Experimental Aerodynamics Division
R&D Profile: 1995-2005

1.5m Low Speed Wind Tunnel / L1

Working section
1.5m x 1.5m

Operation
Open circuit

Velocity range
10 - 50 m/s

Reynolds number
0.5 x 10^6 to 3 x 10^6 per meter

Model incidence / side slip
-25° to 25° / -30° to 30°

0.3m Trisonic Wind Tunnel / H3

Working section
0.38m x 0.30m (subsonic & transonic)
0.30m x 0.30m (supersonic)

Operation
Intermittent blow down

Mach number range
0.3 to 4.0

Reynolds number
8 x 10^6 to 44 x 10^6 per meter

Model Incidence
-10° to 10°

Test duration
20-30 secs

0.5m dia Base Flow Wind Tunnel / H4

Working section
0.52m dia

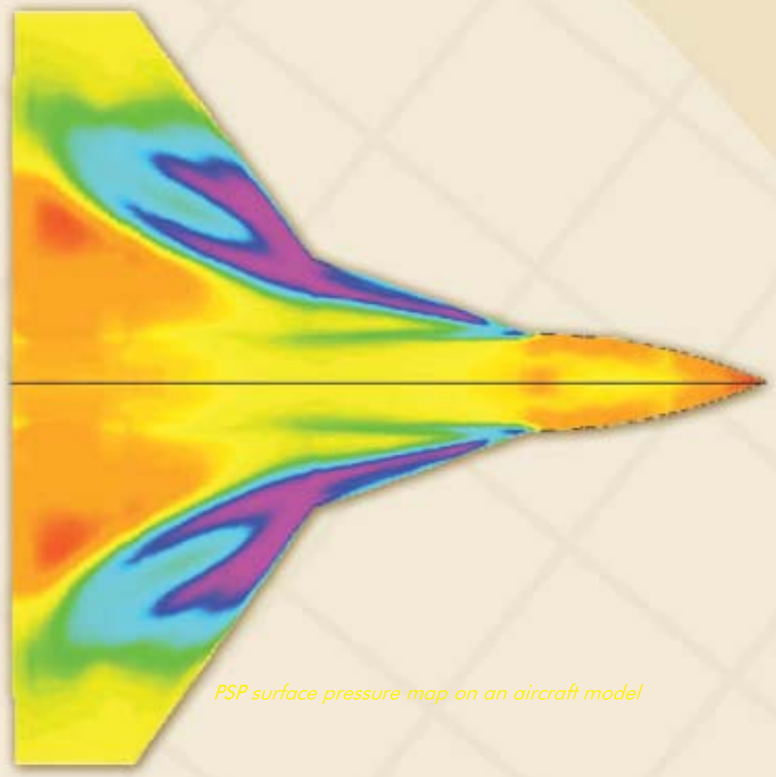
Operation
Intermittent blow down

Mach number range
0.40 to 3.50

Reynolds number
10 x 10^6 to 50 x 10^6 per meter

Model support and diameter
By nozzle inner body, 127mm

Test duration
20-30 secs.



PSP surface pressure map on an aircraft model

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Major emphasis in the Experimental Aerodynamics Division

To understand the physics of complex flows by the use of advanced flow diagnostic tools and to generate aerodynamic data for the development and improvement of aerodynamic design concepts and flow modeling.

Areas of focus and strength

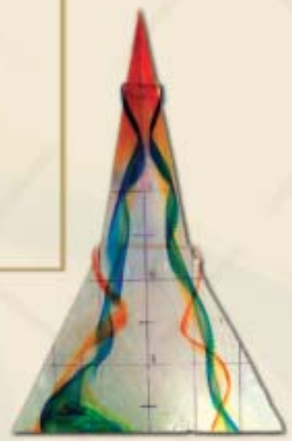
- Aerodynamic research
- Advanced flow measurements
- Aerodynamic data generation

R&D disciplines

- Flow structure and management
- Flow diagnostics and applications
- Aircraft and spacecraft aerodynamics

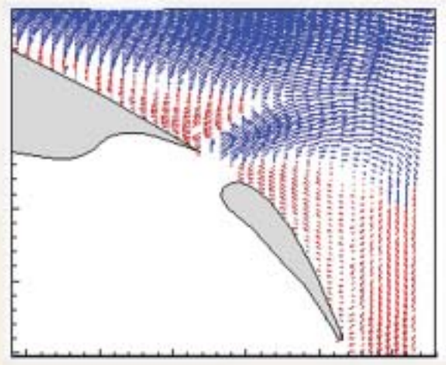
The experimental R&D investigations are carried out in three major facilities (1.5m x 1.5m low speed wind tunnel, 0.3m trisonic wind tunnel and 0.5m base flow wind tunnel) which are well suited and have the necessary state of the art instrumentation for measurements; a 0.3m water tunnel is also available for flow visualization studies.

