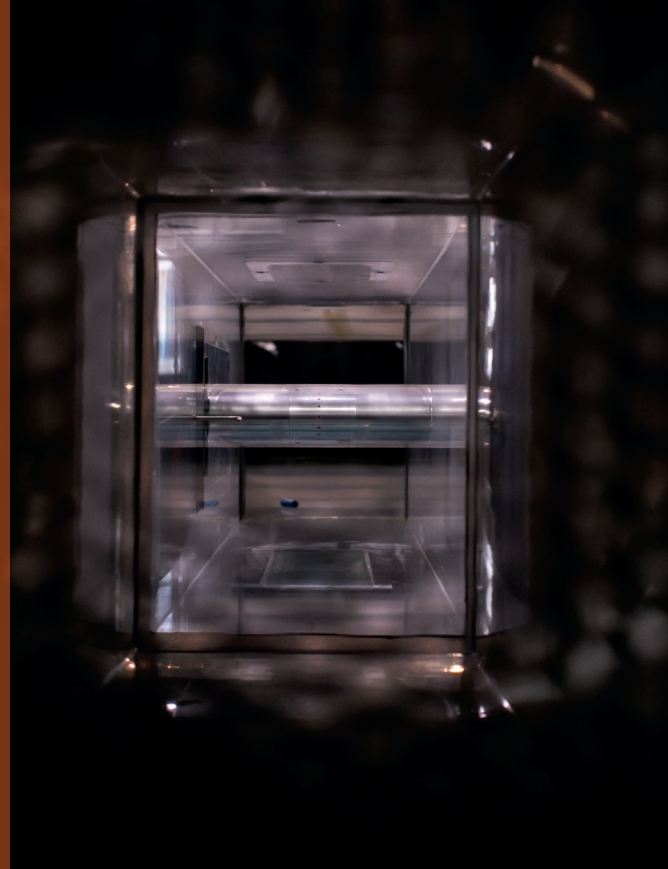




AERODYNAMIC LABORATORY

Laboratory for fluid dynamics
research activities



Laboratory Manager: Ing. Gabriele Campanardi

DIPARTIMENTO DI
SCIENZE E TECNOLOGIE AEROSPAZIALI

Description

The experimental aerodynamics laboratory is located in Building B14. It is provided with different wind tunnels of various dimensions and test regimes. The complete experimental equipment allows carrying out a wide range of tests.

Accredited Staff

Two technicians accredited ISO-IEC 17025 for anemometers calibrations.

Certifications

Anemometers calibration accredited by National Standard Accreditation Body.

References

Agusta Westland, Vulcanair, Oma Sud, CETENA Fincantieri.

Laboratory Manager

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Testing Equipments

- Low-turbulence closed-loop subsonic wind tunnel with 1x1.5m test section. 55 m/s max. speed. The wind tunnel is certified for anemometers calibration.
- Open-loop subsonic wind tunnel; 0.5x0.7m test section; 20m/s max. speed.
- Air duct to test porous screens with circular cross-section duct, 0.4m diameter. It's provided with a Venturi transducer compliant to ISO 5167-1 Standard.
- Open-loop subsonic wind tunnel for calibration of anemometric probes; 100m/s max. speed.
- Small impulsive hypersonic wind tunnel (up to Mach 10) to test small models (20mm test section diameter).
- Experimental rig for the simulation of dynamic stall phenomenon on helicopter blades.
- Experimental rig for micro wind turbines characterization.

Instrumentation & Facilities

- 2C/3C Particle Image Velocimetry measurement system. 200 mJ Nd: YAG laser and up to 2 Megapixel cameras.
- 2C Laser Doppler anemometer provided with 4W continuous argon laser.
- Hot wire measurement equipment: 6 measurement channels, wire and film probes for 1C, 2C and 3C measurements.
- Differential pressure transducers, uni-directional and bi-directional, ranges from 10 up to 10000 pa, accuracy up to 0.01 % FS.
- Kulite differential high sensitivity dynamic pressure transducers. 2 psi bi-directional range.
- Esterline DTC Initium pressure measurement system. Miniature electronics pressure scanners available with pressure ranges from 10 "wc up to 2.5 psi (bi-directional).
- Six components balances for aerodynamic loads measurements on aircrafts and ground vehicles models.
- High accuracy absolute pressure transducers.
- Temperature and relative humidity probes.
- Smoke and fog generators for flow visualization.
- High sensitivity digital camera.
- Multi-axis motorized linear guides.

