SECTION 09848

1-DIMENSIONAL SOUND DIFFUSING WOOD CEILING CLOUD (WAVEFORMTM MONORADIAL W)

**PART 1 GENERAL**

* 1. SECTION INCLUDES
1. 1-Dimensional Sound Diffusing Wood Ceiling Cloud: WaveformTM Monoradial W.
2. Suspension hardware and anchors.
	1. PRODUCTS RECOMMENDED BUT NOT SUPPLIED UNDER THIS SECTION
3. (yes) (no) Fiberglass Batts, low density (1-3 pcf) on topsides of Diffusers.
4. Metal cable seismic suspension hardware and building anchors.
	1. RELATED SECTIONS
5. Section 09510 – Acoustical Ceilings
6. Division 13 Sections – Fire Suppression
7. Division 15 Sections – Mechanical Work
8. Division 16 Sections – Electrical Work
9. Division 17 Sections – Audio, Data, Telecommunication Work
	1. ALTERNATES
10. Prior Approval: Proposed substitutions for products in this section may be submitted to the architect and acoustical consultant no later than ten (10) working days prior to the bid due date. Substitutions shall only be considered if submitted with complete information including acoustic data and a full size sample showing product design, composition, size and finish. Acceptance of substituted products is contingent on the architect’s and acoustical consultant’s approval and the substitution’s compliance with all specified criteria. The architect shall approve substitution requests via an addendum.
11. Unapproved Substitutions. Substitutions not approved via addendum shall not be submitted to the architect or acoustical consultant.
	1. REFERENCES
12. Local Building Code – Current Edition
13. International Organization for Standardization
	* 1. ISO 354 Measurement of Sound Absorption in a Reverberation Room
		2. ISO 10534 - Determination of sound absorption coefficient and impedance in impedance tubes - Part 1: Method using standing wave ratio.
		3. ISO 17497-1 Sound-scattering properties of surfaces- Part 1: Measurement of the random-incidence scattering coefficient in a reverberation room.
14. AES-4id-2001: AES Information Document for Room Acoustics & Sound Reinforcement Systems – Characterization & Measurement of Surface Scattering Uniformity.
15. American Society for Testing & Materials (ASTM)
	* 1. ASTM E 1050-98 - Standard Test Method for Impedance and Absorption of Acoustical Materials Using a Tube, Two Microphones, and a Digital Frequency Analysis System
		2. ASTM C 423 - Sound Absorption & Sound Absorption Coefficients by the Reverberation Room Method
		3. ASTM E 84: Standard Test Method for Surface Burning Characteristics of Building Materials
16. Published technical papers
	* 1. T.J. Cox, B-I.Dalenback, P. D’Antonio, J.J. Embrechts, J.Y. Jeon, E. Mommertz and M. Vorlaender, “A tutorial on scattering and diffusion coefficients for room acoustic surfaces”, Acta Acustica uW Acustica, 92, 1-15 (2006)
		2. AES-4id-2001, “AES Information document for room acoustics and sound reinforcement systems- Characterization and measurement of surface scattering uniformity”, J. Audio Engineering Soc., 49(3), 149-165 (2001)
		3. E. Mommertz, Appl. Acoust., 60(2), 201-204 (2000)
	1. SYSTEM DESCRIPTION
17. Design Requirements – Monoradial W sound diffusing ceiling cloud may be shape, location and orientation optimized to provide uniform diffusion for normal, oblique and random incident sound. The diffusers shall be optimized in 1/3-octave band resolution between 100 Hz and 2000 Hz for far field sources on the stage and receivers in the seating areas. The Diffuser shall provide diffusion between 100 and 2000 Hz. Diffusion Coefficients for the product shall be measured or predicted using boundary element techniques in accordance with the recommendations of AES-4id-2001. The directional diffusion coefficient shall be given by the autocorrelation of the 1/3-octave hemispherical polar response. The absorption coefficients shall be determined according to ASTM C 423 reverberation room method and normal incidence impedance tube testing according to ISO 10534 or ASTM E 1050-98, for low frequency absorption below between 20 and 250 Hz, since this frequency range is below the limit of most reverberation chambers according to ASTM C 423.
18. Performance Requirements
	1. Third-octave band acoustical performance requirements from 100 Hz to 2000 Hz for random incidence sound absorption shall be measured according to ASTM C423 or ISO 354; the normalized random incidence diffusion coefficient shall be the average of measured or calculated directional diffusion coefficients, according to AES-4id-2001 at -60, -30, 0, 30, and 60 degrees and the random incidence scattering coefficient shall be measured according to ISO- 17497-1 (Scattering (ISO)) or determined from the average of the measured directional correlation scattering coefficients (Scattering (c)) according to the method of Mommertz [Reference 1.05/E1 and 1.05/E3]. ***Directional polar responses, which indicate the uniformity of scattering in third-octave bands, for sample and reference reflector, shall be provided to the acoustical consultant for approval.*** The random incidence coefficients shall be what are indicated in the table below:

