14- by 22-Foot Subsonic Tunnel

NASA Langley Research Center

The Langley 14- by 22-Foot Subsonic Tunnel is currently used for low-speed tests of powered and unpowered models of various fixed- and rotary-wing civil and military aircraft.

Wind Tunnel
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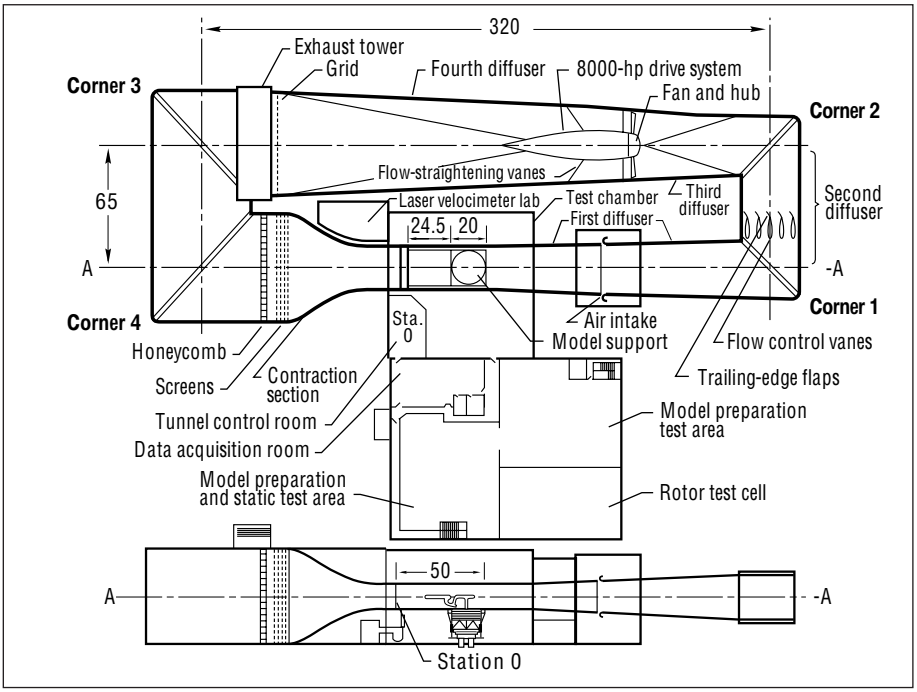
Test Section and Performance

The Langley 14 -by 22-Foot Subsonic Tunnel (14- by 22-Ft ST) is an atmospheric, closed return tunnel with a test section 14.5-ft high, 21.75-ft wide, and 50-ft long which can reach a velocity of 348 ft per sec with a dynamic pressure of 206 psf. The Reynolds number per foot ranges from 0 to 2.2 x10^6. The flow in the test section is relatively uniform with a longitudinal turbulence level of about 0.2 percent.

When the test section is not in the fully closed configuration, the test section velocity is lower and the turbulence level is higher. Test section airflow is produced by a 40-ft diameter, 9-bladed fan powered by a 6650-hp alternating-current induction motor in tandem with a 1350-hp direct current motor. The tunnel has a set of flow control vanes to maintain close control of the speed for low-speed testing.



Schematic of the 14- by 22-Foot Subsonic Tunnel and component sections. Dimensions in feet.

14- by 22-Ft ST Characteristics

Speed, foot per second	348
Reynolds number, per feet	0 to 2.2 x10^6
Test gas	Air
Test section size, feet	14.5 x 21.75
Length, feet	50
Drive power, horsepower	6650

Model Observation

Video cameras and monitors are available for viewing the model and test section while the tunnel is running.

High-Pressure Air, Cooling, and Hydraulic Capability

High-pressure air lines, cooling water lines, and hydraulic lines are available for connection to model components.

Rotorcraft model with 3-joint rotary sting.

Type of Testing

HSR model in tunnel.

