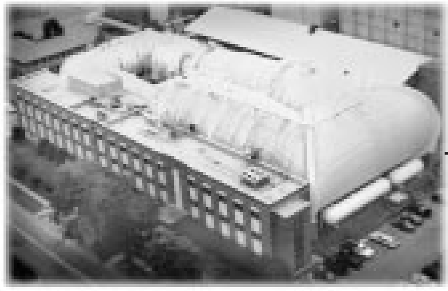


Transonic Dynamics Tunnel

NASA Langley Research Center

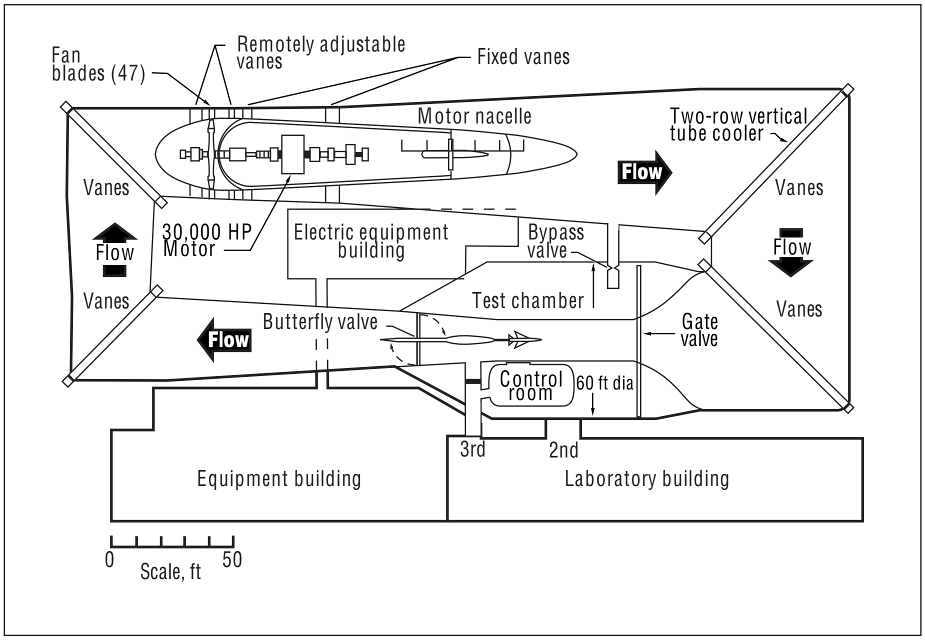
The Langley Transonic Dynamics Tunnel is the best suited facility in the world for flutter testing aeroelastically scaled models at transonic speeds.

Wind Tunnel
ENTERPRISE
NASA Langley Research Center

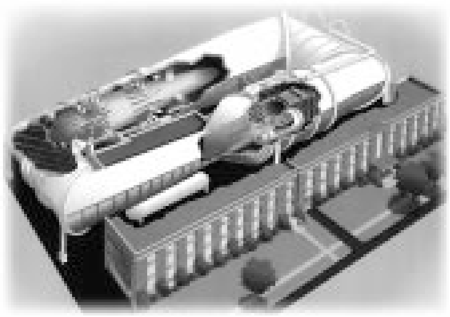
Test Section and Performance

The Langley Transonic Dynamics Tunnel (TDT) is a unique national facility dedicated to identifying, understanding, and solving aeroelastic problems.

The TDT is specifically dedicated to investigating flutter problems of fixed-wing aircraft. However, the tunnel is also used to investigate other aeroelastic phenomena such as fixed-wing buffet and divergence and to conduct rotary-wing tests that investigate the performance, loads, and stability characteristics of both helicopter and tiltrotor configurations. The tunnel is used by aircraft industry, NASA, Department of Defense, and university researchers for a multitude of purposes such as clearing new designs from flutter, studying the use of active controls technologies for both fixed-wing and rotary-wing configurations, determining the effects of ground-wind loads on launch vehicles, and providing steady and unsteady aerodynamic pressure data to support computational aeroelasticity and computational fluid dynamics code development and validation.



Schematic of the Transonic Dynamics Tunnel. Dimensions in feet.



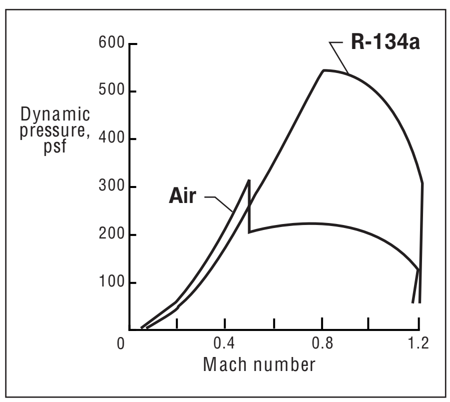
Cutaway drawing of the TDT.

Test Characteristics

The TDT is a closed-circuit, continuous flow, variable pressure wind tunnel with a 16-ft square test section with cropped corners. The tunnel is capable of using either air or R-134a as the test medium.

Testing in a heavy gas, such as R-134a, has important advantages over testing in air, particularly for aeroelastic models. These advantages include improved model to full-scale similitude, higher Reynolds numbers, easier fabrication of scaled models, reduced tunnel power requirements, and in the case of rotary-wing models, reduced model power requirements. The tunnel can operate up to a Mach number of 1.2 and is capable of maximum Reynolds numbers of about 3×10^6 per ft in air and 10×10^6 per ft in R-134a. The tunnel may also be operated at stagnation pressures from near vacuum (0.025 atms) to atmospheric and at dynamic pressures up to 330 psf in air and 550 psf in R-134a.

