



Wind Tunnel Division

S2MA

Transonic & Supersonic Pressurized Wind Tunnel

Modane Avrieux Center

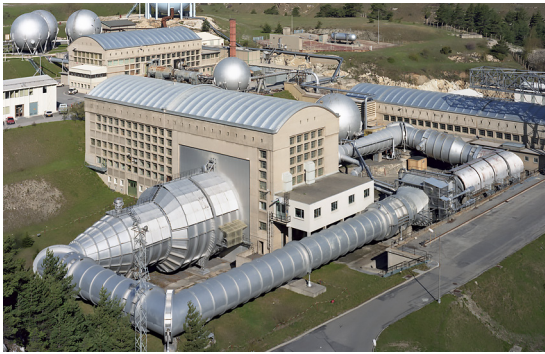
High productivity
Test capabilities over an extensive transonic and supersonic speed range
High levels of customer service

S2MA wind tunnel operation

Mach Number range: 0.03 to 3.0

Compressor driven by water power (up to 63 MW useable).

M940166-01



	Transonic Test section	Supersonic Test Section
X Section (h x w)	1.77 m x 1.75 m	1.935 m x 1.75 m
Mach Number Range	0.03 to 1.5	1.5 to 3.0
Total Pressure	0.2 to 2.5 bar	0.2 to 1.8 bar
Reynolds/Lref (max)	30.10 ⁶	20.10 ⁶
Total Temperature	from 293 K to 313 K	Up to 313 K

High productivity

- Individual confidential test preparation rooms for model assembly and preparation.
- Switching of test sections (from transonic to supersonic and visa-versa) performed in less than 2 hours, with no model disconnect.
- Fully automatic controls of all wind tunnel parameters, the model attitude (incidence, yaw and roll angles); and the data acquisition.

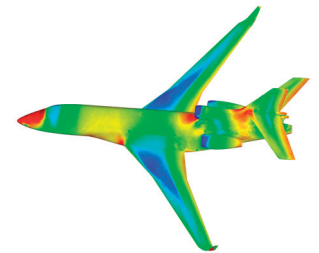
Performance

- Mach number stability during continuous incidence polars : ± 0.001 .
- At transonic speed, total pressure & total temperature are controlled within ± 1000 Pa and ± 1 K.
- Constant total temperature kept below 313 K depending on test conditions.
- Pressurized air supply available to the model, at up to 190 bar (for TPS, nozzle flow, etc.).

Measurement Techniques

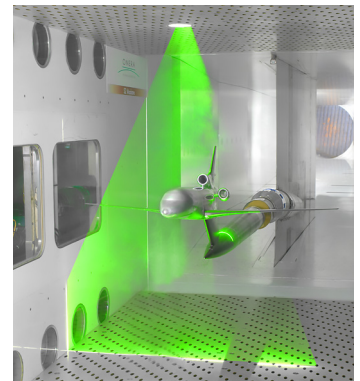
PSP

- Measurement of the pressure field on the wings, fuselage, HTP, moving surfaces, 360° viewing (accuracy in C_p : ± 0.02).
- Measurement of control surface local loads by pressure integrating methods.



PIV

- Wake, model near field (3C-system, on-line data processing - accuracy of 1% on the measured speed).



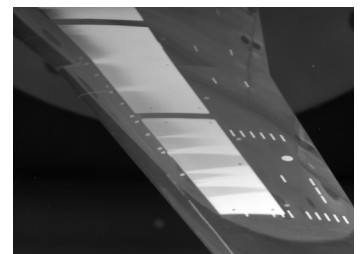
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MDM

- Model Deformation Measurement (in bending and twist) on all kind of wings including moving surfaces. Accuracy: $\pm 0.05^\circ$ for twist, ± 0.3 mm for bending.