Activities

Wind Tunnel Testing

- Measure of airfoils aerodynamic coefficient in static and dynamic conditions.
- Measure of forces and moments on scaled models of aircrafts and ground vehicles.
- Pressure measurements on external surfaces of scaled models or full scale items or components (hoods, cowlings, helmets, etc.).
- Sport aerodynamics wind tunnel testing.
- Real scale micro wind turbines characterization.

Flow field measurements

- Wake characterization.
- Two and three components PIV measurements.
- Mono, two and three components hot wire measurements.

Other activities

- Measure of porous screens pressure loss.
- Anemometers calibrations.



La.S.T.

La.S.T. is the transport safety lab
of the Department of Aerospace
Science and Technology



Laboratory Manager: Ing. Andrea Milanese

DIPARTIMENTO DI
SCIENZE E TECNOLOGIE AEROSPAZIALI

Description

The La.S.T. lab is divided in two main branches, passive and active safety. Research on passive safety began in the Department of Aerospace Science and Technology in the late '60s leading to the constitution of the first academic crash laboratory in Italy. Our mission is to improve transportation safety through numerical simulations and experimental activities.

Accredited Staff

Two technicians.
Responsible of the lab.

Certifications

UNI ISO17025, Accredia, FIA, EASA, UIM, ITALCERT, Dekra.

References

Agusta Westland, Mecaer Aviation Group, Alenia Aermacchi, ArcelorMittal, Snoline, Selex ES, Ansaldo STS, Audi Sport, OAK Racing, Orecar, HP Composites, Mygale, Tatuus, SPM, Ycom, Same Deutz-Fahr, Piaggio, Dekra, Brembo, Dallara.

Laboratory Manager

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Instrumentation & Facilities

- Horizontal sled, energy absorbing tests or deceleration tests.
- Vertical sled, material characterization and components testing.
- Vertical sled, systems and subsystems testing (e.g. landing gear).
- Drop tower, energy absorbing tests on hard soil and on water.
- Bird-Strike cannon, investigation of bird impact phenomena.
- Ballistic cannon, investigation of hailstone, bullets and debris impact phenomena.
- Static load testing, tests on components and subsystems under tension and compression loads.
- Mechanical test rig, static tests on structures (e.g. automotive frames, seats).
- DPI testing rig, tests and certification of DPI - PPE.
- Virtual testing, development of FE models and numerical simulations.

Activities

Horizontal sled

- Tests on restraint systems.
- Crash tests on absorbing structures (e.g. racing cars nose cone).
- Crash tests with cars, motorbikes and railway absorbing structures.
- Tests on systems and subsystems under dynamic loads (e.g. seats).
- Tests on road safety barriers.

High energy vertical sled

- Development and certification tests on landing gears.
- Endurance tests on systems and subsystems.

Drop tower

Drop tests on water and rigid soil of different systems and subsystems:

- Fuel tanks.
- Helicopter subfloors.
- Absorbing structures.
- Rockfall protection.

Static load testing

- Compression and tensile tests on specimens of different materials.
- Tensile tests on bolts.
- Bending tests on different components or subsystems (e.g. road safety barriers).

Bird-Strike cannon

Impact of bird surrogates or large objects (e.g. stones) on different systems and subsystems:

- Nose cone.
- Spinner cone.
- Canopy.
- Leading edge.
- Railway vehicle subsystems.
- Other components or subsystems.

Ballistic cannon

Impact of hailstone, bullets and debris on different objects:

- Panels.
- Helmets.
- Aeronautical components.
- Satellite shields debris.

