

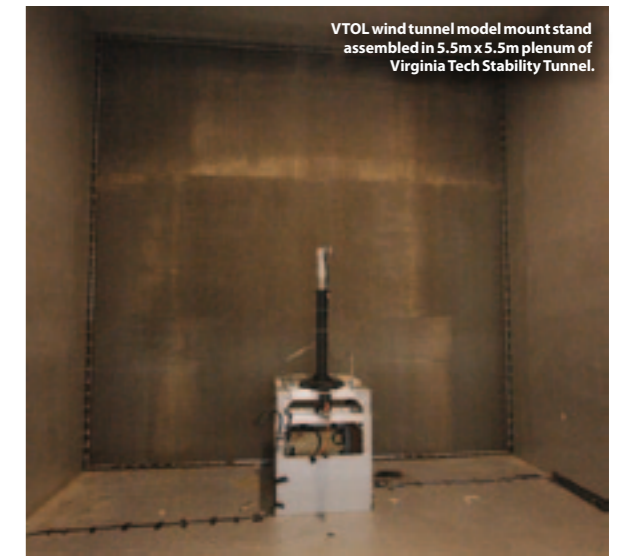
Cross-section schematic of Virginia Tech Stability Wind Tunnel anechoic test configuration. Flow is out of page, Kevlar test section side panels not shown.

Limited budgets can drive innovation

It is often said that “Necessity is the mother of invention”. Replace “Necessity” with “Limited Budget”, and one has an accurate picture of many aerospace product development programs. In today’s wind tunnel testing market, managing overall program cost is certainly necessary to allow the inventing to occur. Engineers at Techsburg and AVEC have worked closely with faculty at Virginia Tech to add new test capabilities to the university’s primary low-speed research wind tunnel, while maintaining the same low cost to customers. By **Jon Fleming, Techsburg, Inc.** and **Patricio Ravetta, AVEC**



Landing gear (image bottom left) and airfoil test models installed in Virginia Tech Stability Tunnel anechoic test section. Inset: Noise map of landing gear.



VTOL wind tunnel model mount stand assembled in 5.5m x 5.5m plenum of Virginia Tech Stability Tunnel.

quality, a special turntable and support stand were built to hold the model in the center of the plenum. Tests were run at speeds from 1 m/s to 7.3 m/s and over a 360° range of pitch angles. Customer feedback indicated improved flying characteristics after integration of this data into the vehicle flight control system.

These are two examples of innovative approaches for wind tunnel testing that usually requires a large budget. Providing high-quality test results that enable real performance breakthroughs, while also maintaining low costs is a primary objective for the team of Techsburg and AVEC.

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THE STABILITY Wind Tunnel was originally built at NASA Langley in 1940 and, 20 years later, was moved to the campus of Virginia Tech in Blacksburg, Va. For the last 50 years, it has provided university research programs as well as commercial customers with high-quality test capabilities. Its 1.83m x 1.83m test section and maximum speed of 80 m/s is well suited to meet a variety of test requirements, and its low cost makeS it a particularly good match for smaller-scale programs, such as unmanned aircraft projects.

Approximately SIX years ago, a new test section was designed and fabricated for the Stability Wind Tunnel to allow aeroacoustic testing. Drs. William Devenport (VT Tunnel Director), Ricardo Burdisso (VT/AVEC, Inc.), and Wing Ng (VT/Techsburg, Inc.) collaborated to create the Virginia Tech Anechoic Wind Tunnel, an innovative approach based on using “acoustically transparent” Kevlar fabric wall panels for a new test section. Acoustically treated sections line the floor and ceiling, while larger anechoic chambers are placed on each side of the test section for placement of microphone arrays or other instrumentation.

The major components were manufactured at Techsburg and moved to Virginia Tech in

2005. Since then, many successful aeroacoustic research projects have been conducted using the new test section hardware. With additional treatment of the wind tunnel circuit, the background noise is sufficiently low to collect acoustic data for smooth airfoils, in addition to shapes and devices that generate considerably more turbulence. One of the first projects to use the new test section was a NASA-sponsored noise identification and reduction study for the main landing gear of a Boeing 777. The anechoic test configuration has also been used for noise studies of powered aircraft models.

More recently, a customer had a need for very-low speed testing of an unmanned VTOL aircraft design. Simulation of descending flight was one of the key test requirements. In order to perform this test, engineers at Techsburg collected flow survey data in the 5.5m x 5.5m plenum of the VT Stability Tunnel, just downstream of the tunnel’s seven anti-turbulence screens. By testing in the plenum section, as opposed to the standard test section, the tunnel mass flow was sufficiently large enough to generate very steady flow no matter the model’s orientation or power setting, and wall interference effects were minimized as well.

After the plenum velocity survey results verified the test flow uniformity and overall

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