|  |  |  |  |
| --- | --- | --- | --- |
| **f (Hz)** | **Diffusion** | **Scattering (ISO)** | **Absorption** |
| 100 | -0.01 | 0.02 | 0.18 |
| 125 | 0.01 | 0.02 | 0.17 |
| 160 | 0.01 | 0.05 | 0.14 |
| 200 | 0.02 | 0.08 | 0.14 |
| 250 | 0.03 | 0.09 | 0.12 |
| 320 | 0.06 | 0.14 | 0.11 |
| 400 | 0.09 | 0.18 | 0.09 |
| 500 | 0.12 | 0.24 | 0.11 |
| 630 | 0.18 | 0.36 | 0.11 |
| 800 | 0.22 | 0.46 | 0.10 |
| 1000 | 0.22 | 0.59 | 0.11 |
| 1260 | 0.24 | 0.70 | 0.12 |
| 1600 | 0.23 | 0.78 | 0.13 |
| 2000 | 0.26 | 0.85 | 0.15 |
| 2500 |   |   | 0.15 |
| 3125 |   |   | 0.16 |
| 4000 |   |   | 0.14 |

2. Normalized directional sound diffusion and correlation scattering coefficients shall be measured in accordance with AES-4id-2001 for angles of incidence of -60, -30, 0, 30 and 60 degrees with respect to the normal. The directional coefficients shall be as indicated in the following tables:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **f (Hz)** | **dn** | **dn**  | **dn** | **dn**  | **dn** |
| **60°** | **30°** | **0°** | **-30°** | **-60°** |
| 100 | -0.02 | 0.00 | 0.01 | 0.00 | -0.02 |
| 125 | 0.02 | 0.00 | 0.00 | 0.00 | 0.02 |
| 150 | 0.00 | 0.01 | 0.01 | 0.01 | 0.00 |
| 200 | 0.03 | 0.02 | 0.02 | 0.02 | 0.03 |
| 250 | 0.03 | 0.04 | 0.03 | 0.04 | 0.03 |
| 315 | 0.04 | 0.06 | 0.09 | 0.06 | 0.04 |
| 400 | 0.06 | 0.08 | 0.15 | 0.08 | 0.06 |
| 500 | 0.08 | 0.12 | 0.21 | 0.12 | 0.08 |
| 630 | 0.09 | 0.23 | 0.29 | 0.23 | 0.09 |
| 800 | 0.09 | 0.31 | 0.31 | 0.31 | 0.09 |
| 1000 | 0.13 | 0.27 | 0.30 | 0.27 | 0.13 |
| 1250 | 0.18 | 0.31 | 0.23 | 0.31 | 0.18 |
| 1600 | 0.23 | 0.22 | 0.23 | 0.22 | 0.23 |
| 2000 | 0.28 | 0.22 | 0.32 | 0.22 | 0.28 |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **f (Hz)** | **sc** | **sc** | **sc** | **sc** | **sc** |
| **60°** | **30°** | **0°** | **-30°** | **-60°** |
| 100 | 0.04 | 0.01 | 0.01 | 0.01 | 0.04 |
| 125 | 0.04 | 0.01 | 0.01 | 0.01 | 0.04 |
| 150 | 0.11 | 0.02 | 0.01 | 0.02 | 0.11 |
| 200 | 0.12 | 0.08 | 0.01 | 0.08 | 0.12 |
| 250 | 0.12 | 0.09 | 0.05 | 0.09 | 0.12 |
| 315 | 0.15 | 0.10 | 0.19 | 0.10 | 0.15 |
| 400 | 0.17 | 0.16 | 0.23 | 0.16 | 0.17 |
| 500 | 0.20 | 0.24 | 0.31 | 0.24 | 0.20 |
| 630 | 0.24 | 0.42 | 0.47 | 0.42 | 0.24 |
| 800 | 0.30 | 0.53 | 0.62 | 0.53 | 0.30 |
| 1000 | 0.40 | 0.69 | 0.77 | 0.69 | 0.40 |
| 1250 | 0.49 | 0.83 | 0.88 | 0.83 | 0.49 |
| 1600 | 0.62 | 0.89 | 0.86 | 0.89 | 0.62 |
| 2000 | 0.81 | 0.88 | 0.87 | 0.88 | 0.81 |