Mechanical test rig

- Static tests on racing car frames and roll-cages.
- Static tests on aeronautical seats.
- Static test on different systems and subsystems.

DPI testing rig

- Tests and certification of climbing harnesses.
- Tests on other Personal Protective Equipment (PPE - DPI).

Virtual testing

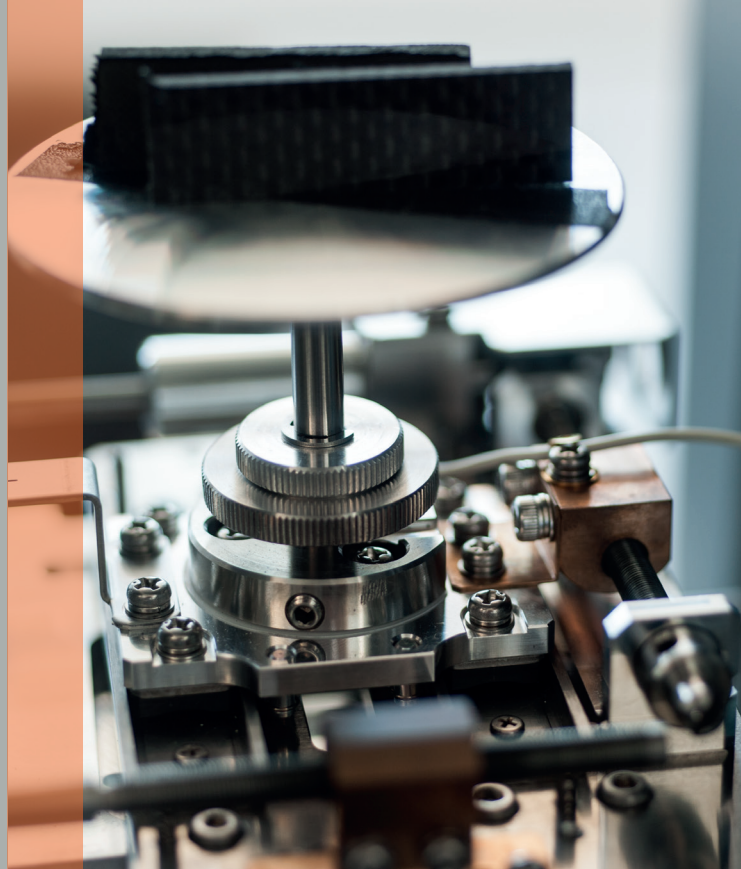
- Numerical simulations are used for different purposes:
- To predict results of experimental tests.
- To verify the behavior of different technical solutions.
- To extend results of experiments to conditions difficult to achieve in normal experimental tests.





EXPERIMENTAL TEST LABORATORY

The laboratory is able to
accommodate testing of
aeronautical and space structures



Laboratory Manager: Ing. Paolo Rubini

DIPARTIMENTO DI
SCIENZE E TECNOLOGIE AEROSPAZIALI

Description

The laboratory is able to carry out several kinds of tests: from characterization tests on simple material coupons to full-scale tests on complete structures, i.e.:

- Material static, dynamic and fatigue characterization tests.
- Static tests; buckling tests; modal analysis tests; fatigue tests.
- Noise active control measure tests; low-energy impact tests.

Accredited Staff

- N° 2 technicians, Level 1 Certificate in the installation of strain gages.

Certifications

- Work in progress on UNI ISO 17025;
- Tensile Properties of Composite Materials ASTM D 3039 - 08.

References

AgustaWestland; Alenia Aermacchi; Brembo;
CGS; ADS International; Sinteal Plustek.

