

**SECTION 27 51 19 –DIRECT-FIRED SOUND-MASKING EQUIPMENT**  
**SECTION 27 15 13 – PAGING SYSTEMS**

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**NOTE TO SPECIFIER**

Lencore CrosswaysOne™ - Direct Fired Sound Masking, Paging, and Music System

Manufactured by Lencore Acoustics Corp.

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**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 in this paragraph be collectively integrated in a printed circuit board, central control units, and music/ paging interfaces.

**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.
- c. ASTM E 1374-93 Standard Guide for Open Office Acoustics and Applicable ASTM Standards.
- d. ASTM E1041-85 – Standard Guide for Measurement of Masking Sound in Open Offices.

### **1.33 SYSTEM PERFORMANCE**

- a. The Sound Masking system must use a unique integrated sound masking, music and paging system that uses an infrared remote control for volume and contour control.
- b. Volume increments for paging and music MUST be in ½ dB steps never to exceed more than 1dB steps as measured 1m from the speaker.
- c. The sound masking source must produce 20Hz through 20,000Hz.
- d. The masking must be random and provide a minimum pattern of no LESS than 25 hours.
- e. The masking volume shall be adjustable via digital means for ½ dB steps for a range of 30-78 dBA for 4 ½" speaker and 32- 80 dBA using 8" speaker, as measured 1m from the center of the speaker.
- f. Sound masking system must be able to provide muting capabilities.
- g. Spatial uniformity of sound must be no more than ±½ dBA

### **1.4 DESCRIPTION OF SYSTEM**

- A. The system must be manufactured in the USA.
- B. All equipment and associated hardware shall be fabricated and installed in accordance with the manufacturer's specified recommendations.
- C. All wiring for power shall be minimum 16 gauge.
- D. All Wiring for Paging and Music shall be CAT 5, 4 pair with RJ45 connectors.
- E. All Wiring for Audio Masking shall be CAT 5, 3 pair with RJ12 connectors.
- F. 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.

- G. In open areas and larger enclosed spaces, the overall sound level produced should have spatial uniformity of no more than  $\pm\frac{1}{2}$  dB between any two sound generating units.
- H. 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. Sound-Power Level produced by system: Sound masking system must not exceed NC 42 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.
- I. 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.
- J. Spatial Uniformity (Directional Effect :) People in masked space under normal operating conditions cannot determine source of masking sound.
- K. 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.
- L. Sound Quality: No audible hum or noise, other than masking noise, from this system in masked spaces should be detected.

## 1.5 PERFORMANCE

- A. The system shall be capable of producing masking frequencies in the preferred spectrum range.
  - a. Each unit shall allow smooth and seamless adjustability of the sound spectrum with a minimum of 25 contours within the preferred curve, to allow for a variety of environmental and ceiling conditions.
- B. Speaker housings/enclosures must be damped to avoid undesirable resonance.
- C. Both sizes of speakers must be white and have dog ear clamps for easy installation.
- D. System shall be designed so that individual speaker or component failure will have no impact on the balance of the system.
- E. Design of system must be powered by low voltage.
  - a. Use adequately rated power supplies.
    - i. Primary: 85-264 Volt AC 47-63 Hz.
    - ii. Secondary: 48 Volt DC

## 1.6 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.

## 1.7 QUALIFICATIONS

- A. Source Limitations: Obtain sound masking equipment components from a single source that assumes responsibility for compatibility of items used.
- B. 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.
- C. 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.
- D. Warranty: A 10 year full warranty from the manufacturer must be produced for the any and all sound masking equipment.
- E. System is capable of using both in-plenum and direct fired speakers by same manufacturer.

## 1.8 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. Power Supplies
  - v. Paging Amplifiers
  - vi. Paging Only Speakers
- 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.

## **1.9 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.

## **1.10 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.

## **1.12 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:

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 molded cylindrical housing.
- B. Speakers: Direct fired, available in two sizes 4 ½ " and 8 ". Can be easily installed in ceilings with special dog ear clamps.
- C. The system must be capable of being independently zoned on both a global and local level for sound masking, paging and music.

