

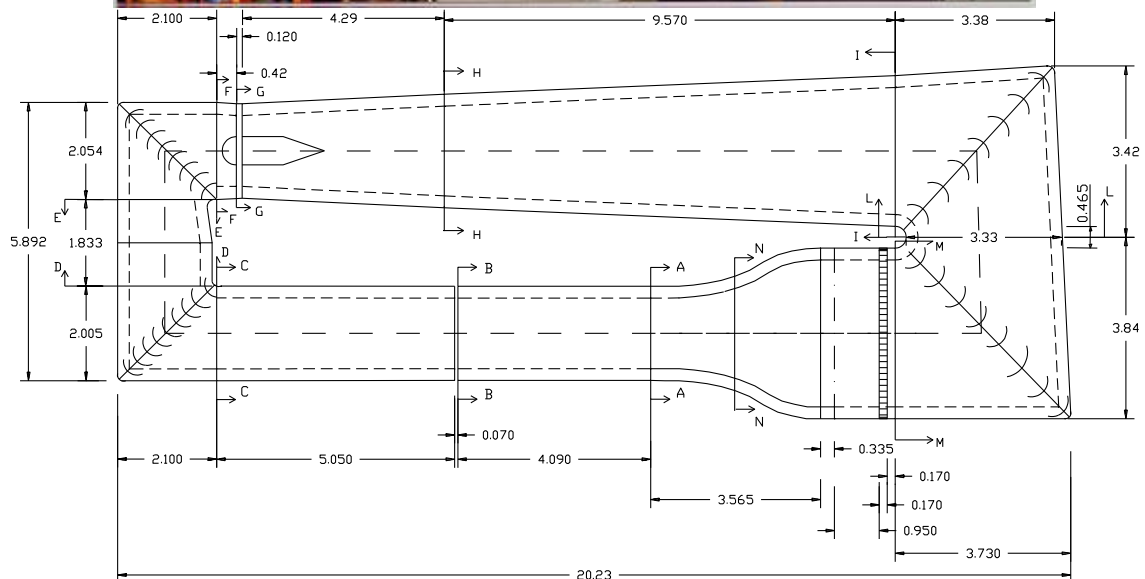
# LOW-SPEED WIND-TUNNEL FACILITY

Department of Industrial Engineering  
University of Naples "Federico II"  
Via Claudio 21, 80125 Napoli

Scientific Responsible  
Prof. Fabrizio Nicolosi [fabrnico@unina.it](mailto:fabrnico@unina.it)



DAF Research Group  
[www.daf.unina.it](http://www.daf.unina.it)



The UNINA Aircraft Design and Flight Technologies group (DAF , [www.daf.unina.it](http://www.daf.unina.it) ) is operating and managing the main low-speed wind-tunnel facility belonging to the Industrial Engineering Department. The Low-speed wind-tunnel is characterized by a test section with dimension of 2m (width) x 1.4m (height), with a maximum speed of about 50m/s. The Reynolds number that can be achieved on 2D airfoil models is between 1.4 and 2.2 million. Concerning 3D aircraft model, the test Reynolds number referred to mean wing chord is usually under 1 million. With 3D semi-models, the achievable Reynolds number is about 1.5-2.0 million. The research group (which usually operates all research activities dealing with this main low-speed wind-tunnel) has matured a strong in performing wind-tunnel tests, dealing with correct test procedures and corrections. More than 15 airfoils for light aircraft and other civil applications were tested. Experimental aerodynamic campaigns have been conducted on more than 15 scaled models of light aircraft and general aviation aircraft in the same tunnel. Since 1998 F. Nicolosi is responsible of wind-tunnel tests at the Department for Tecnam aircraft testing. Tests have been conducted on Tecnam models of P92, P96, P2000RG, P2002, P2006, and recently on P2012 aircraft. Wind-tunnel tests have been also performed for G97 Spotter, Easy Fly STOL Ultralight, P1XX business jet (Piaggio), SkyCar (OmaSud), K4A light Helicopter.

### **Technical Characteristics**

Type: *closed circuit-closed test section*

Test section dimensions : 2.0 m x 1.4 m

Maximum speed : about 160 Km/h (45 m/s)

Turbulence level : 0.1%

Temperature range : 10-50 °C (during test the air temp increase)

Speed range : 5-45 m/s

Reynolds number : 1 - 2 mil. For airfoil 2-D tests (see below). Usually about 0.9 – 1.0 mil. For 3D model tests (chord of about 0.25 m)

Dynamic Pressure : 15 – 1200 Pa

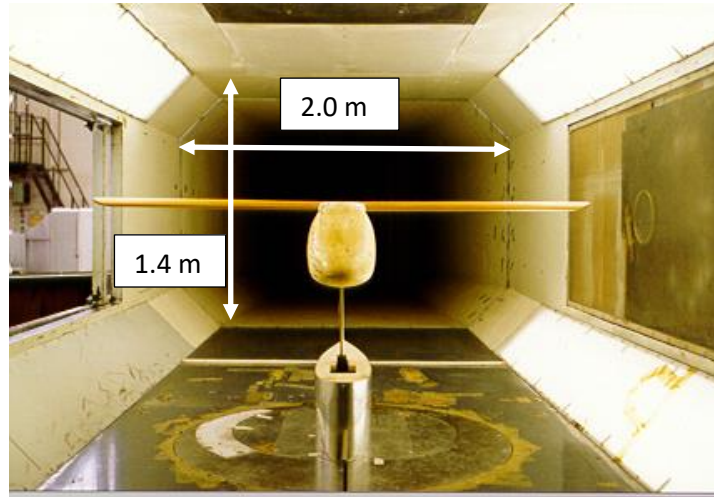
Stagnation pressure : Dyn press + ambient pressure (about 103500 Pa + q = 104700 Pa)