* 1. SUBMITTALS
1. Product Data: Submit manufacturers’ technical data including basic system description, options and component sizes. Identify all applicable features and options. Cross out any inapplicable features or options.
2. Shop Drawings: The contractor shall produce and submit shop drawings of products and suspension or mounting systems overlaid on base drawings (interior elevations or reflected ceiling plans) supplied electronically by the architect. Show overall layout with dimensions and references to details as necessary for penetrations, joints, ends and intersections with other materials or building components. Submit schedule of all quantities and finishes. Field-verify site conditions with dimensions shown on shop drawings.
3. Samples: 10” (25.4cm) x 10” (25.4cm) size sample of specified panel and finish.
4. Certifications: Manufacturers’ certifications that products comply with specified requirements, including laboratory reports showing compliance with specified tests and standards.
	1. QUALITY ASSURANCE
5. Flame Spread / Smoke Developed Characteristics: Product facing components tested by independent, accredited NVLAP facility according to ASTM E 84 and NFPA 255.
	1. Composite Flame Spread Rating: 25 (maximum)
	2. Smoke Developed: 450 (maximum)
	3. DELIVERY STORAGE AND HANDLING
6. Packing, Shipping, Handling and Unloading: Deliver Diffusers to the project site in the manufacturer’s original, unopened packaging. Diffusers are fragile and must be removed from packaging and handled with care. Diffusers should be handled by no fewer than two people. Raise and lower diffusers uniformly when moving. Raising units by one end or corner may result in bending or twisting and breakage.
7. Acceptance at Site: Installation constitutes complete acceptance.
8. Storage and Protection: Protect stored units from water and extreme moisture. Store units flat on clean, level, dry surface.
9. Waste Management and Disposal: Dispose of all packaging materials and debris in a safe and environmentally responsible manner according to the instructions set forth by the General Contractor, local ordinances or codes and the Environmental Protection Agency.
	1. PROJECT CONDITIONS
10. Project Environmental Requirements: Installation area shall be enclosed, protected from weather and be temperature and humidity controlled prior to unpacking and installing Diffusers.
	1. WARRANTY
11. Submit to Owner or Owner’s Representative a written and dated warranty issued by the Diffuser manufacturer warranting the Diffusers against defects in materials or manufacturing for a period of one (1) year from the date of delivery.
12. Components used in the system but not provided by the manufacturer are excluded from the manufacturer’s warranty. Damage caused by exposure to moisture or rapid or extreme changes to temperature or humidity are excluded from the manufacturer’s warranty. Damage caused by improper storage, handling, acclimatization, or installation is excluded from the warranty.

