

Director's message

Hiroki Nagai

Director of Advanced Flow Experimental Research Center
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The Institute of Fluid Science (IFS) promotes world-class fluid science research by utilizing cutting-edge research facilities. The knowledge gained from these facilities has served to push the boundaries of fluid science and is widely used to lead various industrial sectors.

Our Advanced Flow Experimental Research Center (AFX) was established in April 2013 to create next-generation flow experiment technologies through R&D by utilizing low-turbulence wind tunnels and shock wave facilities. The AFX manages its operational management to ensure that the facilities are available to both academics and industries.

In the 21st century, the R&D of environmentally friendly technologies and products is crucial to achieving a sustainable society. Thus, improvements in aerodynamic performance and wind resistance will contribute to environmental issues and energy conservation. We hope that our facilities, with a variety of speeds, will be used in your next product development and design.

From breath (5m/s) to atmospheric re-entry speed (6km/s)

From gentle breezes to atmospheric re-entry speeds, our facilities make it possible, as our wind tunnels are equipped to handle low-speed flows within the incompressible regime, while our shock wave facilities provide high-speed flows, allowing phenomena in the compressible regime to be observed.

Please feel free to contact us.

Consultation is free of charge. We also provide R&D support in problem-solving through establishing connections and collaboration with other research institutes.

Company

New product
(High performance,
Low noise etc.)
product deficiency

Issue Extraction



AFX

Planning
test support, instruction
Search for applicable
institutions

Solution proposal

joint research
Facility use
Refer applicable
institutions

Frequently asked questions

Is it possible to use without any prior knowledge of wind tunnel testing?

Yes, our technical staff will provide guidance to you from the design of the experimental model to measurements. We accept "Entrusted use", in which our staff will conduct your experiment at Tohoku University. We also welcome "joint research" and "sponsored research" based on more specialized knowledge. Please contact us at first. Consultation is free of charge.

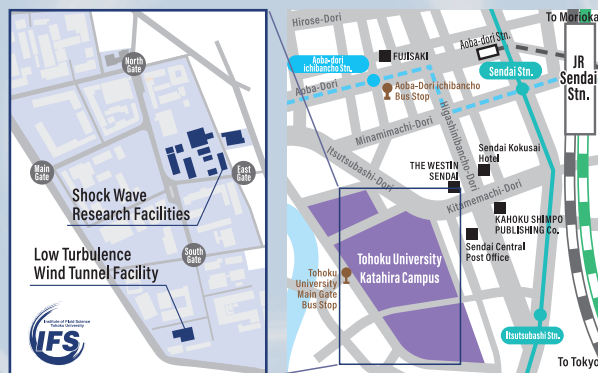
How does the fee expense?

This differs by facility, equipment, and amount of support required. The fee structure is available at the Tohoku University Research Infrastructure Portal (<https://portal.cfc.tohoku.ac.jp/>). For more details, please contact AFX.

Will Confidentiality be protected?

You can construct a Non-Disclosure Agreement (NDA). However, we would appreciate your cooperation in disclosing as much information as possible that does not fall under confidential information, such as company names and an outline of your experiment, to promote the use of our facilities.

Access



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Shock Wave Research Facilities Phone: +81-22-217-5037
Low Turbulence Wind Tunnel Facility Phone: +81-22-217-5898

AFX Overview and User Guide

Advanced Flow Experimental Research Center
Institute of Fluid Science, Tohoku University

http://www.ifs.tohoku.ac.jp/jpn/afx_index.html



Introduction of affiliated institutions and shared facilities

Experimental and Computational Fluid Dynamics
Sharing Consortium

<https://www.ifs.tohoku.ac.jp/jpn/nagare/>



Advanced Flow Experimental Research Center

Institute of Fluid Science, Tohoku University

Low Turbulence Wind Tunnel Facility
Shock Wave Research Facilities



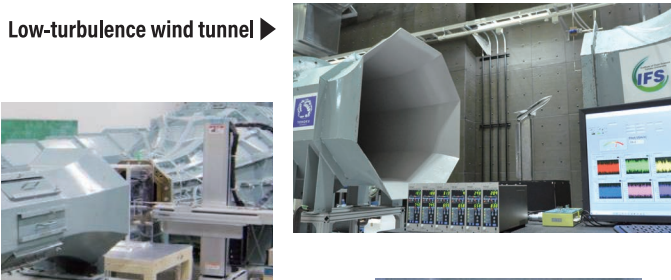
東北大学流体科学研究所
Institute of Fluid Science, Tohoku University

World-class performance wind tunnel facilities available to everyone

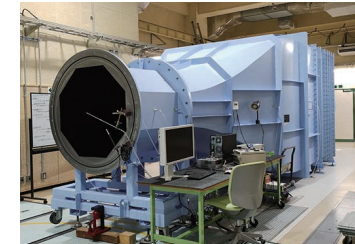
Our low turbulence wind tunnel facility was established in 1975 with a variety of wind tunnels. Our main wind tunnel, which is a low-turbulence heat transfer wind tunnel, can achieve a maximum wind speed of 80 m/s with a remarkable low turbulence intensity of less than 0.02%*. We also have several other facilities, such as a small low-turbulence wind tunnel for the development of measurement technologies, a small low-noise wind tunnel for wind noise research, and a blowdown wind tunnel. These wind tunnels are used for a wide range of purposes, from academic research, such as laminar-to-turbulent transition, to industrial product development.