Operational status : In operation

Testing capabilities :

- 2-D airfoil model tests (with application of suction at wall junction). Pressure measurement and wake measurement for CD extraction.
- 3-D aircraft scaled model test. Model span up to 1.7 m. Model chord about 20-30 cm. Aerodynamic force measurement through straining gauges balances. Possibility to measure also pressure on the body through several pressure taps.
- 3-D semi-model tests. Aerodynamic forces measurement through an external 4-component balance. Possibility to have also pressure acquisition through pressure taps.

- Drag and lift measurement of particular bodies (i.e. reentry capsule).
- Flow-visualization



## Equipment

The main wind-tunnel is equipped with several instruments for pressure acquisition (on 2-D airfoil models) and force measurements (3D model tests).

In particular :

- ADVANCED OPTICAL PRESSURE MEASUREMENT SYSTEM (100 channels)
- SCANIVALVE 128 channel electronic pressure measurement system
- SMOKE GENERATOR
- FLUORESCENT OIL FLOW VISUALIZATION SYSTEM
- UPPER AND LOWER WALL SUCTION SYSTEM
- LONGITUDINAL AND LATERAL-DIRECTIONAL STRAIN-GAUGE INTERNAL BALANCES
- LONGITUDINAL BALANCE FOR WALL-SUPPORTED SEMI-MODEL TESTS
- PIV system

## Activities

The wind-tunnel is extensively used for 2D airfoil tests and for 3D tests performed on aircraft model or on semi-model (wall supported). All the pressure acquisition systems are used for 2D tests in order to acquire pressure distribution on the airfoil model (through several pressure holes) and total pressure distribution in the wake (to evaluate airfoil drag).

Tests have been performed also on airfoil models to test separation control and reduction through boundary layer suction/blowing.

Extensive activity is related to 3D aircraft model tests. More than 20 light and general aviation aircraft model have been tested in DPA Main wind-tunnel in the last 20 years. Tests includes measurement of longitudinal and lateral directional aerodynamics coefficients, pressure measurements on model surface and wake survey, flow visualization (oil, tufts, smoke, etc).

The wind-tunnel is also used for tests of non-aeronautical components like: sail model, boat appendages models, model of buildings, heat exchanger for train, etc.

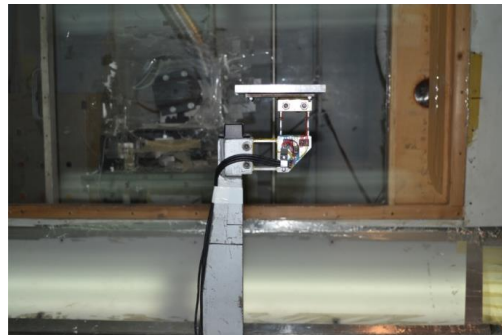
The wind tunnel is also used for horizontal and vertical axis wind-turbine model tests.



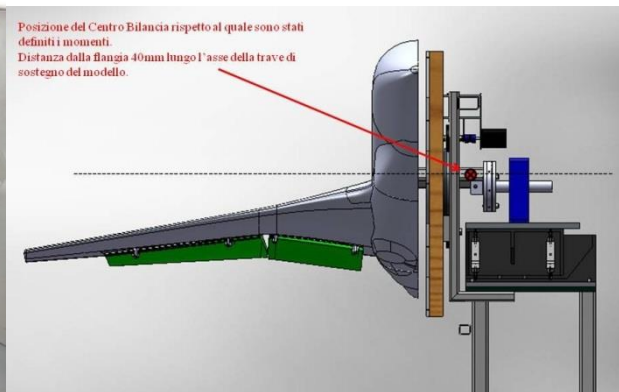
**Airfoil 2-D tests**



**Aircraft 3-D model tests**



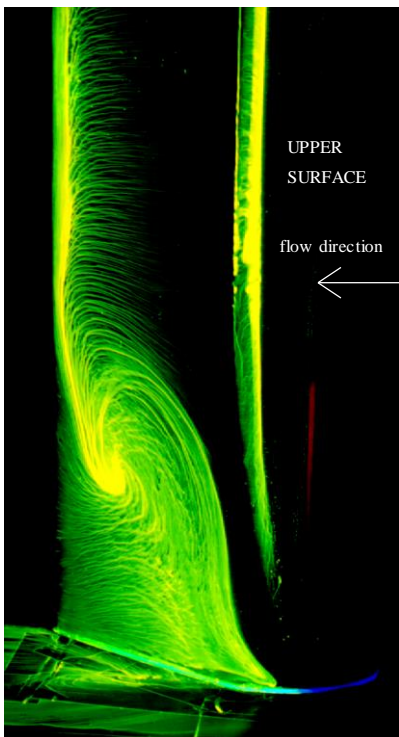
**Strain-gauge internal balance**



**Aircraft 3-D semi-model tests**



Flow visualization through tufts (stall path detection)



Flow visualization through fluorescent oil  
Vortex on a 2-D airfoil (left), laminar separation bubble (right)



**Wake Visualization through smoke generator**



**Wind - tunnel tests of a light helicopter model**



**Wind - tunnel tests of a re-entry capsule**