### **D. LOUDSPEAKER**

1. Size: 4 1/2" diameter
2. Power Rating: 3 - 5 Watts Root Mean Squared (RMS)
3. Frequency Response: 250-20,000 Hz
4. Impedance: 32 Ohms

E. Noise generator:

1. Contour Adjustments
2. Spectrum adjustment shall meet acoustical preferred curve
3. Output 20 Hz – 20 KHz

OUTPUT ADJUSTMENTS

- i. Via infrared remote volume control, contour control for each masking channel.

F. Wire:

1. The power wiring shall be minimum 16 gauge, stranded, non-shielded, UL Listed, Plenum Rated
2. The Paging/Music wiring shall be CAT 5, 4 pair with an RJ45 jack.
3. The audio wiring shall be CAT 5, 3 pair with an RJ12 jack.

G. Power Supply:

1. Output:
  - i. DC VOLTAGE: 48v
  - ii. RATED CURRENT: 3.2A

2. Input:

- i. Voltage Range: 85~264VAC
- ii. FREQUENCY RANGE: 47~63Hz
- iii. POWER FACTOR (Typ.): PF>0.93/230VAC

H. Remote Central Volume and Contour Control:

1. Generation and integration of multiple random sound masking sources using E-sound™ technology.
  - i. Contour control – At the source using infra-red technology for each independent channel, quad-pod global control.
2. Integration of paging or music.

I. 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)

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
  - i. (Band pass 20 – 20,000 Hz) Telephone Page: 75 dB
  - ii. (Tone controls: set at center) Program: 75 dB, Aux: 75dB
- 8. TONE CONTROLS
  - i. Bass: + / - 10 dB at 100 Hz
  - ii. Treble: + / - 10 dB at 10,000 Hz
  - iii. Controls affect only program input and aux input
- 9. 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
- 10. INDICATORS
  - i. 1 Power LED
  - ii. 1 Signal LED
  - iii. 1 Peak LED
- 11. POWER CONSUMPTION 60 W (15 W RMS) 90 W (30 W RMS)
- 12. OTHER FEATURES Automatic electronic drive limiter, Electronic muting
- 13. 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 installed into the acoustical ceiling. The loudspeakers shall be suspended by integrated dog ear clamps into the center of an acoustical tile. 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. Each speaker shall be suspended in an inverted orientation with the speaker facing downward (Free-Field).
- B. Wiring Method: Install wiring in accordance with all local electrical codes. Conceal cable in accessible ceilings, walls and floors where possible. Keep all cables properly suspended away from the ceiling tile. Follow all appropriate National and Local standards and methods for cable in a ceiling plenum.
- 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
- 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. Loud speaker Operation:
  - c. Freedom from Buzzes, Rattles and Objectional Distortion:
  - d. Gain Control Settings
  - e. Written report. 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.
- 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.
  - Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  - Inspection: Verify that units and controls are properly labeled and interconnecting wires and terminals are identified.
  - 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:
- Instrumentation: Use a professional quality sound level meter in accordance with ANSI S1.4
  - Record test observations, readings and corrective actions.
  - System Tests: Include the following for each zone:
  - Relative Sound Power Level**

Band	Open Plan Areas	Enclosed Offices
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
- Walk Through Test: People in masked spaces cannot discern speaker locations.
  - 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:
  - a. Train owner's maintenance personnel on procedures and schedules for starting up and shutting down, troubleshooting, servicing, and maintaining equipment and schedules.
  - b. Review data in maintenance manual. Refer to Division 1 Section "Contract Closeout"
  - c. Review data in maintenance manual. Refer to Division 1 Section "Operation and Maintenance Data"
  - d. Schedule training with owner through Architect with at least seven days advance notice.

**End of Section 27 51 19 and Section 27 15 13**