The tunnel is specially configured for flutter tests of fixed-wing models. There is excellent model visibility from the tunnel control room and safety screens protect the tunnel fan blades from debris in case of a model failure. One feature of the TDT which is particularly useful for flutter tests is a group of four bypass valves that connect the test section area to the opposite leg of the wind-tunnel circuit downstream of the fan motor. In the event of model instability, these quick actuating valves are opened, which causes a rapid reduction in the test section Mach number and dynamic pressure that serves to stabilize the model. The TDT also offers an airstream oscillation system for studies of the effects of gusts on fixed-wing and rotary-wing aircraft.



TDT boundary for air and R-134a test mediums.

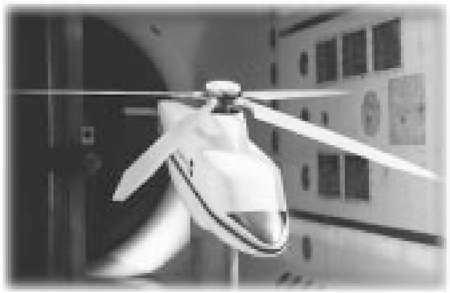
Data Acquisition and Processing

The TDT open-architecture dynamic data acquisition system (DAS) allows real-time acquisition and display of measured static and dynamic data as well as online analysis of the acquired data.

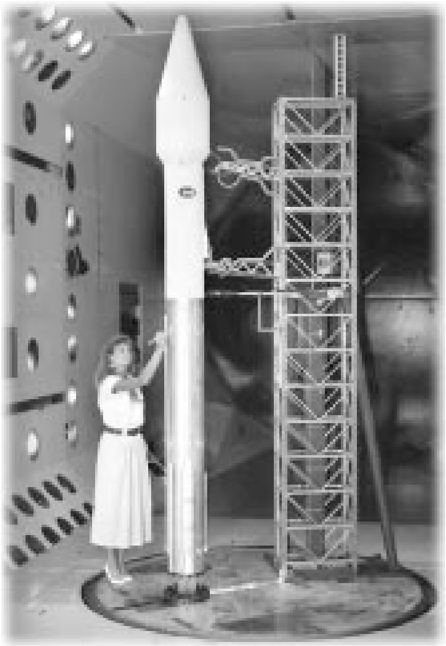
The DAS hardware is comprised of three subsystems, each switch connectable to a subset of four NEFF "front ends". Each NEFF provides signal conditioning, filtering, and sample-and-hold analog-to-digital conversion for 64 channels for a total capability of 256 channels. Data can be sampled at an aggregate rate approaching 300,000 samples per sec, which typically provides data acquisition at a rate of at least 1000 samples per sec for all available model instrumentation. The computer systems supporting the DAS perform basic data acquisition, archiving, and continuous buffering that is necessary to provide high quality dynamic data during tests. The facility also has the capability to provide on-line frequency analysis, postpoint time- and frequency-domain data analysis, and controller performance evaluations. All computers and terminals are connected, via networks, to work-stations at the TDT or at remote sites, which provides a distributed real-time data display capability.

Model Supports

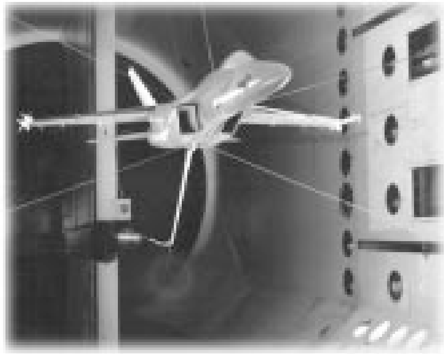
Model support systems for use in the TDT include the following: a sidewall turntable for use with semispan models, a variety of stings for full-span models, a 2-cable suspension system for "flying" models, a floor-mounted turntable for ground-wind loads studies, a sidewall mount for semispan tiltrotor models, and a floor-mounted post specifically used for the TDT rotorcraft testbed ARES (Aeroelastic Rotor Experimental System).



ARES on floor mount.



Atlas-Centaur ground wind loads.



F/A-18 E/F cable mount model.

Cessna CX sidewall mount.

Test Request Procedures

The first step of the test process is to submit a test request form. The form can be found at the following URL: http://sonicboom.larc.nasa.gov/aeroelasticitybranch/

Safety and Design Criteria

Langley's LHB 1710.15 *Wind Tunnel Model System Criteria* is the guideline for model design and fabrication. Model installation and any exceptions to this document must have the approval of the TDT Safety Head on a case-by-case basis to assure personnel and tunnel hardware are not exposed to risk. This document is available on the Wind Tunnel Enterprise web site at URL http://wte.larc.nasa.gov

Instrumentation

The DAS can handle typical model instrumentation arrangements such as strain-gage balances, potentiometers for position indication, and electronically scanned pressure (ESP) transducers. Additionally, most aeroelastic models are highly instrumented with dynamic signal instrumentation such as strain gages and accelerometers. Individual in situ unsteady pressure measurements are often made for well over 100 orifice locations on a model.

Document Version 1.0

Operating Hours

The TDT operates
14 hours per day
Monday through Friday
8:00 am - 10:00 pm

For more information contact

The TDT Manager • NASA Langley Research Center • Mail Stop 340 • 648 Dodd Boulevard • Hampton, Virginia 23681-2199

phone: 757 • 864 • 1267 | **fax:** 757 • 864 • 8678 | **e-mail:** wte+fm_tdt@larc.nasa.gov | **web site:** http://wte.larc.nasa.gov