Wind Tunnel Division

F1

Low Speed Pressurized Wind Tunnel

Le Fauga-Mauzac Center

High productivity
High Reynolds numbers
High levels of customer service

ONERA
THE FRENCH AEROSPACE LAB

F1 wind tunnel operation

Low speed pressurized wind tunnel

Fan driven by a 9.5 MW electric motor

Wind Tunnel Key Features	
Test Section (h x w)	3.5 m x 4.5 m
Mach Number Range	Up to 0.36
Total Pressure	1 to 3.85 bar
Reynolds/Lref (max)	20.10^6
Typical Model Size	3 m span for full model * 2.5 m semi-span for half model

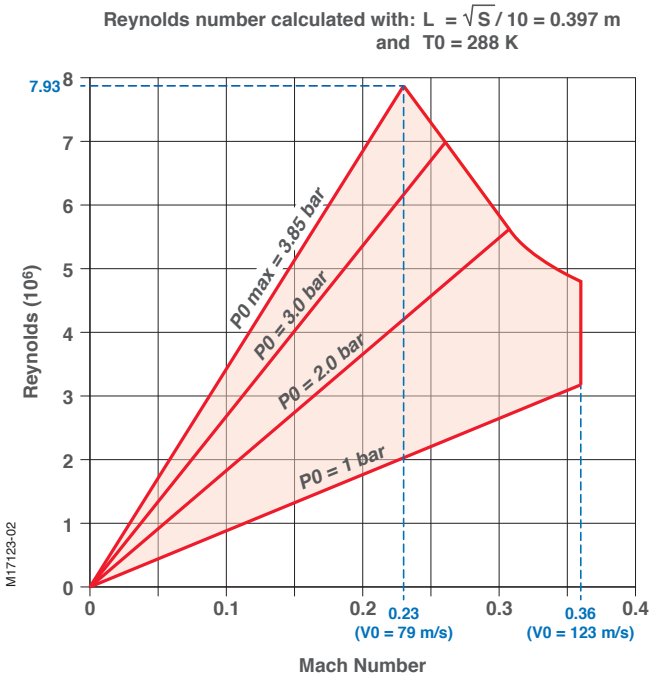
F050003

* Can also be tested at high speed in ONERA's S1MA wind tunnel, with the same sting balance.

Using the same model for low speed testing (F1) and high speed testing (S1MA) is beneficial to accelerate the design process of a new aircraft.

High productivity

- Large scale allows models to be highly motorised (flaps, ailerons, HTP, spoilers, etc.).
- Fast access to the model: 10 min from wind tunnel shutdown to hands on.
- Time to wind-on after a model configuration change at maximum pressure is approximately 6 min.
- Usual continuous pitch angle rate: 0.3°/second.
- Time to change Mach number set-point: less than 1 min.



Performance

- Stability in Mach Number during a continuous angle of attack sweep: ± 0.001.
- Total pressure and total temperature are controlled within ± 200 Pa and ± 0.2K respectively.

Measurement Techniques

MDM

- Model Deformation Measurement (bending and twist) on aerofoil surfaces, including flaps.

DSFM090044

Typical accuracy on wing: ± 0.05° on twist, ± 0.3 mm on bending.

PIV

- Particle Imaging Velocimetry - Wake and flow measurements.
- 3 component system. Accuracy: 1% on usual measured speed.

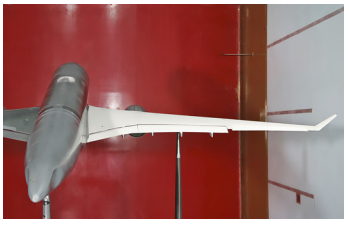
F040025

IR

- Visualisation of the transition of the boundary layer on wings with infra-red camera.

PSP

- Measurements of the pressure distributions on the wings, flaps, and/or complete model surface. Measurement of local controls surface loads possible. Accuracy in Cp: ± 0.15 at M = 0.2.



DSFM080092

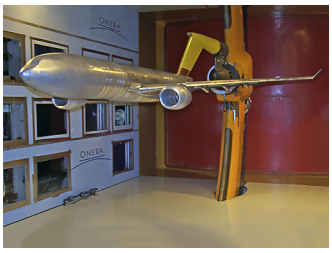
Visualisations

- Coloured oil flow, acenaphten, mini-tufts.

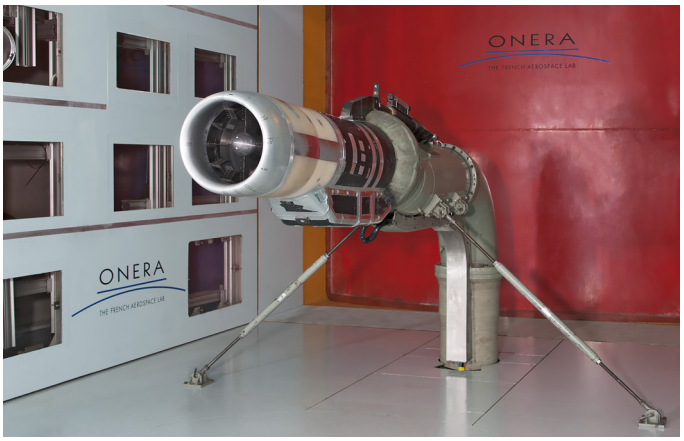
F050137C

Typical tests

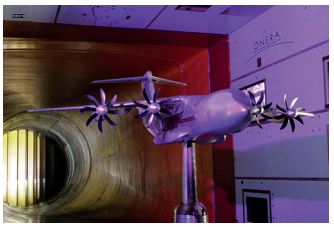

F030088

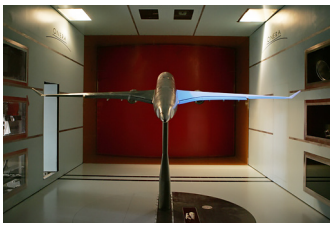

DSFM2010-01-07

- Simultaneous measurements of loads, steady and unsteady pressures.
- Ground effect testing with boundary layer blowing.
- Setup interference effects when CFD assessment is not available.


