

## Icing Wind Tunnel (IWT)

### *Type of Infrastructure*

Wind tunnel

### *Main technical features*

The IWT is a closed-loop, cooled and pressurized/depressurized wind tunnel. Three interchangeable test chambers and an Open Jet configuration are available for aerodynamic and/or icing testing. The cooling of the flow is obtained by means of a heat exchanger placed at the end of the diffuser in the return circuit of the tunnel: the minimum temperature that can be reached and controlled is  $-32\text{ }^{\circ}\text{C}$  for the MTS (Main Test Section), ATS (Additional Test Section) and Open Jet, and  $-40\text{ }^{\circ}\text{C}$  for the STS (Secondary Test Section). A pressurization/depressurization system also allows to reach and control the static pressure in the test chamber between 0.39 and 1.45bar. This allows both to carry out tests at altitudes up to 7000m, and to increase the maximum number of Reynolds in aerodynamic tests. The table below shows the characteristics of the three test chambers and the Open Jet.

TEST SECTION	Dimension [m]	Speed (Mach)	Temperature [ $^{\circ}\text{C}$ ]	Altitude [m]
MAIN	2.25 x 2.35	0.41	$-32 < T_s < +40$	7000
SECONDARY	1.15 x 2.35	0.7	$-40 < T_s < +40$	7000
ADDITIONAL	3.60 x 2.35	0.25	$-32 < T_s < +40$	7000
OPEN-JET	2.25 x 2.35	0.34	$-32 < T_s < +40$	7000

The generation of the cloud for the simulation of ice accretion on the test model is ensured by the Spray Bar, a system consisting of 20 horizontal bars, aerodynamically profiled, and placed, equally spaced in height, in the calm chamber of the tunnel circuit. Up to 50 nozzles can be installed on each bar, for a total of 1000 available positions, fed with air and water under pressure for the generation of the droplets constituting the cloud.

### *Application Domains*

- Fluid physics
  - a. Unsteady aerodynamics
  - b. Flow control
  - c. High lift systems
  - d. Wing design
- Propulsion
  - e. Air intakes – High lift de-icing systems
- Avionics of aircraft, systems and equipment
  - a. Ice protection systems
- Integrated design and validation (analysis tools and methodologies)
  - a. Flight tests/tunnel tests
- Test methodologies
  - a. Scale laws for cloud conditions
- Cloud generation methodologies
  - a. Spray analysis (optimizations and developments)
- Innovative scenarios

- a. New technologies with a high innovative content

### *Main measuring instruments/techniques*

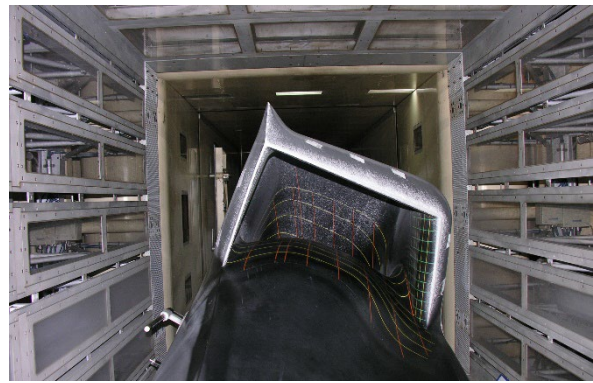
- Droplet sizing techniques (PDPA/LDS/ADA/PDI, FSSP, OAP, HSI)
- LWC/TWC measurements (icing blade, hot-wireDMT-LWC100, SEA LWC probe, Multiwire probe, Robust probe)
- Cloud Uniformity measurements (icing grid, cylinders)
- Ice accretion (manual ice tracing, ice thicknesses, laser scanning)
- Infrared thermography
- Particle Image Velocimetry
- Laser Doppler Velocimetry
- Hot-wire anemometry
- Pneumatic measurements

### *Operational Status*

The IWT plant is fully operational



Icing Wind Tunnel aerial view



JSF inlet installed in the MTS