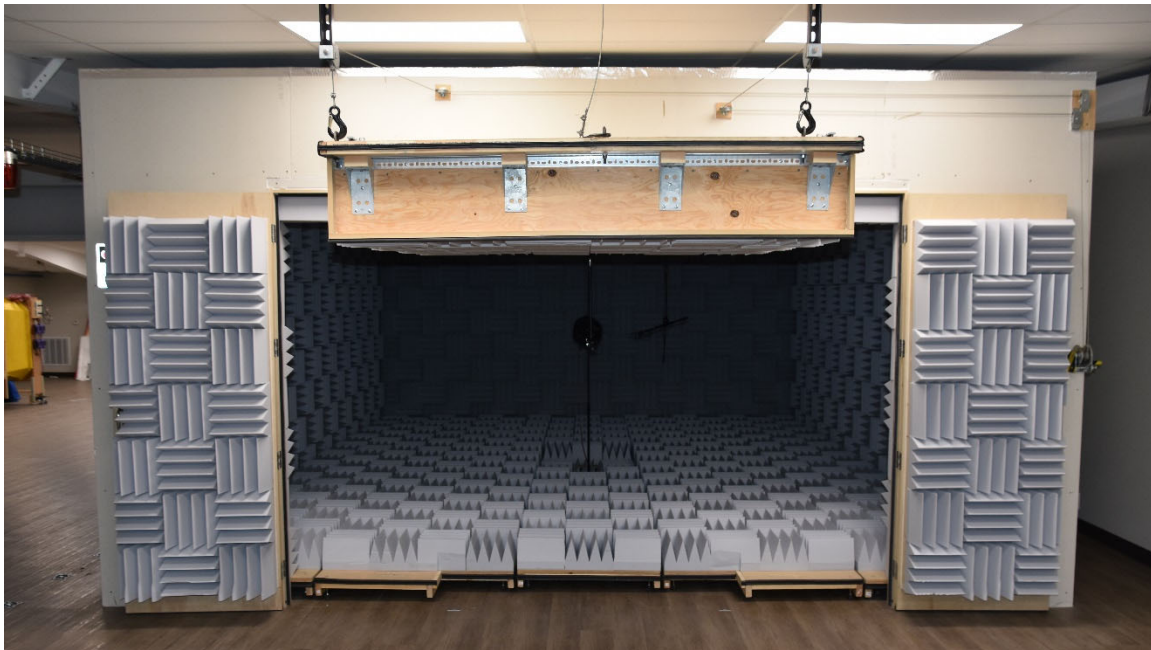


Design, Analysis and Research Corporation (DARcorporation) has designed and built an onsite acoustic anechoic chamber. With 22'×17'×7'8" internal dimensions this chamber provides the capability to validate and benchmark analytical acoustic analyses. Using first-order acoustic analytical tools, the noise characteristics can be obtained as a function of fan angle. The physics-based high-fidelity simulation tools we use predict the sound pressure levels (SPLs) at various propeller/ducted fan working conditions. With an on-site acoustic chamber and acoustic testing instruments, we can measure and compare the acoustic/noise signature of different propellers and ducted fans. These measurements allow us to help customers design or select the quietest propeller or ducted fan possible.

The chamber is constructed with 1'×1'×8" melamine foam wedges with NRC rating of 1.35 and insulated with multiple layers of sound dampening materials. Palletized flooring and large 12'×8' access openings (Figure 1), allow for flexibility in the size of the test article and test stand. All floor panels can be removed to convert to a hemi-anechoic chamber. Microphone jacks and mounting points are located throughout the chamber allowing measurements to be taken from any point in the chamber. All openings are sealed to reduce sound transmission from the exterior.

