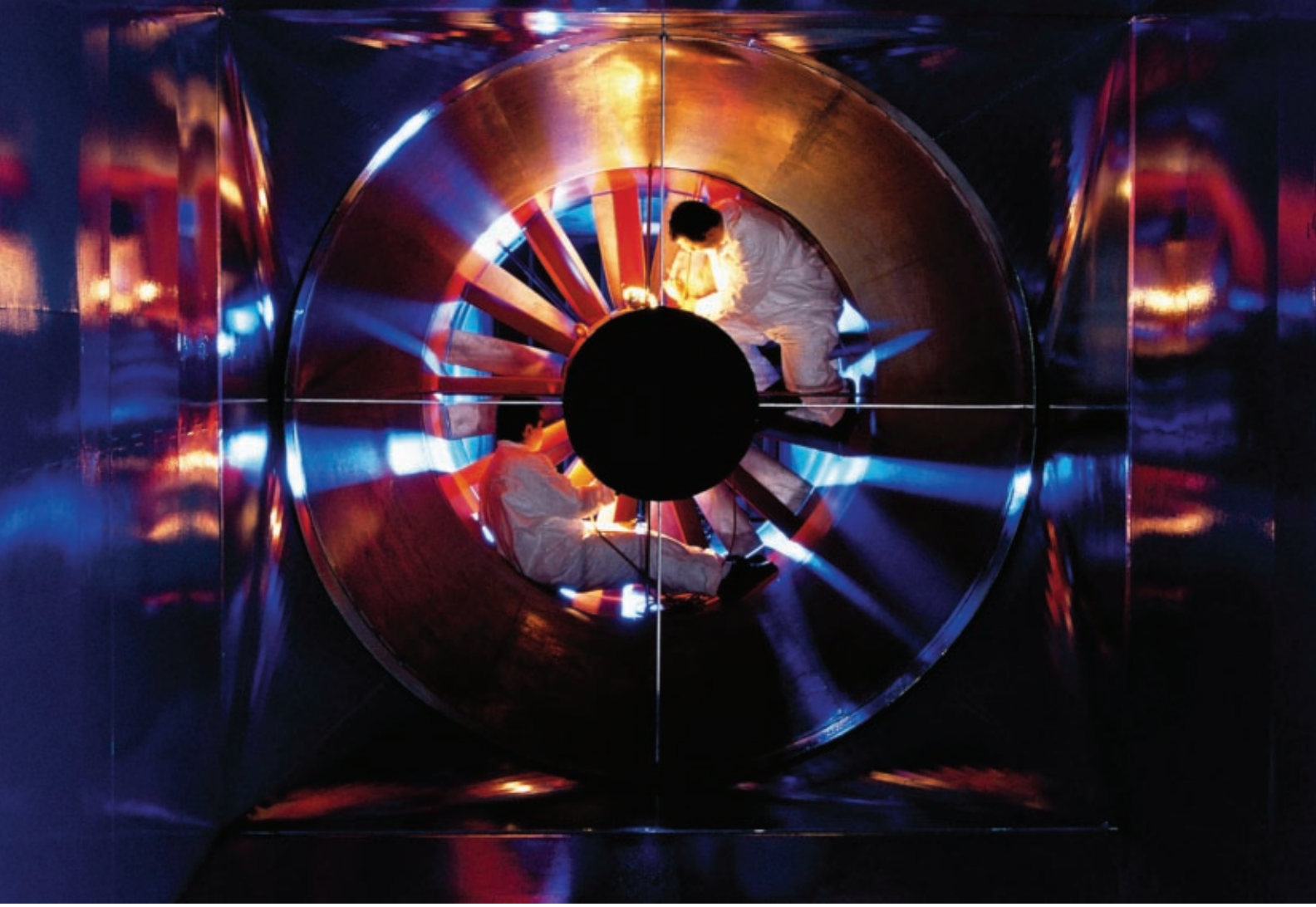
COX & COMPANY

LECLERC ICING RESEARCH LABORATORY & ENGINEERING SERVICES



The LeClerc Icing Research Laboratory (LIRL) is a world-class test facility for the study, design, and certification of ice protected and unprotected aircraft components in icing conditions. This in-house test capability provides Cox with the means to simulate the wide variety of icing environments encountered by aircraft under actual operating conditions of wind speed, liquid water content, droplet size and extreme low temperature conditions. The LIRL was designed and built directly by Cox personnel in 1996. Our facility includes state-of-the-art noise suppression technologies, including vibration isolation and acoustic noise damping materials to provide our customers with a user-friendly operating environment during testing.

Cox performs research and development programs using the LIRL for a number of Government agencies, including the Small Business Innovation Research (SBIR) Program. Past research programs have included the study of mixed-phase conditions and laboratory snow generation. Cox uses this icing tunnel facility for in-house R&D activities and to support the development and qualification of new customer products. The LIRL test facility and support staff are also available for rental on a daily or weekly basis.