Laboratory Manager

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Instrumentation & Facilities

- MTS uniaxial servo-hydraulic, load from 15 to 250 kN, temperature from -129 to +316 °C.
- INSTRON uniaxial electromechanical, load 10 to -10000 N, temperature -100 to +350 °C.
- TA DMTA (Dynamical Mechanical Thermal Analysis), temperature -140 to +600 °C; frequency 0.001 to 100 Hz.
- Rheometrics RDAII rheometer, temperature -140 to +450 °C; frequency. 0.001 to 70Hz, shear rate 0.001 to 1000 s⁻¹, torque 2 to 2000 gcm.
- TA AR2000 rheometer, temperature -140 to +550 °C; frequency. 0.001 to 100Hz, shear rate 0.001 to 1000 s⁻¹, torque 0.2 to 2000 gcm.
- TA DSC (Differential Scanning Calorimetry), temperature -50 to +350 °C.
- Mettler TMA (thermo-mechanical analyzer), temperature -100 to +550 °C.
- LMS dynamics test system, Scadas III I/O hardware, electrodynamics exciters, accelerometer and instrumented hammer, piezoelectric load cells.
- Hitachi TM 3000, SEM microscope up to 30000 magnifications.

Activities

Material characterization tests, (MTS, Instron)

- Tensile test (ASTM D3039).
- Compressive test ASTM D3410).
- Flexural test (ASTM C293).
- In-plane shear test (ASTM C273).
- Lap-shear test (ASTM D1002).
- Bearing test (ASTM D5961).
- Short-beam strength (ASTM D2344).
- Mode I Interlaminar.

Thermal characterization, (DSC)

- Degree of polymerization (ASTM D3418).
- Glass-transition temperature T_g, melting point T_m, Crystallization T (-50°C/+350 °C) (ASTM D7426).

Thermo-mechanical analysis, (TMA)

- Coefficient of thermal expansion (ASTM E 831).

Dynamical Mechanical Analysis, (DMTA, RDAII, AR2000)

- Storage Modulus and Loss Modulus by flexural tests (ASTM D5023 – ASTM D5418).
- Shear Storage Modulus and Shear Loss Modulus by torsional tests (ASTM D4065).

Viscosity measurements, (RDAII, AR2000)

- Dynamic viscosity curve (plate or Couette geometry) (UNI EN ISO 3219/ISO 6721).
- Complex viscosity curve (plate or Couette geometry) (UNI EN ISO 3219/ISO 6721).
- Brookfield viscosity.

Dynamics tests, (LMS)

- Modal analysis tests.
- Noise and vibration measurement tests.



SP-LAB

Space Propulsion Laboratory



Laboratory Manager: Mr. Giovanni Colombo

**DIPARTIMENTO DI
SCIENZE E TECNOLOGIE AEROSPAZIALI**

Description

The scientific activity has mostly been devoted to fundamental combustion problems of solid-phase energetic materials, from both experimental and theoretical viewpoints, with specific attention to: steady burning rates and temperature profiles, radiant ignition. Static and dynamic extinction, non-steady burning, linear and nonlinear intrinsic stability, radiation assisted/augmented burning, deflagration limits, frequency response functions, transient flame modelling. In the more recent years, interest has moved to combustion of innovative high-energy condensed materials, nano-energetics for propulsion, performance of metallized formulations, aggregation and agglomeration, dual metal formulation, quasi-steady regression rates, solid and hybrid rocket motors, space launchers, in-space propulsion.

Accredited Staff

N° 1 technician

References

AVIO Space Propulsion, MBDA, MACH-I, Sibthermokim. SPLab takes an active part in international, scientific and educational programs and cooperates with DLR, CNES, Tomsk Polytechnic University, Omsk State Technical University, and other universities and research centers of Russia, USA, Japan and leading European countries involved in aerospace science and technology.

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Laboratory Address

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Testing Equipments

- Test Chambers for Characterization of Combustion of Energetic Materials at Constant Pressure.
- Fast Depressurization Facility for HEMs combustion.
- Sub atmospheric Test Facility for HEMs Combustion.
- Set-up for manufacture of micro-thermocouples
- Pt-Pt/Rh (range from 50 to 12 micron).