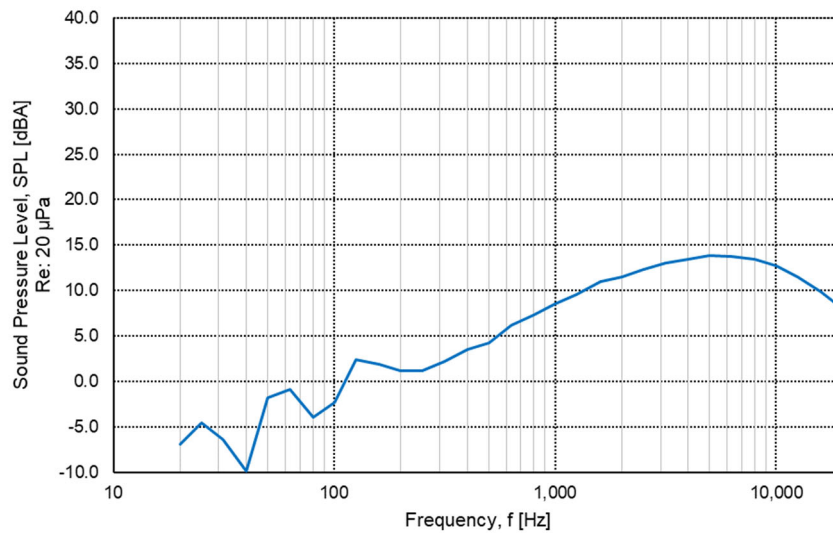


*Figure 1 Anechoic Chamber Entrance*

Sound pressure level measurements are recorded with a class 1 microphone system consisting of an Earthworks M23 microphone, Millennia HV-3D microphone preamplifier and PicoScope

oscilloscope. Data are recorded and processed with an inhouse LabVIEW virtual instrument. Current equipment allows for recording of up to four microphones. Measurements can include sound pressure level, sound power level and sound intensity. Propeller RPM, motor temperature, and ambient temperature are also monitored.

Preliminary characterization of the anechoic chamber has been performed. The anechoic chamber is in the process of being characterized to meet ISO 3745 standards. The overall ambient sound pressure level is measured at 24.0 dBA. Ambient sound pressure levels for 1/3 octave band levels are shown in Figure 2.



*Figure 2 A-Weighted Ambient SPL at 1/3 Octave Bands (Overall SPL 24.0 dBA)*

The anechoic chamber is also characterized with a Noise Criteria value of NC-23 based on ANSI/ASA S12.2-2008. The chart of the Noise Criteria curves is provided in Figure 3. For comparison, data from the NASA Quiet Flow Facility in the Langley Aircraft Noise Reduction Laboratory are shown in Figure 4 and it is observed that our inhouse chamber has lower ambient noise levels.

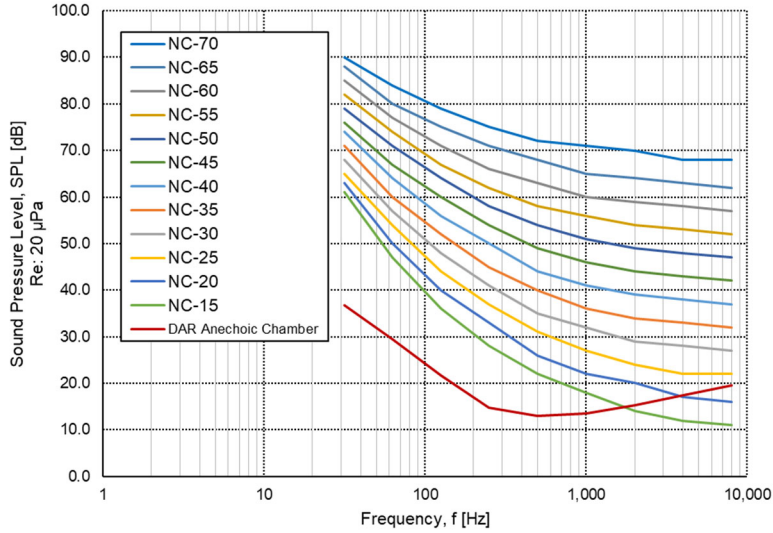


Figure 3 Noise Criteria Curves (ANSI/ASA S12.2-2008)