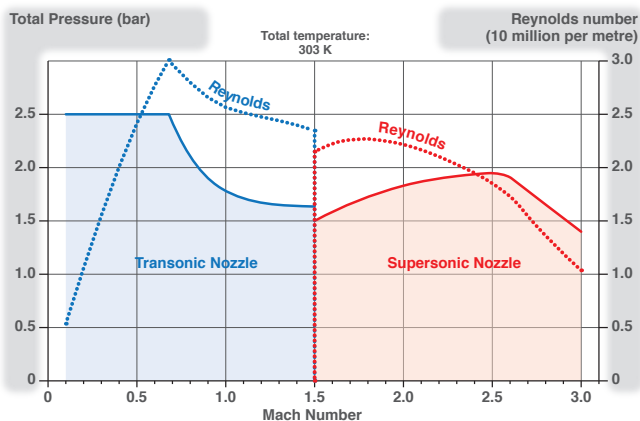
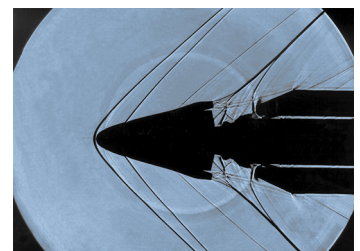
IR

- Visualisation of the transition of the boundary layer on wings with infra-red cameras. Efficient control of triggering devices for boundary layer transition.

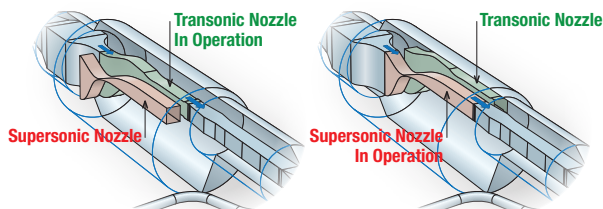


Visualisations

- Acenaphten, coloured oil techniques, shadow-graph method, fast video (4000 frames per second).



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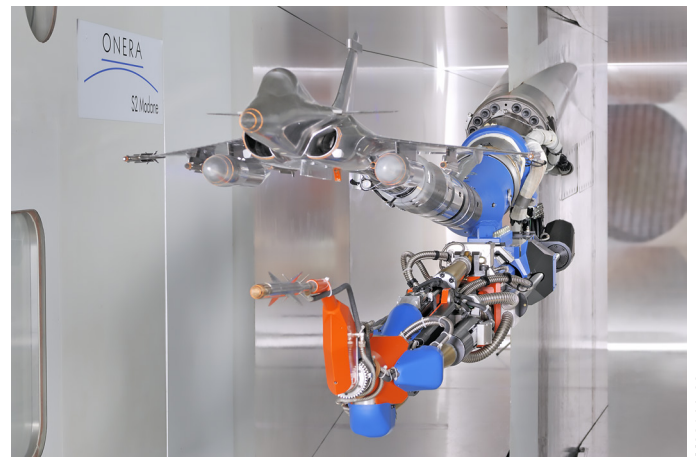
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Typical tests

- Transonic and supersonic tests performed on a single model in the same campaign.
- Simultaneous measurements of aerodynamics loads and steady and unsteady pressures.
- Store separation tests with Captive Trajectory System.
- Air Intakes, static and dynamic distortions.
- Flutter, buffeting and dynamic stability tests.
- Combat aircraft: loads, and air intake performance.
- Business jet: force and moment testing, control surface loads.



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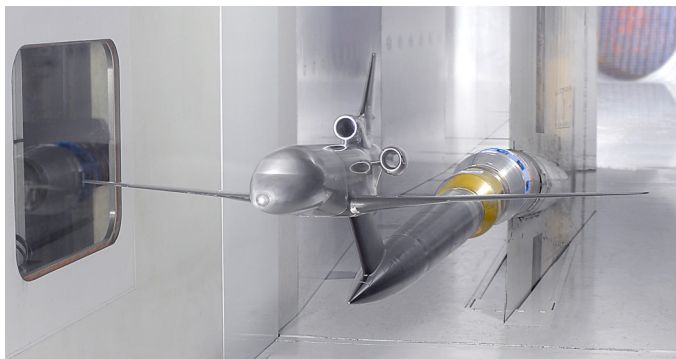
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- Missile tests. Rotating models with nozzle jets simulated with hot or cold gas.
- Launcher tests: nozzle flow simulated, booster separation.



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Model supports



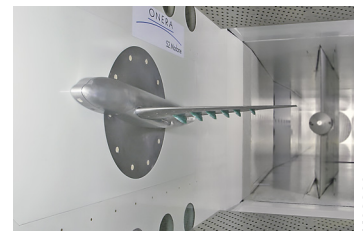
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- Sting holder sector with an incidence angle range of $\pm 12^\circ$ a rolling angle range of $\pm 180^\circ$.
- Large selection of model supports adapted to numerous types of tests (straight, fin, Z stings, etc.).

