The Langley Low-Turbulence Pressure Tunnel is a unique facility that provides flight Reynolds number tests capability for two-dimensional airfoils and a low turbulence environment for laminar flow control and transition studies and tests of low-drag airfoils.
Test Section and Performance

The Langley Low-Turbulence Pressure Tunnel (LTPT) is a single-return, closed-circuit tunnel that can be operated at stagnation pressures from 0.1 to 10 atmospheres. The test section is rectangular (3-ft wide by 7.5-ft high by 7.5-ft long) with a contraction ratio of 17.6:1. The chord length for a typical airfoil tested in the facility is approximately 2 ft. There are provisions for sidewall boundary layer control from tangential blowing through tubes located on model endplates or passive suction through porous endplates vented to atmosphere. There is also the capability for tests of three-dimensional models with six-component force balances mounted on a centerline strut. The turbulence levels of the LTPT are very low due to the large contraction ratio and fine-mesh antiturbulence screens.

Instrumentation

For two-dimensional (2-D) single or multi-element airfoil tests, the model is mounted by endplates to a unique model-support and force-balance system. For three-dimensional model tests, a wide variety of internal strain-gage balances can be used for force and moment measurements. The electronically scanned pressure (ESP) system provides highly accurate steady-state pressure measurements of the model and the facility. Airfoil surface boundary layers (BL) can be measured with a BL traverser mechanism mounted on the model endplate.

Data Acquisition and Processing

The standard data acquisition system consists of an analog-to-digital converter, capable of acquiring 128 channels of analog data (up to 1000 Hz) and 40 channels of digital data, and a UNIX computer. Final data is reduced on a separate UNIX workstation. For data analysis, the facility provides UNIX and Macintosh computers. Customer supplied computers can be networked to the data reduction system if desired. Secure data links are available for classified projects.

Model Supports

A high-lift model support and three-component force balance system are provided for testing both single-element and multiple-element airfoils for two-dimensional tests. For three-dimensional tests, sting mounted models are attached to an arc-sector support system. The support system also includes a mechanized roll coupling.

Sketch of three-dimensional tests model support system. Dimensions are in inches unless stated otherwise.
Type of Testing

The LTPT has been used for two-dimensional and three-dimensional tests of airfoils including multi-element, high-lift, basic research and theory validation. Capabilities include three-dimensional model tests, high-lift model support and balance system, sidewall boundary-layer control system, excellent flow quality, and boundary layer and wake traverser systems.

Energy efficient transport (EET) semispan flap model installed in LTPT.

LTPT's capabilities of low disturbance, low Mach numbers, variable density tests and high-lift, multi-element airfoil tests at flight Mach and Reynolds numbers are unique in the U.S. and the world.

The high Reynolds number capability anchors the low subsonic range, which in combination with the 0.3-Meter Transonic Cryogenic Tunnel and the National Transonic Facility provide an unparalleled capability over the subsonic to transonic Mach number range.

In addition, this tunnel is ideal for preliminary aerodynamic configuration screening because of low operational cost and relatively inexpensive models, which are properly sized for testing in both the 16-Foot Transonic Tunnel and the Unitary Plan Wind Tunnel. Therefore, configurations can be quickly evaluated with one model to a Mach number of 4.7.

Test Techniques

Various oil or paint flow techniques, as well as sublimating chemicals, are available to investigate transition or separation locations on the model. Pressure sensitive paint (PSP) techniques have been developed to acquire global surface pressure measurements also. Acoustic measurements with a focused microphone array that is mounted in the test section have been successful in determining noise from high-lift airfoils. In addition, two- and three-component laser velocimetry measurements can be taken in the test section.

High-Pressure Air and Cooling Capability

A 350-psi off site air supply system provides dry compressed air to the facility. On site storage tanks are utilized with an air capacity of 8000 ft³ at 300 psi. The heat exchanger upstream of the anti-turbulence screens can be used either for cooling or heating the air flow.

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 LTPT 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

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.

Model Observation

Photographic and video coverage of the test section are possible from the sidewalk and ceiling windows. Video images of the model can be recorded on VHS recorders.

Facilities Available to Users

A model buildup bay is provided at the facility for buildup of models. Also, a calibration area provides instrumentation and propulsion air systems for further calibrations that may be required to quantify deflection constants.

Facility Productivity Rates

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

<table>
<thead>
<tr>
<th>Year</th>
<th>Points/UOH</th>
</tr>
</thead>
<tbody>
<tr>
<td>FY 1998</td>
<td>7.4</td>
</tr>
<tr>
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</tr>
<tr>
<td>FY 1996</td>
<td>6.1</td>
</tr>
</tbody>
</table>
Operating Hours

The LTPT operates one shift per day Monday through Friday Hours 7:00 am - 3:30 pm

For more information contact

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