The R&D problems being addressed are chosen relevant to the aerospace projects in the country. In the area of flow structure and management, some of the problems that have been investigated include vortex dominated flows on wings and bodies, drag reduction methodologies, boundary layer transition and relaminarization, separated flows and control and certain aspects of high-lift aerodynamics relevant to civil aircraft like SARAS. Flow control, employing both passive and active methods, has been an inseparable ingredient of our research. The aerodynamic research is significantly assisted by the development and application of novel flow visualization and flow diagnostic tools employing laser-based systems and image processing: some of the recent activities include use of pressure sensitive paint (PSP) technique, 2D and stereo particle image velocimetry (PIV), background oriented Schlieren (BOS) technique and laser Doppler velocimetry (LDV) for data generation and for understanding complex flows. In the discipline on aircraft and spacecraft aerodynamics, the emphasis has been in the topics of high speed intakes, slender body aerodynamics, afterbody and base flows of axisymmetric bodies, including jet flow effects.

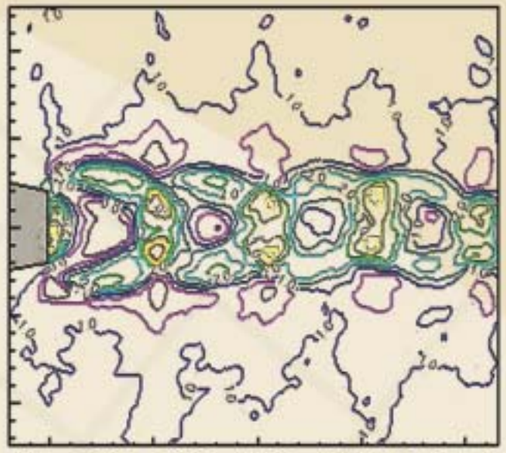


Dye flow visualization on a double delta wing

Propeller thrust measurements on an aircraft model

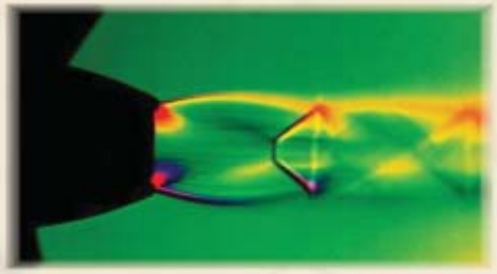


PIV measurements on a wing-flap configuration



Density field in a sonic jet using BOS technique

Colour Schlieren photograph of high speed intake flow



Colour Schlieren photograph of sonic jet flow

Streamlined KSRTC bus

In addition to research, over the years, the Division has contributed significantly to aerodynamic data generation relevant to the national aerospace projects (sponsored by ADA, DRDL and VSSC) in the different wind tunnels.

Aerodynamic streamlining of a transport bus for enhancing fuel efficiency was successfully carried out in a spin off activity.

Some of the current R&D topics include:

Lift augmentation using Gurney flaps and by separation control, wing-tip devices for drag reduction, application of PSP technique to supersonic flow problems, phase-averaged 2D PIV measurements, exploratory studies on a seedless PIV technique, density measurements in complex flows using BOS technique, intake flows relevant to high-speed airbreathing propulsion systems and simulation of afterbody and base flows relevant to complex launch vehicle systems.

New Initiatives

Experimental aeroacoustics is a new activity launched recently with the aim of gaining expertise is this emerging and important area. As a first step, a small research aeroacoustic jet facility is currently under development in order to address R&D problems like aeroacoustics of single and multiple jets and aspects of noise reduction, aeroacoustics of impinging jets etc.; the facility can be also be exploited for flow investigations employing advanced diagnostic tools. The Division is also making a beginning in the topic of low Reynolds number aerodynamics relevant to MAVs.

Over the last decade, the Division has gained considerable strength and expertise in carrying out research in a variety of topics in aerodynamics and also in the application of advanced flow diagnostic tools to complex flow problems; numerous scientific papers have been published in international journals and conferences. The Division has also successfully carried out research for international agencies like the Boeing Commercial Airplane Co (USA) and Daimler Chrysler Aerospace (Germany).