1.5 m x 1.5 m Trisonic Blowdown Wind Tunnel

This major facility of the NRC Institute for Aerospace Research (NRC Aerospace) is a pressurized, intermittent flow wind tunnel capable of running in the subsonic, transonic and supersonic flow regimes. The speed range is from 1/10 to more than four times sonic speed. Stream stagnation pressure is closely controlled during the blowdown and, by varying the diffuser throat area or controlling the outflow from the plenum chamber, the test Mach number may be held within very close limits as a model pitches, even at sonic conditions.

Testing configurations

The basic test section is 1.5 m square with solid walls for measurements in subsonic and supersonic flow. For high subsonic and transonic flow regimes, a separate test section with perforated walls is contained within a pressure-tight plenum chamber and minimizes the impact of shock reflections and blockage. A test-section insert (0.38 m wide and 1.5 m high) is available to produce aerodynamic data on 2-D aerofoil sections. Chord Reynolds numbers approaching full-scale values on transport aircraft for Mach numbers up to 0.9 can be achieved. While the run time of this tunnel in its various modes depends on the flow conditions required, a typical time is 20 seconds. A captive trajectory system for advanced store-release studies is under development.

Model mountings

Complete three dimensional models are mounted using either a rear sting, or a “plate mount” system which permits correct modeling of the rear fuselage for transport aircraft configurations. By installing a “reflection plane” and five-component sidewall balance, it is possible to test semi-span models of larger scale, for which higher Reynolds numbers can be achieved. Two-dimensional models for aerofoil development are supported between three component balances in each sidewall.

Half-model of Bombardier Global Express business jet

Data acquisition and analysis

In addition to force and moment data, high-precision surface pressure measurements are routinely made on aircraft or aerofoil section models. These measurements are made using electronic pressure scanning (EPS) techniques. Force and moment measurements can also be made on external stores in the parent aircraft flow field. The data system used for recording nominal steady state information is built around DEC PDP and VAX computers with extensive disk storage. A high-speed data acquisition system (with 192 channel capacity and sampling rates to 40 kHz per channel) is also available for making measurements involving unsteady phenomena.

Test program support

Support provided: wind tunnel testing techniques, wind tunnel instrumentation, model design, model manufacture, data analysis capability, computational fluid dynamics.

Pilot wind tunnel

NRC Aerospace also operates a one-twelfth scale “pilot” version of the 1.5 m wind tunnel which offers the same performance envelope, with virtually unlimited running times. This facility is very cost-effective for testing small models, such as the calibration of flow measurement probes.

...cont’d

Technical specifications

Type of wind tunnel:	• Blowdown trisonic
Air supply:	• 8.4 MW (11,250 hp) synchronous motor; 10-stage compressor
Useful running time:	• 5 to 60 seconds
Data system (Tunnel control, data gathering & processing):	DEC PDP 11/55 Computer Low Speed System: • 98 analog amplifier channels • 15 bit A/D conversion • 60 kHz max through-put High Speed System: • 192 channels sampled @ 38.4 kHz/ channel, parallel recording of filtered & RMS data @ 100 Hz

Typical production:	• 10 to 20 blowdowns / day • 1,350 blowdowns / year
Air storage:	• 31,430 m^3 (50,430 ft^3) @ 21 atm & 21°C
Time to charge tanks:	• 35 min. from empty, 20 min. between blowdowns
Schlieren system:	• Multi source focussing type
ESP capability:	• Scanivalve Z0C modules (1, 5, 15, and 50 psid ranges) • Support for up to 16 modules (32 ports ea) @ 100Hz rate, or more at lower data rate
Max Reynolds number:	• 1.5m x 1.5m: 80 x 10^6 /m (25 x 10^6 /ft) • 0.38m x 1.5m: 160 x 10^6 /m (50 x 10^6 /ft)

	Sting/plate mount testing	**Two-dimensional testing**	**Half-model testing**
Test section size:	• 1.524 x 1.524 m (5 x 5 ft) • Closed solid wall subsonic and supersonic • Porous walls in transonic test section, 60° inclined holes with splitter plates, porosity variable from 1% to 6% open area ratio	• 0.381 x 1.524 m (15 in x 5 ft) • Solid sidewalls • Variable porosity ceiling and floor with same geometry as transonic test section walls	• 1.467 x 1.524 m (4.813 x 5 ft) • Solid reflection plate in transonic test section • 3 walls with variable porosity in range 1% to 6% open area ratio
Model size:	• 1 m (~40”) maximum span	• 0.3 m (~12”) chord	• 1 m (~40”) max half-span
Mach number range:	• 0.1 to 0.75 subsonic • 0.7 to 1.4 transonic • 1.1 to 4.25 supersonic	• 0.1 to 0.9	• 0.2 to 0.99
Model support:	• Sting and internal balance on vertical strut (range of balances available) • Plate support option available when rear fuselage geometry must be correctly represented	• Pair of 3-component external sidewall balances 89 kN (20,000 lb) maximum normal force, smaller ranges also available	• 5-component external sidewall balance
Pitch motion:	• Sting mount: 11° to +23°@ max 23°/s • Plate mount: 30° range @ max. 15°/s	• ±50° @ max 15°/s dual-sided synchronous balance drives	• ±50° @ max 15°/s external balance drive
Roll motion:	• ±354° @ max 37°/s	• N/A	• N/A
Special features:	• Model air supply of 0.9 kg/s (2 lb/s) or more @ 17 atm • Air extraction to 1 atm from model • Combined pitch/yaw motion • Captive store load measuring rig (articulated sting) • Schlieren windows in transonic and supersonic test sections	• Dual-sided model air supply of 4.1 kg/s (9 lb/s) @ 17 atm • 2-D test standards • 192 orifice max model surface pressure instrumentation (96/side) • 54-tube vertically traversing wake rake • Ejector augmented sidewall suction for boundary layer removal	• Model air supply of 2.3 kg/s (5 lb/s) @ 17 atm • Air extraction to 1 atm from model

CONTACT:
Cabot Broughton
Aerodynamics Laboratory
NRC Institute for Aerospace Research
Ottawa, Ontario, Canada K1A 0R6
Tel: (613) 998-9401 Fax: (613) 998-1281
E-mail: cabot.broughton@nrc.gc.ca

Mr. Jeff Mackwood
Marketing and Contracts Office
NRC Institute for Aerospace Research
Ottawa, Ontario, Canada K1A 0R6
Tel: (613) 990-0765 Fax: (613) 952-7214
E-mail: jeff.mackwood@nrc.gc.ca

September 2005
Aussi offert en français
IAR-AL03e

Or visit our Web site at: www.nrcaerospace.com