NRC·CNRC

Engine research facility

Reducing aviation icing risks for aircraft engines

The National Research Council of Canada (NRC) is a world leader for engine icing certification testing and analysis, as well as development of ice detection and mitigation systems for aircraft and engines. For more than 80 years, the NRC has performed icing simulation testing in its Ottawa-based test cells. Current NRC icing system capabilities can produce a liquid water content of up to 4.0 g/m³ at peak airflows over a 15 to 45 micron range of median volumetric diameters. These facilities rely on ambient air temperatures to produce the desired conditions during winter months (December through March), and deliver icing testing at lower cost.

The NRC has several test facilities capable of performing engine and probe icing for airworthiness certification.

Icing facilities and capabilities

- FAR 33.68 icing certification testing
- Ice slab or hail stone ingestion (FAR 33.77 testing)
- Iso-Kinetic Probe for accurate total water content measurements
- Laser measurement techniques for measuring droplet diameters
- Specialized icing instrumentation development
- Suite of particle and ice measurement sensors, including hot element and direct imaging for melt, shape, size and velocity measurement
- Techniques for snow and ice crystal ingestion

As a partner in the Global Aerospace Centre for Icing and Environmental Research (GLACIER), the NRC has developed and currently operates the icing system for certifying large turbo fan engines in Thompson, Manitoba.

Technology maturation for next generation engines

Our gas turbine engine test cells also support a variety of performance, operability and other types of certification testing, including bird ingestion, blade-off, alternative fuel qualification and endurance trials.

Engine test cells capabilities

- Alternative fuels testing and certification
- Altitude and moderate attitude testing
- Blade-off testing
- Endurance or cyclic testing
- Full authority digital engine control (FADEC) and control logic testing
- Icing testing and certification
- Ingestion testing for water, ice slab, sand, volcanic ash and birds
- Operability testing
- Thermomechanical testing

Close-up shot of 3D lobster tail icing

Engine test cells specifications

	TC 2	TC 4	TC 5
Engine type	Turboshaft/jet/fan	Turboshaft/jet/fan	Turboshaft/jet/fan
Dimensions	15 ft x 15 ft x 35 ft (4.6 m x 4.6 m x 10.7 m)	25 ft x 25 ft x 75 ft (7.6 m x 7.6 m x 22.9 m)	15 ft x 15 ft x 75 ft (4.6 m x 4.6 m x 22.9 m)
Thrust/power	9,000 SHP at 3,600 rpm	50,000 lbs (222 kN)	50,000 lbs (222 kN)
Air flow	110 lb/s (50 kg/s)	1,000 lb/s (454 kg/s)	300 lb/s (136 kg/s)
Inlet	Ambient	Ambient with icing tunnel	Ambient with icing tunnel
Design and correlation	SAE AIR4989, SAE ARP4755	SAE AIR4869, SAE ARP741	

Other test cells suitable for propulsion R&D

	TC 1	TC 3
Type	Mini through-flow altitude chamber or tests using high-flow compressors	Ground-level, access to medium-flow compressors
Dimensions	15 ft x 15 ft (4.6 m x 4.6 m)	—
Features	Inlets, electrically driven rotors, components	Particle separators, inlet icing, blowers
Air flow	20 lb/s (9.1 kg/s)	—
Inlet	Heated 90 °F (32.2 °C) at 20 lb/s (9.1 kg/s)	—

Test cell capabilities

- Emissions (gaseous and particulate matter) measurement capability available in any test cell
- 1,000+ channel DAS and high-speed dynamic DAS in all test cells
- Conventional and alternative fuels (including biofuels) at flow rates of up to 71,500 lb/h (32,500 kg/h)
- Four storage fuel tanks at 10,567 US gallon (40,000 litre) capacity
- Additional measurement capabilities: High speed cameras, support for vibration and high-speed measurement, particle detection probes for sand or volcanic ash detection
- Additional facility capabilities: Hailstorm simulation rig, air cannons for bird and hailstone ingestion testing, compressor/exhauster capability, conditioned air supplies and engine flow simulator

Contact

Eric Lefebvre, Director, Business Development
613-949-7548
eric.lefebvre@nrc-cnrc.gc.ca

canada.ca/nrc-aerospace

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