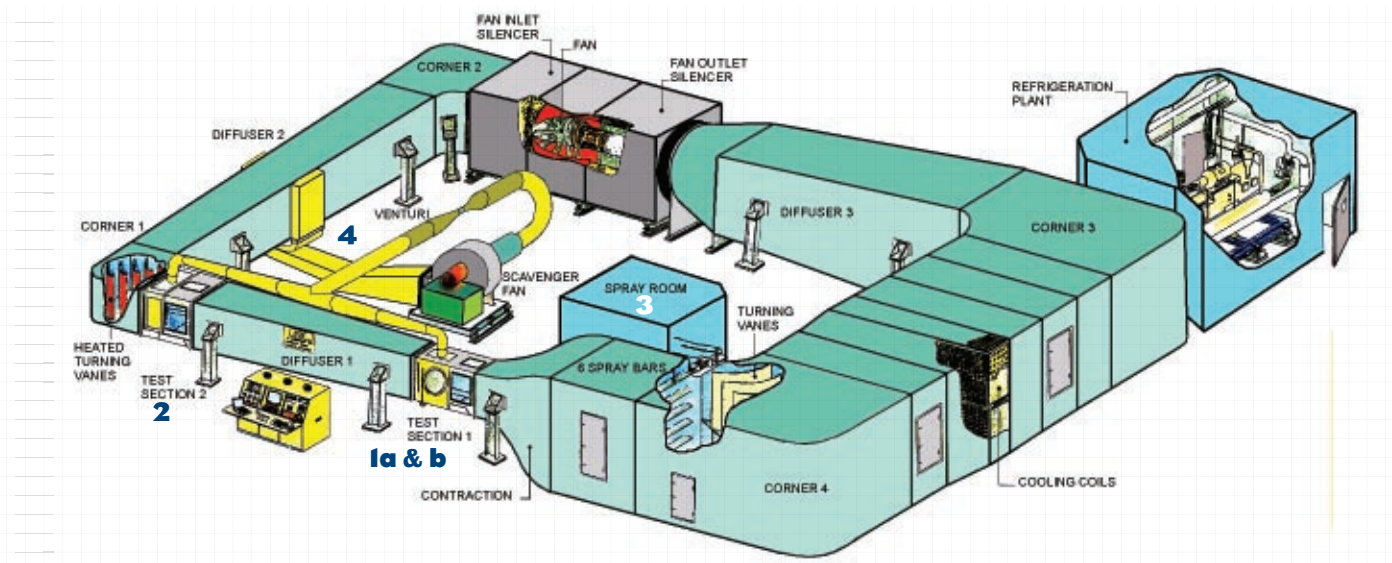
AEROSPACE TECHNOLOGY

ICING WIND TUNNEL SPECIFICATIONS

The Cox Icing Wind Tunnel (IWT) located within the LIRL facility was engineered to meet a number of design criteria and be environmentally non-intrusive to the surroundings as well. The IWT consists of a closed-loop refrigerated wind tunnel with the capability of simulating a cloud of super-cooled water droplets as specified in the Federal Aviation Regulation (FAR) and the European Aviation Safety Agency (EASA). Additionally, a unique capability of simulating ice crystal environments is offered.

Technical Specifications of the IWT include the following:

- A 200 Hp, constant RPM, axial fan with 16 variable-pitch blades of 72″ diameter to control airspeed
- A 250 Hp and a 100 Hp refrigeration compressor provide in excess of 80 tons of cooling capacity to maintain an ambient temperature as cold as -22°F (-30°C) at full speed
- Dedicated water cooling tower for heat rejection
- Lifting surfaces, engine and ECS inlets, fairings, air data probes, other aircraft structures, and complete potable and waste water systems can be tested in the LIRL



1a. Primary Test Section (No. 1)

46 in. high x 28 in. wide x 6.5 ft. long (1.17 m x 0.71 m x 2.0 m)
Maximum airspeed 195 Knots (100 m/sec)
Rotating side mounts for variable AOA airfoil testing
Three heated windows for viewing and imaging of test article

1b. High Speed Test Section (Insert in No. 1)

Additional contraction and insert in the Primary Test Section:
24 in. high x 28 in. wide x 6.5 ft. long (0.61 m x 0.71 m x 2.0 m)
Useful for smaller test models requiring higher speeds
Maximum airspeed 226 Knots (116 m/sec)
Two heated windows for viewing and imaging of test article

2. Secondary Test Section (No. 2)

48 in. high x 48 in. wide x 5 ft. long (1.22 m x 1.22 m x 1.52 m)
Maximum airspeed 109 Knots (56 m/sec)
Three heated windows for viewing and imaging of test article