Instrumentation & Facilities

- High Speed Videocameras:
PHOTRON – FASTCAM Ultima APX
FASTVIEW – F13
- Acoustic Mixer RESODYN – LABRAM
- CO2 Lasers:
Advanced Kinetics – 100, 120W CW
Valvire – 200, 180W CW
El.En. BLADE – 500, 400W CW
Nd-YAG Baasel, 30W
- TGA/DTA SII-EXSTAR6000 Seiko Instr.
- Diffraction Granulometer MALVERN
MASTERSIZER-2000
Scirocco 2000 Dry Powder Dispersion Unit
Hydro-2000-S Wet Sample Dispersion Unit

Activities

High Energy Density Materials Characterization

- Burning Rate Measurement of High-Energy Materials (HEMs).
- Improvement of Ageing Behaviour of HEMs and Metals.
- Nano-sized ingredients characterization.
- Formulation Development of Advanced Solid Fuels and Propellants.
- Frequency Response Function.
- Dynamic Extinction.
- Pressure Deflagration Limit.

Powder Characterization

- Optical Microscopy Morphology.
- Laser Diffraction Granulometry.

Metal Combustion and Oxidation

- Ignition Temperature.
- Metal Powders Agglomeration Phenomena.
- Dual Metal Characterization.
- Activated Powders.

Coatings

- Particle Coating Functionalization.
- Nanomaterial-Based Complexes.

Fast Visualization and Image Processing

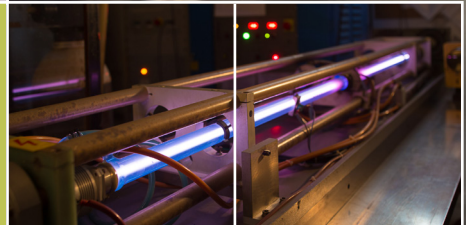
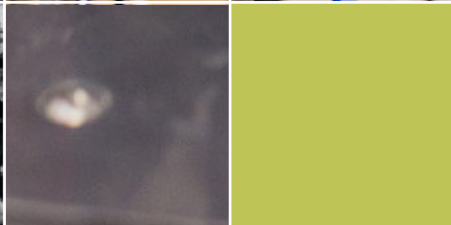
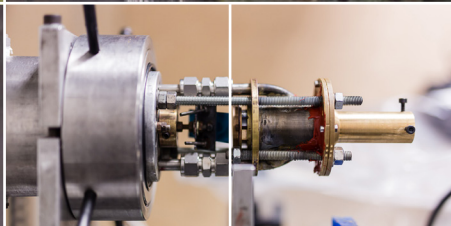
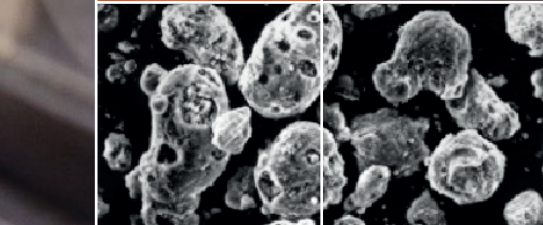
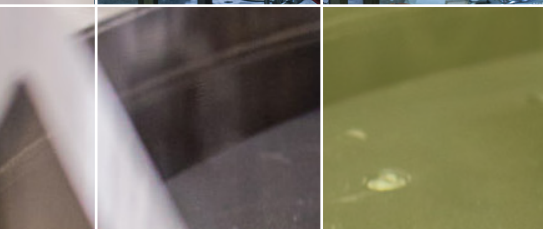
- Agglomeration Phenomena During Combustion of HEMs.
- Non Intrusive Video Techniques for Burning Rate Measurement.

Thermal Analysis

- DSC and TGA Analyses on HEMs.

