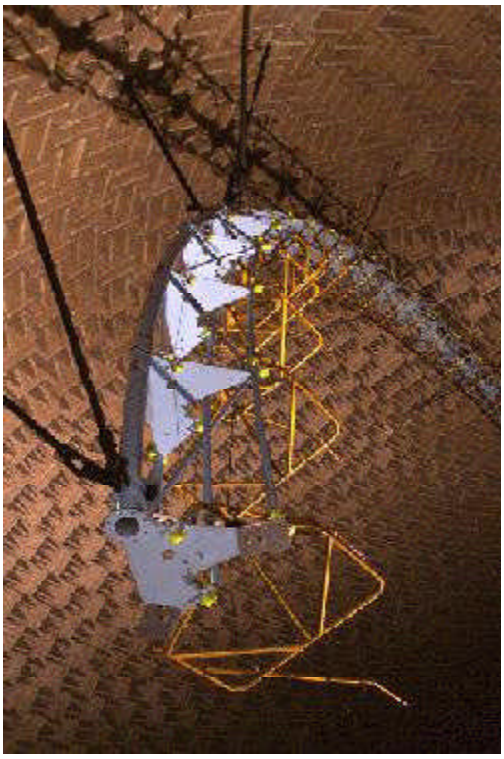
Traversing Microphone Track Installed in NASA Lewis' Aero-Acoustic Propulsion Laboratory Dome

The Aero-Acoustic Propulsion Laboratory is an acoustically treated, 65-ft-tall dome located at the NASA Lewis Research Center. Inside this laboratory is the Nozzle Acoustic Test Rig (NATR), which is used in support of Advanced Subsonics Technology (AST) and High Speed Research (HSR) to test engine exhaust nozzles for thrust and acoustic performance under simulated takeoff conditions. Acoustic measurements had been gathered by a far-field array of microphones located along the dome wall and 10-ft above the floor. Recently, it became desirable to collect acoustic data for engine certifications (as specified by the Federal Aviation Administration (FAA)) that would simulate the noise of an aircraft taking off as heard from an offset ground location. Since nozzles for the High-Speed Civil Transport have straight sides that cause their noise signature to vary radially, an additional plane of acoustic measurement was required. Desired was an arched array of 24 microphones, equally spaced from the nozzle and each other, in a 25° off-vertical plane.

The various research requirements made this a challenging task. The microphones needed to be aimed at the nozzle accurately and held firmly in place during testing, but it was also essential that they be easily and routinely lowered to the floor for calibration and servicing. Once serviced, the microphones would have to be returned to their previous location near the ceiling. In addition, there could be no structure could between the microphones and the nozzle, and any structure near the microphones would have to be designed to minimize noise reflections. After many concepts were considered, a single arched truss structure was selected that would be permanently affixed to the dome ceiling and to one end of the dome floor.



Traversing microphone track assembly in Lewis' Aero-Acoustic Propulsion Laboratory.

This structure, which was mostly installed in November 1997, forms a track on which each microphone rides on its own "carriage." The 150-ft-long, roller-coaster-like track consists of three 1-in.-diameter tubular rails, a 4-in.-diameter structural tube, diagonal stiffeners, and web plates that hold the components together. Twenty-four carriages constructed of light aluminum tubing traverse in series along the track. Each carriage engages all three rails and is shaped like a tripod, with wheels at each leg to provide complete support to each microphone. This configuration also allows each carriage to nest into the next when the microphones are brought to the ground for calibration and servicing. As a tow cable attached to the lead carriage is pulled up by a winch on the ground, the other carriages follow in series and are properly spaced along the cable. The tow cable is guided along the truss by rollers on each web. Most of the wheels and rollers are roller-skate wheels--a likely choice because of their rugged urethane construction (like that of the roller-coaster wheels used at the Cedar Point amusement park in Sandusky, Ohio), integral dual ball bearings, and availability.

Each microphone extends from its carriage on a "stinger" tube. These stingers can be offset from the carriage enough to place the microphones in different planes, up to 5° to either side of the 25° track plane, extending the research capability of the system. This new traversing microphone system will greatly increase the amount of valuable research data that can be collected during future nozzle tests in this already highly productive research facility.

Find out more about the AAPL facility:

http://www.grc.nasa.gov/WWW/Aapl/traverse.htm
http://www.grc.nasa.gov/WWW/AFED/facilities/aapl.html

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