INFORMATION

AERODYNAMICS

2 m x 3 m Wind Tunnel

The 2 m x 3 m wind tunnel at the NRC Institute for Aerospace Research (NRC Aerospace) is a world-class facility for subsonic aeronautical and industrial testing. It has been used extensively by commercial organizations, universities, and government for research and development in the areas of steady and unsteady aircraft aerodynamics, aeroacoustics, surface vehicle aerodynamics, marine hydrodynamics, wind engineering, and wind energy generation.

The staff of NRC Aerospace continually pioneer specialized test rigs, flow simulations, and measurement techniques to augment the tunnel's capabilities. Integrated data acquisition and control systems complement the aerodynamic capabilities of the facility and ar e tailored to each customer's needs. Carefully performed wind tunnel measurements are the cornerstone of cost-effective design when subsonic and unsteady aerodynamics are important.

Technical support
NRC Aerospace provides expertise in most aspects of steady and unsteady aerodynamics as applied to aircraft, surface vehicles, and ground-based structures. Expertise is also available in:

- vehicle and structure dynamics
- aerodynamic stability and structural response
- static and aeroelastic wind tunnel model design
- all aspects of wind tunnel test technology, flow visualization and instrumentation.

NRC Aerospace staff have proven capabilities in model design, construction and instrumentation; appropriate test program selection; and data analysis and interpretation.

Model of prototype helicopter undergoing tests

Business environment
The 2 m x 3 m wind tunnel provides a superior and secure working environment for commercial or government customers that can be rented at a single, all-inclusive, hourly fee. Its staff provides a full range of consulting services to support any aerodynamic investigation at competitive commercial rates. The customer's needs are always a priority.

Areas of expertise

- steady-state aircraft aerodynamics
- unsteady aircraft aerodynamics
- surface vehicle aerodynamics
- wind engineering/ bluff body aerodynamics
- aeroacoustics
- flow measurement and visualization.

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Technical specifications

Tunnel geometry:	• Contraction ratio: 9:1 • Test section: 1.9 m x 2.7 m x 5.2 m • Test section area: – Standard: 5.07 m^2 – Groundboard: variable height
Tunnel characteristics:	• Fan power: 1490 kW • Maximum speed: 1 40 m/s • Speed uniformity: ±0.7% • Turbulence level: 0.14% • Longitudinal static pressure gradient: – Standard: negligible – Groundboard: 0.0044/m
Auxillary systems:	• Compressed air: up to 2,000 kPa – Dew point (40°C): 2.7 kg/s – Undried: 5.0 kg/s • Model supports – 3-D steady state: 3 point and single strut supports – 3-D unsteady: sting – 2-D steady state: upper air bearing • Flow traverse rigs: several, automated • Auxiliary power: 156 kvA, variable frequency • Acoustic liner: anechoic above 400 Hz
Main balance:	• Measurement accuracy: ±0.1% to ±0.05% full-scale • Maximum model weight: 450 kg • Lift, drag, side force (kN): ±6.7, ±2.3, ±4.4 • Pitch, yaw, roll (kN m): ±2.7, ±2.7, ±2.7
Data system and instrumentation:	• A/D channels: 24 & 16 bit @ 100 kHz, custom configurations • Redundant tunnel condition sensors • Software: test-specific MatLab code, Labview • Model/probe control: 16-axes, Aerotech • Pressure measurements: Scanivalve ZOC™ Kulite • Anemometry: hot-film/hot-wire • Balances: internal (TASK, NRC, various) and external (cruciform, various) • Flow visualization: PIV, Acoustic Array, PSP laser light sheet, smoke, surface oil film, fluorescent mini-tuft

A three-point mount is commonly used for static tests, while sting mounts are used for unsteady measurements with oscillating models

Typical installation for surface vehicle aerodynamics experiments (photo courtesy Honda R&D Americas)

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