Thermal Imaging

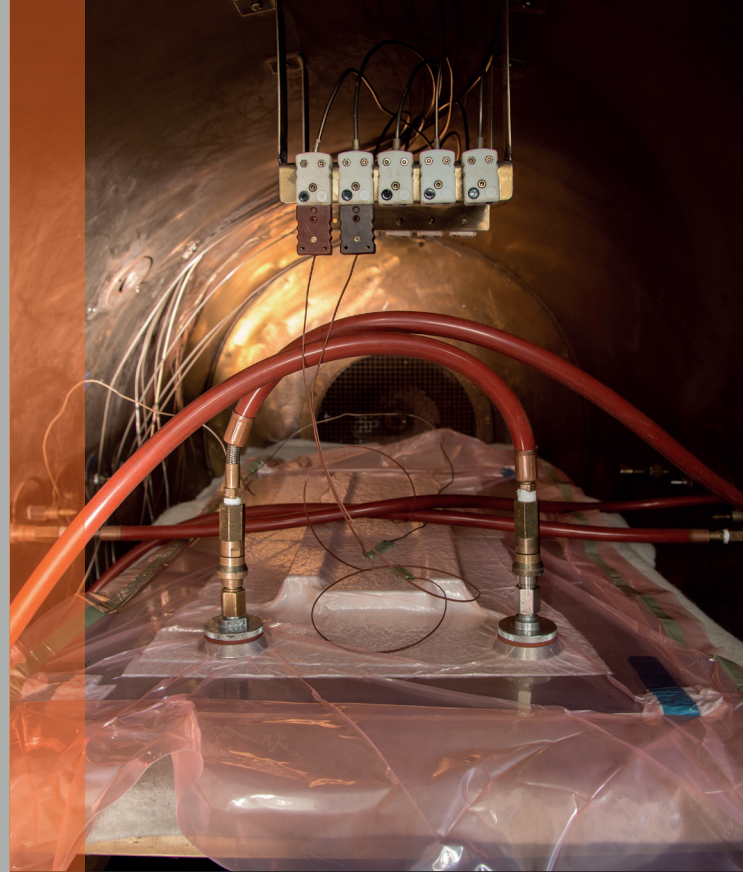
- Thermal Protection Emissivity.





TECHNOLOGICAL LABORATORY

Tech Lab is the structure which deals with the manufacture of components and equipments



Laboratory Manager: Ing. Silvio Ferragina

DIPARTIMENTO DI
SCIENZE E TECNOLOGIE AEROSPAZIALI

Description

Tech Lab is divided into three main areas:

- Conventional technological processes.
- Composite and SMART Structures.
- Non-Destructive testing.

Area 2 is able to produce components and structures made of composite materials, through filament winding or clean room lamination plus autoclave, oven or heated-platen press curing. Area 3 evaluates the properties of a component without causing damage.

Accredited Staff

N.1 qualified technician to optical stereo-microscopy.

References

Most of the laboratory work is done toward departmental research.

Laboratory Manager

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Instrumentation & Facilities

- 5-axis CNC machining centre.
- Autoclave (450 °C, 16bar, 1m diameter, 2.5m length)
- 100.000-class clean room (-18 °C refrigerated warehouse).
- Curing oven (200 °C, 1x1x5m dimensions).
- 3 d.o.f. filament winding machine (mandrel 5m long)
- Heated-platen press (200 °C, 10bar, 0.5x0.5m platens dimensions).
- Optical stereo-microscopy (magnification range 10X-120X) provided with digital image analyzer.
- Immersion transmission and time-of-flight ultrasonoscopy (1.5x0.8x1.0 tank dimensions).
- Opaque-enhanced dye penetrant stereo-radiography (voltage 70 keV, 0.4 beryllium focal spot).
- Thermography (spectral range 3-5_μm, temperature range from -20 to +250 °C).

Activities

Design, modeling and production, with dedicated software, on specifications provided

Manufacturing of components, semi-finished products, and tools in the mechanical and aerospace sector using:

- Traditional processing techniques typical of metallic materials.
- Processing techniques typical of composite materials (autoclave, curing oven, heated-platen press or 3 d.o.f. filament winding machine).

Manufacturing of scale prototypes for wind gallery testing

Manufacturing of equipment for the implementation of structural tests

Manufacturing of equipment (molds) in order to obtain parts in composite materials

Manufacturing of specimens for characterization tests (metallic and composite materials)

Polymerization cycles for composite materials (autoclave, curing oven or heated-platen press)

Non-Destructive tests (stereo-radiographic and thermographic analyzes, penetrating fluids)