DSFM120047

- Air Intake tests: head-wind or cross-wind. Ground effect simulation. Reynolds number close to full scale. Air intake mass flow up to 75 kg/s.
- Motorized complete or half models with propellers or TPS – Turbine Power Simulators (pressurized air supply up to 118 bar, at a mass flow up to 20 kg/s).


F060019


DSFM090013

Model support examples

- Mono-strut for testing over a wide range of incidence & sideslip. Pitch range is 34° with offset adaptors available. Yaw range is generally ± 30°.
- 3-strut for high-incidence testing offering a stiff and discreet model support. Pitch range is about 30°. No yaw is possible.


F020022


F030013

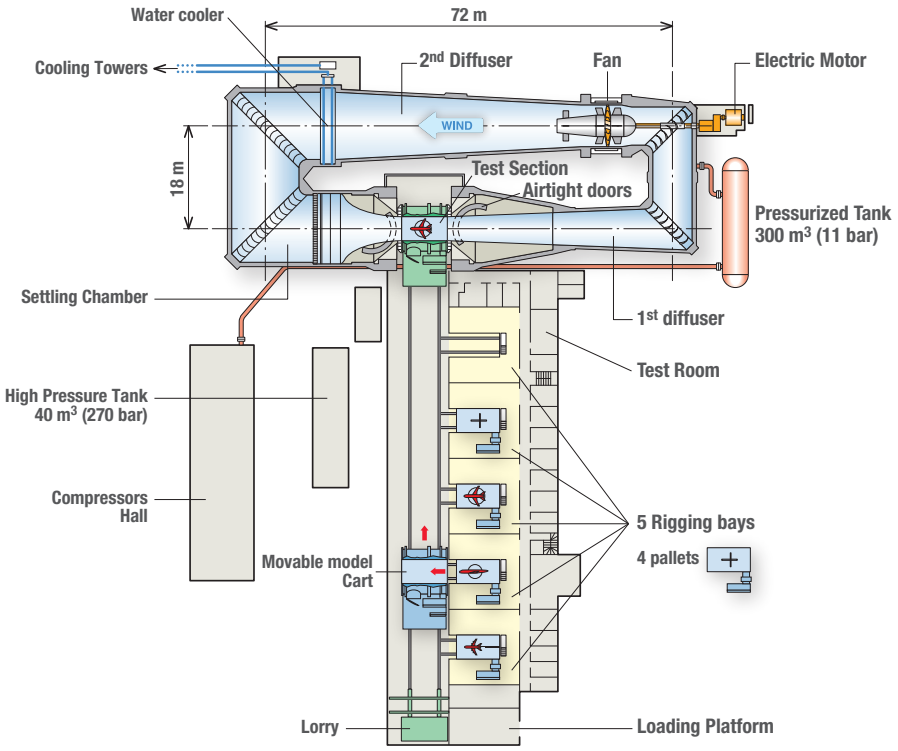
- Sting holder quadrant.
  - Main pitch range is -19° to 21°.
  - Secondary pitch angle of ± 10°.
  - Main ± 180° roll mechanism.
  - Secondary ± 180° roll mechanism to achieve ± 15° sideslip angles.


DSFM070063

Data acquisition and processing

- Test data are delivered real-time to the client representatives at the wind tunnel.
- Pressure acquisition with PSI® multi-sensors is available, and up to 2000 pressure taps can be acquired on a single model.
- Repeat polars, and daily checks of our data acquisition units are part of our quality procedures.
- Measurements are generally performed during continuous sweeps of a test parameter.
- Steady analogue measurements are captured on 48 channels (up to 144) with a 16-bit A-to-D converter and a digital filter.
- Data can be tuned to specific customer data acquisition requirements.
- A high-speed DAS with 48 (up to 96) channels at a sampling frequency of 25 kHz is available, using a 16-bit A-to-D converter and a digital filter.
- Real-time corrections for wall & support interferences are applied during data processing.

M17123-01



Quality Management

- Our Quality Management system is certified to be ISO 9001 compliant.
- High level of customer service.
- The ONERA wind tunnel division is committed to deliver the best service and value for money to its customers. Test matrices can be customised during the test itself, to maximise value to the customer.

Design office & workshop

- In-house model design and manufacture capabilities. Internal balances: 80 balances available and new ones designed and manufactured on request.

Confidentiality

- Secure site with card access, data and computer firewalls.

Productivity / Availability

- The F1 has productive design features.
- Individual test cart for model assembly and equipment, with dedicated carts for each setup, allowing rapid model installation and removal from the test section.
- Test section isolation doors to allow rapid model changes in pressurized conditions.

Photo credit:
© AIRBUS
© DASSAULT

ONERA Centre du Fauga-Mauzac
31410 Mauzac – France
Website : www.onera.fr/en/windtunnel
Tél. : +33 1 80 38 69 21
contact : ds-contact@onera.fr

ONERA
THE FRENCH AEROSPACE LAB

afaq ISO 9001 Qualité AFNOR CERTIFICATION