- Articulated motorized sting line to achieve an incidence or yaw angle range of -10° to $+25^\circ$.
- Mounting of half model on the side-wall balance in a motorized turntable ($\pm 180^\circ$).
- Motorized model support sting civil "Otarie" with a range of -5° to $+40^\circ$ in incidence and $\pm 11^\circ$ in yaw.
- Motorized model support sting military "Otarie" with a range of -5° to $+41^\circ$ in incidence and $\pm 11^\circ$ in yaw.



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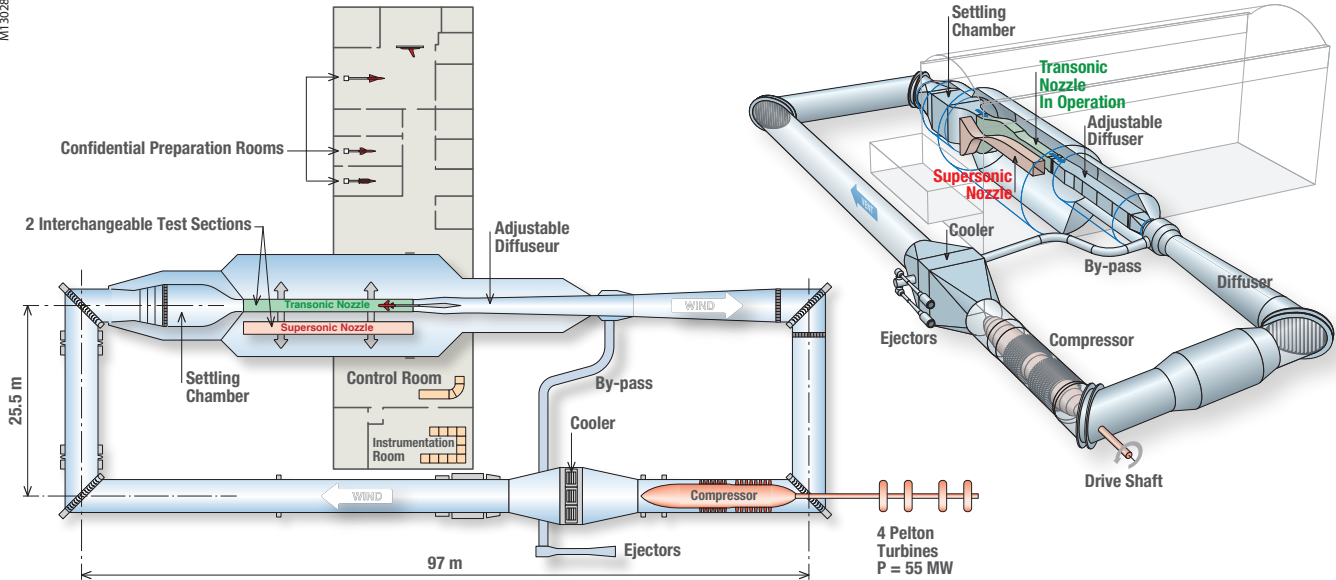
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Data acquisition and processing

- Static Data Acquisition System with digital filtering for 112 channels, extendable to 256 channels. Accuracy : 10^{-4} of FS, Static bandwidth: 0 to 10Hz.
- Real time corrections for wall and support interferences are applied to the data processing. Sting effects are assessed using CFD RANS calculations.
- Dynamic Data acquisition system with digital filtering for 64 channels, extendable to 256 channels. Sampling up to 100 kHz. Accuracy: 10^{-3} of FS. Dynamic bandwidth: 10Hz to 30kHz.
- Pressure data acquisition system using pressure scanners (PSI® systems), 992 channels, expandable to 1984 channels.



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.

Productivity / Availability

- Individual confidential preparation rooms for model assembly and equipment. Transonic, supersonic testing possible in a single campaign. Productive continuous polar testing. High Mach number stability assured.

Photo credit:

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Quality in measurement techniques

- New capabilities are being introduced as part of our continual improvement strategy.

Confidentiality

- Secure test preparation and testing sites with card access, data & computer firewalls.

Carbon footprint

- S2MA is a water driven wind tunnel.

Design office & workshop

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

