7. OUTPUT REGULATION                      Less than 2.0 dB, no load to full load
- 8. SIGNAL TO NOISE RATIO                      Mic: 60 dB
  - i. (Band pass 20 – 20,000 Hz)                      Telephone Page: 75 dB
  - ii. (Tone controls: set at center)                      Program: 75 dB, Aux: 75dB
- 9. TONE CONTROLS
  - i. Bass: + / - 10 dB at 100 Hz
  - ii. Treble: + / - 10 dB at 100 Hz
  - iii. Controls affect only program input and aux input
- 10. CONTROLS
  - i. 1 Mic/Tel gain control
  - ii. 1 Program gain control
  - iii. 1 Aux gain control
  - iv. Bass tone control
  - v. 1 Treble tone control
  - vi. 1 MOH control
  - vii. 1 Sense control
  - viii. 1 Mic/Tel selector control
  - ix. 1 Power ON/OFF switch
- 11. INDICATORS
  - i. 1 Power LED
  - ii. 1 Signal LED
  - iii. 1 Peak LED
- 12. POWER CONSUMPTION                      60 W (15 W RMS)                      90 W (30 W RMS)
- 13. OTHER FEATURES                      Automatic electronic drive limiter, Electronic muting
- 14. DIMENSIONS                      210 (w) x 93 (h) x 276 (d) mm

## PART 3 - EXECUTION

### 3.1 MOUNTING OF MASKING SOUND LOUDSPEAKERS

- A. Mountings and Loudspeakers shall be concealed above the acoustical ceiling. The loudspeakers shall be suspended from the slab above by chain. The speaker face shall be located at a height equal to one-quarter of the ceiling plenum depth. Where possible, the bottom, of each speaker shall be located a minimum of 6" to 8" (150 to 200mm) above the acoustical ceiling tile. However, it is most important that all units hang at a uniform height throughout to insure a uniformity of sound when the system is turned on.
- B. Wiring Method: Install wiring in accordance with all local electrical codes. Conceal cable in accessible ceilings, walls and floors where possible.
- C. Pulling Cable: Do not exceed manufacturers' recommended pulling tensions. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between normal termination points. Remove and discard cable where damaged during installation and replace it with new cable.
- D. Exposed Cable: Install parallel to building lines, follow surface contours, and support as

- recommended by manufacturer.
- E. Grounding: As recommended by manufacturers, unless more stringent requirements are indicated. Ground equipment and conductors to eliminate shock hazard and to minimize ground loops. Common mode returns, noise pickup, cross talk and other impairments. Install 5-Ohm ground at main equipment location. Measure, record and report ground resistance.
  - F. Impedance Matching: For systems components including connecting cable, provide end-to-end level and impedance matched signal paths. Use matching networks and balancing devices at connections where necessary to avoid mismatches.
  - G. Splices, taps and terminations: Make splices, taps and terminations on numbered terminal strips in junction, pull and outlet boxes; and equipment closures.
  - H. The speaker locations shown on the drawings are schematic only and may require field modification to avoid major ductwork, structures and other plenum barriers. Additional speakers may be required to provide uniform sound distribution because of these plenum obstructions.
  - I. All local hanging codes must be reviewed and observed by the installer/contractor.
  - J. Identification:
    - a. Identify system components, wiring, cabling, and terminals according to Division 16 Section "Electrical Identification" Use color coded conductors and apply wire and cable marking tape to designate wires and cables so media are identified in coordination with system wiring diagrams.
    - b. Identify system components, wiring, cabling, and terminals according to Division 16 Section "Basic Electrical Materials and Methods". Use color coded conductors and apply wire and cable marking tape to designate wires and cables so media are identified in coordination with system wiring diagrams.
  - K. All equipment and associated hardware shall be fabricated and installed in accordance with the manufacturer's specified recommendations.