* below 50m/s with the closed test section

Low-turbulence wind tunnel ▶



▲ Small low-turbulence wind tunnel



▲ Small low-noise wind tunnel

◀ Blowdown wind tunnel

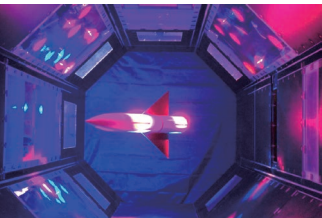
		Low turbulence wind tunnel	Small low turbulence wind tunnel	Small low noise wind tunnel	Blowdown wind tunnel
Type		Return type	Return type	Suction type	Blowdown type
Test section	Closed	Octagonal cross-section; length 3.5m, width 1.01m	Octagonal cross-section; length 1.0m, width 0.29m		
	Open	Octagonal cross-section; length 1.42m, width 0.81m	Octagonal cross-section; length 0.53m, width 0.29m		
Velocity range	Closed	5~70m/s	5~70m/s	0.5m(H)×0.3m(W) ×1.0m(L)	Octagonal cross-section; length 3.5m, width 1.01m
	Open	5~80m/s	5~65m/s		
Turbulent intensity		0.02% (closed)	0.06% (closed)		
Sound pressure Level				65dB(A) at 45m/s	

Magnetic Suspension and Balance System(MSBS)

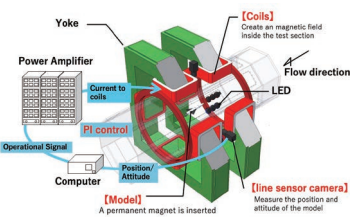
Pure air force measurement without interference of support systems

A magnetic suspension and balance system, MSBS, is a unique model support system that can suspend the model and measure aerodynamic forces by controlling the magnetic field created by the coils to balance the magnetic field of the permanent magnet inserted into the model. It enables ideal wind tunnel experiments due to no support interference and dynamic motion with 6 degrees of freedom. The world's largest* 1 m-MSBS was introduced in March 2015, and three MSBSs are currently operational in the IFS.

*As of November 2024



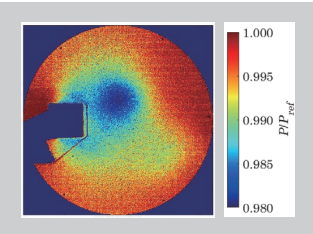
Winged model in high angle of attack (AGARD-B)



System configuration diagram of MSBS

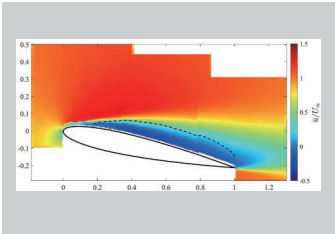
Measurement techniques in Wind Tunnel Facilities

Pressure field in the wake behind a square cylinder obtained by fast-response PSP



Pressure-Sensitive Paint (PSP) is an advanced flow-measurement technique that optically measures the global surface pressure. Source: Ikami et al., Journal of the Visualization Society of Japan (2021).

Velocity field around the airfoil by PIV

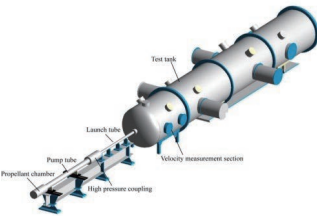
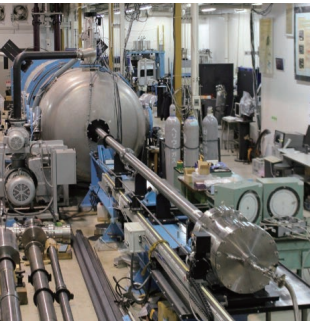


Particle Image Velocimetry can capture a velocity vector field with one or more cameras and laser sheets. Provided by Spacecraft Thermal and Fluids Systems Laboratory (Nagai - Ikami lab)

The world's highest-performance supersonic projectile launching apparatus.

Ballistic range

The ballistic range apparatus can launch a projectile at supersonic speeds into a stationary gas. The apparatus was installed in 2002 and is operated in three launch modes: a single-stage light gas gun, a single-stage gunpowder gun, and a two-stage light gas gun. The projectile can be launched over a wide velocity range, from subsonic speeds of 100 m/s to hypersonic speeds of up to 6 km/s. Various gas and water chambers can be introduced, and a large test model can be installed in a large test section. Our ballistic range can provide high-speed free flight and high-speed impact testing in various science and engineering fields, including aerospace, material mechanics, and geophysics.



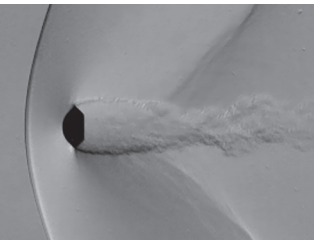
Schematic of the external region of the ballistic range.

Characteristic of Ballistic range

Operating mode	Diameter of projectile (sabot)	Launch velocity
Single stage light gas gun	15mm / 51mm	100m/s ~ 850m/s
Single stage powder gun	15mm	400m/s ~ 2.4km/s
Two stage light gas gun	15mm	2.0km/s ~ 6.0km/s
Test section	inner diameter 1.66m、length 12m	

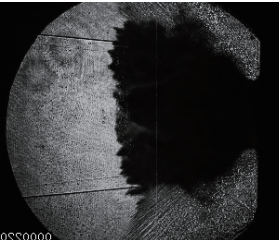
Measurement techniques in Shock Wave Research Facilities

Free flight experiments with supersonic projectiles



Shock waves and wake behaviour generated by theHayabusa capsule during free flight at Mach 1.7.

High-speed impact experiments



Cylindrical projectile in high-speed impact with an aluminum target at 6.9 km/s.