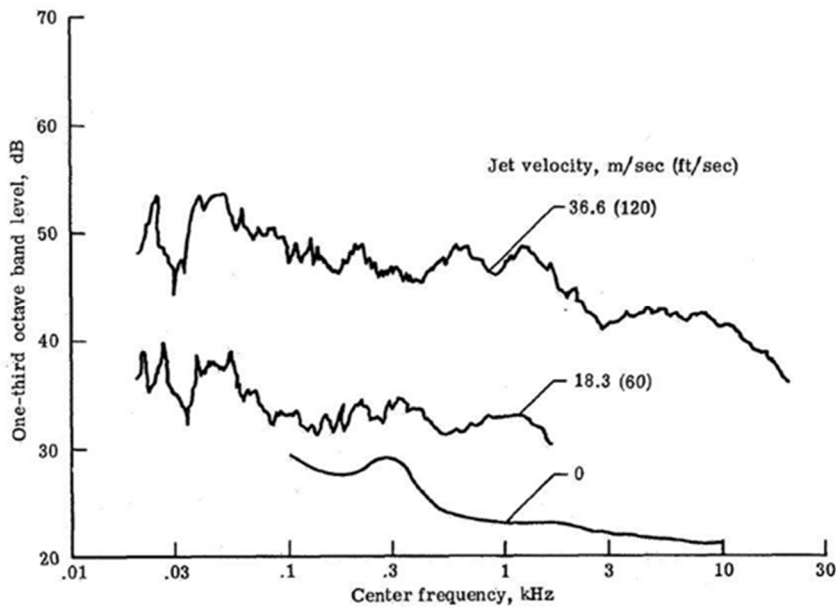
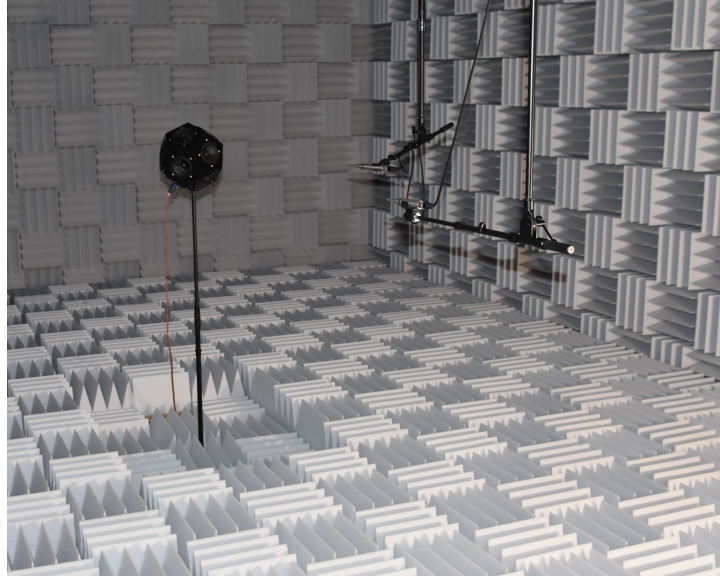


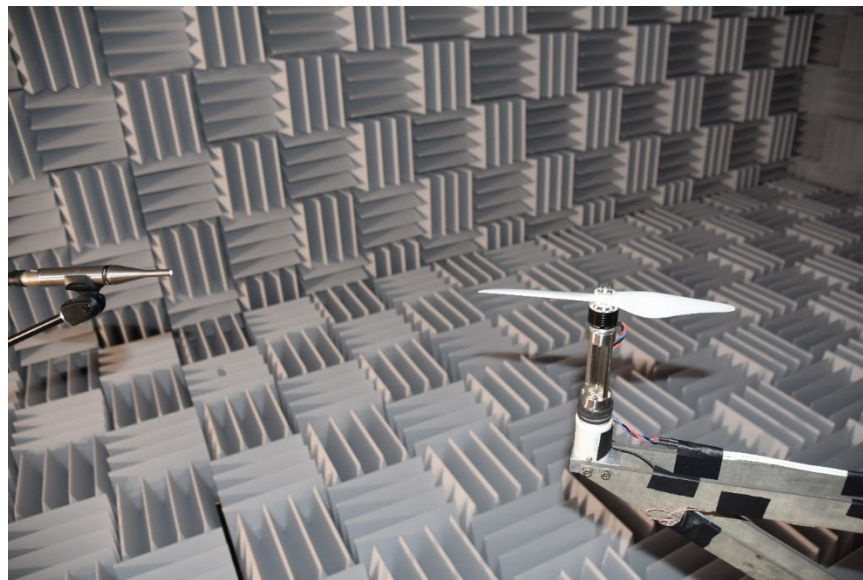
Figure 4 NASA Langley Quiet Flow Facility (Lines identified by air velocity, NASA TM-84585)

Free field conditions are verified using a dodecahedron speaker built inhouse and tested at multiple points throughout the anechoic chamber.