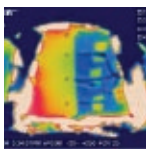
3. Water Spray System Array

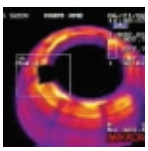
Six horizontal spray bars (102 possible nozzle locations).
60 Hp at 100 psig air compressor to atomize water droplets, and 30 kW heater
Calibrated NASA type nozzles using FSSP, OAP, and Malvern laser instrumentation systems
Maximum Liquid Water Content (LWC) of 3.0 g/m^3
Mean Volume Diameters (MVD) from 13 to larger than 50 microns

4. Engine Inlet and ECS Flow Simulation System

An auxiliary (scavenger) flow system simulates engine and ECS inlet air flows up to 15 lb/sec (6.8 Kg/sec)
70 Hp AC motor with variable frequency drive control
Accessible from the Primary or Secondary Test Section

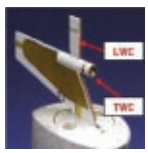
AVAILABLE TUNNEL AND ENGINEERING SERVICES





Infrared Thermal Imaging using a FLIR Systems ThermoVision A20M camera for monitoring and recording heated surfaces in real time through an access window.

Bleed Air for Deicing and Anti-icing Simulation: Maximum 600°F air temperature at 50 SCFM flow rate and 50 psig supply pressure. Can also be used to remove ice.



Laser Droplet Measuring System and Nevzorov Cloud Instrumentation for ice and liquid water content measurements in clouds.

Ice Crystals and Mixed-Phase Icing Conditions:
An ice shaver and a snow gun were developed to simulate in-flight mixed-phase and glaciated icing cloud environments. Cox was awarded NASA SBIR Phases I & II contracts for this development. This capability has continued to be developed and used extensively by commercial customers and government agencies (NASA, FAA, Environment Canada).

Applications include development, calibration, and certification of air data probes, in-situ cloud characterization instruments, and validation of thermal ice protection on lifting surfaces and engine inlets in ice crystal conditions.

Additional Services Offered:

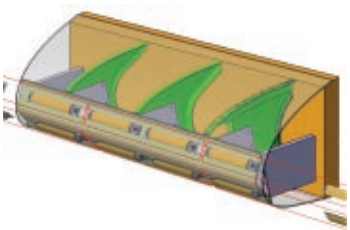
- Digital still photography and video recording on VHS and DVD media format
- Data acquisition, including thermocouples and other analog signals
- Dry air up to 100 psig with a dew point temperature as low as -40°C/°F
- Test article design and fabrication
- Design and fabrication of special test mounts
- Custom-heated components and temperature control
- Icing test analysis and test reports

ICING ANALYSIS EXPERTISE AND DESIGN TOOLS

Computational and Analysis Capabilities:

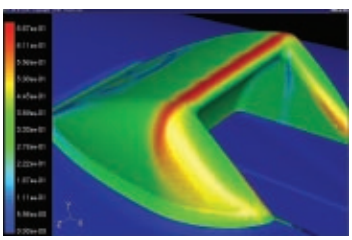
- Fluent CFD program used for 3D flowfield and ice impingement
- NASA LEWICE 2D and 3D used for ice accretion and analysis of thermal deicing and anti-icing systems
- ANTICE, a detailed model used for thermal ice protection systems, including electro-thermal and bleed air systems
- ALGOR, a Finite Element Model used in the study of thermal systems and structural integrity of aircraft components and assemblies

CAD Design and Engineering: Cox uses the latest version of the industry standard CATIA® design tool. This is a CAD/CAM/CAE commercial software suite developed by Dassault Systems to perform 3D part and assembly design and the generation of production drawings.

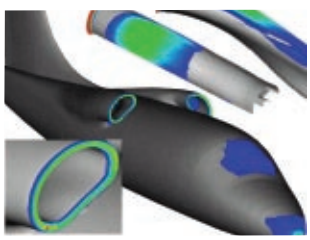


CATIA® representation of a tunnel test model of the Cox EMEDS low power ice protection system.

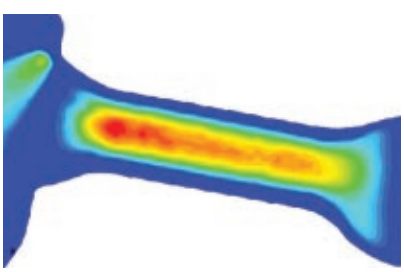
Surface Heat Transfer Coefficients on the EH-101 inlet scoop as predicted using the Fluent software.



Ice accretion zones and droplet impingement rates predicted on multi-surfaces of a business jet aircraft using the NASA Lewice3D software.



Use of Analytical Tools and Icing Tunnel: Cox relies heavily on existing and in-house developed analytical tools in combination with the icing wind tunnel and a Thermal Test Management System (TTMS) to design state-of-the-art ice protection systems. The TTMS is a powerful data acquisition and closed loop heater control system operated by a PC.



Analytical ice impingement predictions on the EH-101 Helicopter winch fairing

Tunnel ice accretion agreement validating the analytical prediction and test setup

1664 Old Country Road, Plainview, NY 11803 ✦ www.coxandco.com ✦ TEL. 212.366.0200