### **3.2 PRELIMINARY TESTS AND ADJUSTMENTS**

- A. At the completion of installation of speakers, the Subcontractor shall perform initial tests and adjustment. It is suggested that, with the speakers installed in accordance with specified spacing and orientation, tests be conducted in an open area of 35 ft. x 35 ft. minimum size. Tests shall indicate that all acoustical performance requirements described herein are satisfied.
- B. All testing and adjusting of the system shall be accomplished in the absence of the eventual occupants whenever possible. These precautions are essential to insure that the attention of the occupants will not be unnecessarily drawn to the noise or to its source.
- C. Tests and adjustments shall be performed as described below.
  - a. Hum and Noise Level
  - b. Loudspeaker Operation
  - c. Freedom from Buzzes, Rattles and Objectional Distortion
  - d. Gain Control Settings
  - e. A written report representing the results of the above tests, including numerical values where applicable, shall be submitted for review

### **3.3 FINAL TESTS AND ADJUSTMENTS**

- A. The manufacturers' agent with the support and cooperation of any Subcontractor installer shall perform the acceptance testing of the completed installation. These tests shall be performed to demonstrate that the equipment is fully furnished and installed in compliance with the terms of the Specifications in all Contract Documents. Except as otherwise specified, the Manufacturer or Subcontractor shall provide all instruments, equipment, labor and materials necessary to complete these tests
- B. Manufacturers Field Service: Engage a factory authorized service representative to inspect field assembled components and equipment installation and connections. Report results in writing. Include the following.

- i. Operational Test: Start system to confirm proper operation. Remove malfunctioning units, replace with new units and retest. Make initial sound spectrum and level adjustments for each zone.
  - ii. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  - iii. Inspection: Verify that units and controls are properly labeled and interconnecting wires and terminals are identified.
  - iv. Sound Masking Power Level Adjustments: Adjust independently for each space to minimum level of 47dBA to ensure speech privacy between adjacent workstations while complying with other system requirements.
- C. The Subcontractor shall project the completion date of tests and adjustments so that he can give a minimum of one week's notice to the active Project Manager.
- D. Measurements of system performance shall be made using a calibrated ANSI precision sound level meter set for "slow" meter damping and 'A' scale filtering. The measurements shall be made at not less than twenty test positions at 4' height above the floor level, with gain adjusted to provide the system design level. All interior finishes and furnishings shall be in place. Tests shall be for each floor at times not occupied by personnel.
- E. Final Acceptance Testing:
- i. Instrumentation: Use a professional quality sound level meter in accordance with ANSI S1.4
  - ii. Record test observations, readings and corrective actions.
  - iii. System Tests: Include the following for each zone:

**iv. Relative Sound Power Level**

<b>Band</b>	<b>Open Plan Areas</b>	<b>Enclosed Offices</b>
200	+2.5	-2
250	+3	-2
315	+2	-2.5
400	+1	-3
500	0	-4
630	-1	-5
800	-2	-6
1000	-3	-7
1250	-4	-8.5
1600	-5	-10
2000	-6	-12

- Adjust level of masking sound for each space so one third octave band centered at 500 Hz has final selected sound power level for that space. Measure deviation from listed values in one-third octave bands from 400 to 2000Hz. Measured values must not deviate from those listed by more than 4 dB for open plan areas and 8dB for enclosed offices. The total of individual band deviations in eight bands must not exceed 16 dB for open plan areas and 30 dB for enclosed offices
    - v. Walk Through Test: People in masked spaces cannot discern speaker locations.
    - vi. Temporal Stability Test: Check for uniformity of time by measuring sound level in each of 11 octave bands at one-minute intervals over a 30-minute test period. Deviations must not exceed limits specified in "System Description" Article in Part 2
- F. Retest: Correct deficiencies identified by tests and observations and retest until meeting specified requirements.
- G. Recording Control Settings and System Adjustments: Record final control settings and

programming and final tap setting of speaker matching transformers. Record final sound level measurements and observations.

### **3.4 Adjustment**

- A. Occupancy Adjustments: When requested within 12 months of date of substantial completion manufacturer is to provide on site assistance in adjusting system to suit actual occupied conditions. Provide one visit to site outside normal occupancy hours for this purpose without additional cost to the owner.

### **3.5 Demonstration**

- A. Engage a factory authorized service representative to train Owner's maintenance personnel to adjust, operate and maintain services as specified below:
  - i. Train owner's maintenance personnel on procedures and schedules for starting up and shutting down, troubleshooting, servicing, and maintaining equipment and schedules.
  - ii. Review data in maintenance manual. Refer to Division 1 Section " Contract Closeout"
  - iii. Review data in maintenance manual. Refer to Division 1 Section " Operation and Maintenance Data"
  - iv. Schedule training with owner through Architect with at least seven days advance notice.

**End of Section 27 51 19**