**PART 2 PRODUCTS**

* 1. MANUFACTURERS

A. RPG Acoustical Systems, LLC, 99 South St, Passaic, NJ 07055 (telephone) 973-916-1166, <http://www.rpgacoustic.com>.

* 1. MATERIALS
1. Core (standard): Medium density fiberboard (MDF) made of soft and hard wood fibers with added binding agents, 3/4” thick.
2. Face Material as Selected by Architect:

1.       Wood Veneer Species: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1.1       Veneer Matching: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1.2 Veneer Finish: Clear Lacquer or Stain & Clear Lacquer \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

2.      Laminate Type: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

3.      Colored Lacquer: Paint Code \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

* 1. MANUFACTURED UNITS
1. Standard Unit Dimensions: 94-1/2” x 47-3/4”
	1. Standard depth is 12”
2. Weight: 96 pounds (maximum); Surface Weight 3 psf (maximum)
3. Units can be suspended from the ceiling with appropriate hardware or mounted to walls with wood cleats

**PART 3 EXECUTION**

* 1. INSTALLERS

A. Installing contractor shall have a minimum of five (5) years successful experience installing ceiling and wall systems in similar applications using similar mounting techniques or suspension systems.

* 1. EXAMINATION
1. Site Verification of Conditions: Examine installation area for compliance with all manufacturers’ project environmental requirements and ensure uninstalled products have been stored, handled and acclimatized properly prior to commencing installation. Inspect all substrates for completion and quality of work to ensure that surfaces are level, plumb, clean, dry and completely cured from water or solvent evaporation. Do not commence installation if the structural capacity of the substrate is questionable or inadequate.
2. Coordination with Other Trades: Coordinate with all other trades to ensure that wet work including concrete, terrazzo, plastering, painting, etc. in the installation area is complete, cured and dry prior to installation. Coordinate with all other trades to verify that components associated with mechanical, electrical, lighting, data, telecommunication, audio, video, fire suppression and other building systems are installed behind or above designated installation areas prior to commencing installation. Coordinate the exact size, location and sequencing of building system components that penetrate the ceiling/wall panels.
	1. PREPARATION
3. Protection: Protect all floor, wall and ceiling finishes against possible damage prior to commencing installation and during installation.
4. Surface Preparation: When necessary, field measure substrates to acquire accurate dimensions of panels and submit final dimensions to manufacturer.
	1. INSTALLATION
5. Install panels as shown and detailed in the architectural drawings and according to manufacturer’s guidelines and industry standards.
6. Install panels with a minimum ¼” gap between any adjacent units both vertically and horizontally. The gaps are there to help conceal alignment differences that present due to the natural movement of wood and assembled wood products.
	1. CONSTRUCTION
7. Interface with Other Work: Support all light fixtures, HVAC air inlet/outlet devices, speakers, signage, sprinkler heads/piping, etc. independently from panels. Contractor shall not use panels to support the weight of any other building element or component.
	1. ADJUSTING
8. Following initial installation, adjust mounting hardware or suspension system so that removable panels can be removed easily, yet stay safely secured upon replacement. Adjust panels so that surfaces are aligned, flush and level or plumb and gaps in between units are of a consistent width and straight.
9. Remove and replace at no extra charge any damaged panels that cannot be repaired to the Owner’s and Architect’s satisfaction.
	1. CLEANING
10. Remove dust from surfaces and penetrations by vacuuming using only a soft brush. Do not scratch surfaces with sharp metal or plastic vacuum cleaner extensions. Remove pencil marks with soft erasure. Remove general surface dirt with a clean, soft cloth dampened with a diluted, mild, cleaning agent and warm water. Wipe again with clean, soft cloth dampened only with warm water. Finally, dry surface completely with clean, dry cloth. Do not use abrasive cleaners with grit or cloths that could scratch the finish.
11. Remove and replace at no additional charge any materials that cannot be cleaned to the Owner’s satisfaction.
	1. DEMONSTRATION
12. Demonstrate to the building owner or to the owner’s representative the safe and proper method for removing and replacing all types of accessible panels.
13. Supply the building owner or the owner’s representative with any special tools provided by the manufacturer required to unlatch safety hardware on accessible panels.
	1. PROTECTION

A. Upon completion of work, protect installed surfaces from damage or soiling until project substantial completion and owner occupancy.

END OF SECTION