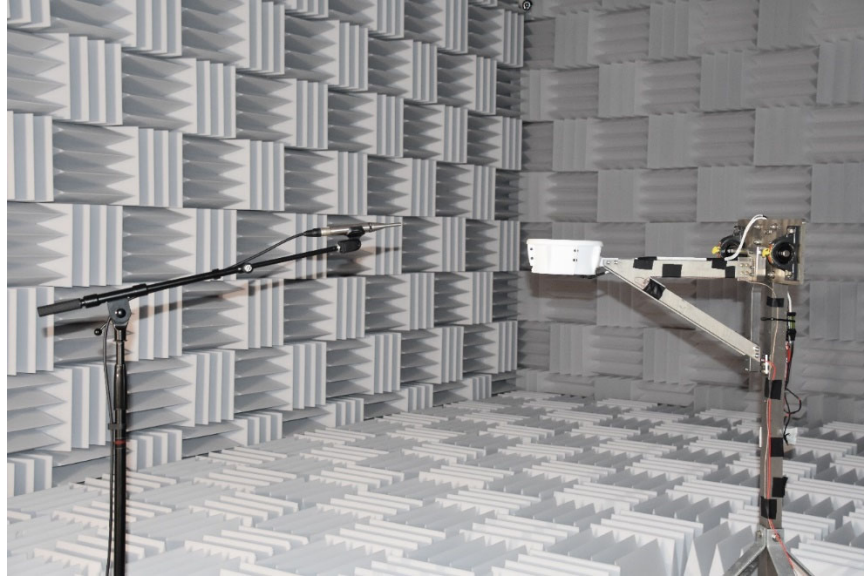
*Figure 5 Verification of Free Field Conditions Using Dodecahedron Speaker*

Test installations of an open propeller and a ducted fan in the anechoic chamber are shown in Figure 6 and Figure 7. The control room for the chamber is shown in Figure 8.

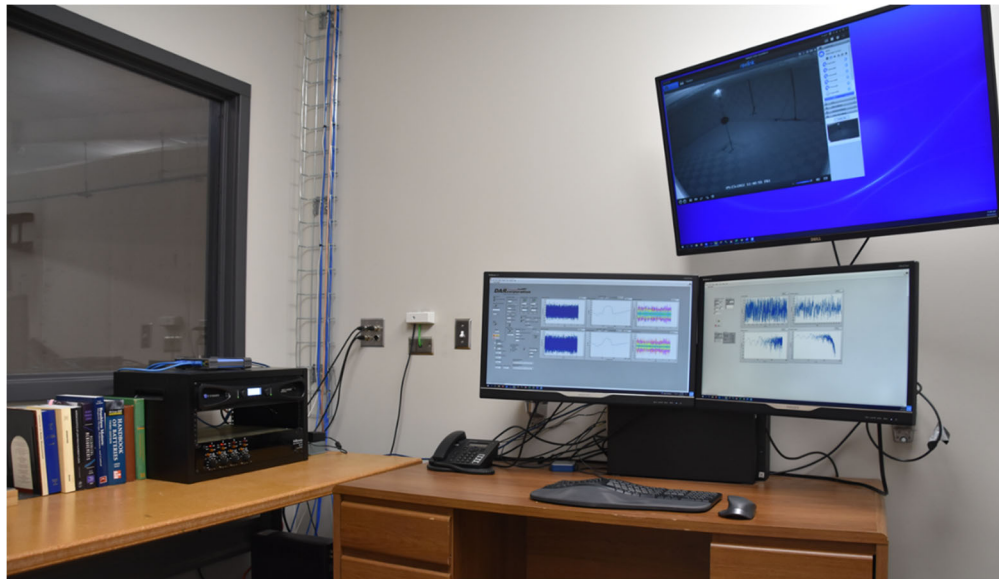


*Figure 6 Propeller on Thrust Stand in Anechoic Chamber*





*Figure 7 Ducted Fan on Thrust Stand in Anechoic Chamber*



*Figure 8 Anechoic Chamber Control Room*