The tunnel (initially named the V/STOL Tunnel and later the 4- by 7-Meter Tunnel) was constructed in 1970 to provide an improved understanding of the aerodynamics of vertical/short takeoff and landing (V/STOL) aircraft configurations. This facility addresses the distortion of the tunnel flow that results from the strong downwash generated by the V/STOL model lift fans or jets and the interaction of the floor boundary layer with the vertical or forward-facing propulsion flow components from the model. Tunnel configurations include a fully closed test section, a closed test section with slotted walls, and an open test section closed only on the floor. A boundary layer removal system and moving-belt ground plane prevent the formation of a floor boundary layer in the test section and provide a uniform vertical velocity distribution for ground-effects testing. The 14- by 22-Ft ST is also ideally suited for low-speed tests to determine high-lift stability and control, aerodynamic performance, rotorcraft acoustics, turboprop performance, and basic wake and flow-field surveys.

An extensive modification was completed in 1984 to improve flow and expand capabilities for both acoustic and rotorcraft testing.

Instrumentation

Model force and moment measurements are typically made with 6-component strain-gage balances. Multiple pressure measurements are made with an electronically scanned pressure (ESP) system, and iron-constantan thermocouples are typically used to measure temperatures.

Data Acquisition and Processing

Static and dynamic data acquisition systems are available. The static system has two UNIX computers; one dedicated to the tunnel and one to the model preparation area (MPA). Each is capable of handling input from 96 analog, 16 digital, 8 tachometer, and up to 1024 pressures from ESP module channels. The dynamic system can handle 72 channels with a 0- to 20-kHz bandwidth. All channels can be digitized in real time (16 bits for a 90-dB dynamic range), and stored on removable disk drives.

Facility Productivity Rates

The average productivity rate in terms of data points per user occupancy hour (UOH) is presented in the following table:

FY 98, points/UOH	29
FY 97, points/UOH	19.5
FY 96, points/UOH	15

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 14- by 22-Ft ST 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

Model Supports

Blended wing-body model.

Models can be mounted on carts for ground-effects, high angle-of-attack, rotorcraft, forced oscillation, or semispan testing. Models are typically assembled and disassembled in the MPA, which has several static test areas, as well as the rotor test cell. Two carts have the capability of vertical traverse for ground-effects testing with ranges of ± 14° in pitch and ± 150° in yaw. One cart can accommodate a vertical strut support system with pitch (-10° to 50°) and elevation (0 to 87 in. above floor) capabilities. The facility also has a unique support system with a 3-joint rotary sting, which keeps the model center at the test section centerline. This system has a pitch range of ± 32°, a yaw range of ± 30°, and a vertical traverse of 6 ft. The carts can also be lowered 2 ft below the test section floor to accommodate acoustical treatment, a microphone traverse system, or the third component of the laser velocimetry system.

Test Techniques

Flow visualization techniques available at the facility include a laser light sheet, propylene glycol smoke flow, titanium dioxide oil flow, and fluorescent minitufts.

Additional capabilities and test techniques are being developed for the 14- by 22-Ft ST, primarily in the form of new or modified model carts. The first checkout test of a dynamic ground-effects cart was recently completed. This cart will provide the ability to investigate rate of descent effects and large amplitude, high-rate angular motions in the facility. In addition, three techniques formerly used at the Langley 30- x 60-Foot Full-Scale Tunnel are being developed for the 14- by 22-Ft ST. These are (1) the small model, high angle-of-attack technique, (2) free flight testing, and (3) forced oscillation testing. A new model cart is currently being constructed for the forced oscillation technique, while the small model, high angle-of-attack hardware was recently built into a refurbished model cart.

Facilities Available to Users

Five model carts complete with model support systems are available for model assembly and disassembly in the 4 buildup test sites of the MPA or in the rotor test cell. Common instrumentation interfaces are provided with quick connections at all sites. In addition, static tests of powered models can be performed at these sites.

Test Request Procedures

The first step of the test process is to submit a test request form. The form can be filled out electronically or printed for mailing at the Wind Tunnel Enterprise web site. A posttest questionnaire is also available at this site. The URL is http://wte.larc.nasa.gov Our customers are encouraged to provide feedback to the facility for our continuous improvement process.

Operating Hours

The 14- by 22-Ft ST operates
two shifts per day
Monday through Friday
7:00 am - 11:00 pm

Facility User's Guide

Additional facility information can
be found in the facility user's guide
at the Wind Tunnel Enterprise web site.
http://wte.larc.nasa.gov

For more information contact

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