3 m x 6 m Open-Circuit Propulsion and Icing Wind Tunnel

The 3 m x 6 m Propulsion and Icing Wind Tunnel (PIWT) at the NRC Institute for Aerospace Research (NRC Aerospace) is a facility which bridges the gap between a conventional wind tunnel and an engine test cell. The wind tunnel has several unique features which lend themselves to a variety of applications.

The open-circuit layout, with fan at entry, permits contaminants associated with the test articles (such as heat, combustion products, wakes, jets, lost lubricants etc.) to discharge directly, without recirculating or contacting the fan. Additionally, a high solidity fan attenuates unsteadiness due to atmospheric wind. The fan is normally driven electrically but high-speed operation can be accommodated by a gas turbine drive system.

Experiments on models of aeronautical propulsion systems are facilitated by a connection to the NRC Aerospace compressor/exhauster facility. Compressed air to simulate jet effluxes or to drive turbine-powered fans, and suction to simulate intake characteristics, are available.

Research on surface transport propulsion systems conducted in the PIWT has been concerned with cooling airflows.

Icing test in PIWT

Open-Circuit Propulsion and Icing Wind Tunnel

Aeronautical propulsion applications have included tests on a turbo-prop engine (complete with propeller) mounted on force balances to permit engine performance to be measured under a variety of simulated flight conditions. Other development work has been concerned with the behaviour of thrust reversers applicable to turbo-fan engines. The facility is also ideal for large-scale bluff-body aerodynamic investigations such as cable vibration studies.

Most recently, the PIWT has been used in icing research. The open-circuit design of the wind tunnel means a naturally cold test section is available in the winter. This capability, combined with the working section height, results in the ability to simulate larger water droplets than most icing wind tunnels. A test section insert is available to further increase wind speed.

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Technical specifications

Tunnel geometry:	• Test section (w x h x l): 3.1 m x 6.1 m x 12.2 m (3.1 m x 4.9 m x 6.4 m with insert) • Test section area: 18.9 m^2 (15.2 m^2 with insert)
Tunnel characteristics:	• Fan power: – Electric = 750 kW – Gas turbine = 6,000 kW • 18.9 m^2 test section max speed: – Electric = 40 m/s – Gas turbine = 54 m/s • 15.2 m2 test section max speed: – Electric = 50 m/s – Gas turbine = 67 m/s • Speed uniformity: ±0.5%
Auxillary systems:	• 480 port, computer-controlled icing-spray rig • Compressed air: up to 14.5 kg/s at 700 kPa • Flow traverse rigs: several, automated
Data system and instrumentation:	• Software: test specific MatLab & LabView • Model mounts: pitch rig and custom mounts available • Pressure measurements: Scanivalve ZOC™,Kulite • Anemometry: hot-film/hot-wire • Balances: internal (TASK, NRC, various) and external (cruciform, various) • Photography: digital DVD, S/VHS, 35 mm • Flow visualization: PIV, Acoustic Array, PSP, laser light sheet, smoke, surface oil, fluorescent mini-tuft

Inclined stay-cable test

PIWT test section with spray bars in operation

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