Comprehensive Capabilities

Nowhere in the world are there as many aerospace ground testing facilities as exist at NASA. Offering the most complete suite of facilities; all specifically built to collect, analyze and interpret test data.

Aerosciences Evaluation and Test Capabilities (AETC) is setting the strategic direction for NASA's versatile and comprehensive portfolio of ground test aeroscience research capabilities including subsonic, transonic, supersonic and hypersonic wind tunnels and propulsion test facilities.

AETC provides critical evaluation and support for NASA's Aeronautics and Space Missions with world class wind tunnel testing including the development of new test technologies and facility capabilities. The state-of-the art testing support is a crucial component in the advancement of innovative technologies that will take NASA into the future, expand the human presence into space, further the understanding of our solar system, provide benefits to humanity, and national and international collaboration.

A One-Stop Setting

All types of vehicles, from subsonic through hypersonic, have been evaluated at NASA.

Our unique infrastructure is complemented by unmatched computational capabilities, including state-of-the art tools, access to world-renowned specialists and extensive code validation.

In addition, test article fabrication capabilities, advanced instrumentation, cutting-edge test techniques, a diverse, highly skilled and experienced workforce, and excellent data support are all available and we continually invest to maintain, upgrade, and modernize our facilities to keep pace with customer requirements.

Delivering Solutions to Complex Challenges

We have a critical mass of subject-matter experts with internationally recognized core competencies in aero-sciences, acoustics, structures, and materials to identify and deliver solutions to your complex aerospace systems challenges.

Doing Business with Us

Our extensive aerospace expertise and unique ground testing capabilities will prove invaluable to your enterprise.

We have the most comprehensive ground testing capabilities in the world, and we want to share with you the benefits of our decades of accomplishments. We offer what others can't.
Infrastructure. Know-how. Experience.
And most importantly: Success.

The solution to your aerospace challenges starts by contacting:
www.nasa.gov/directorates/armd/aetc/

Aerosciences EVALUATION and TEST Capabilities Portfolio
The Right Facility at the Right Time

National Aeronautics and Space Administration

NASA Headquarters
300 E. Street SW, Suite 5R30
Washington, DC 20546
www.nasa.gov/directorates/armd/aetc/

www.nasa.gov

NP-2018-11-127-LaRC

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Digital Transformation

National Aeronautics and Space Administration

Wind Tunnel Testing Guide

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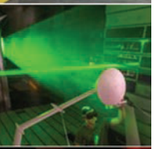


Facility Capabilities at a Glance

Facility		Speed	Site	Reynolds Number	Test Section Size	Total Pressure	Total Temperature	Test Gas	Type	Sample Test Capabilities
SUBSONIC SPEED RANGE										
14-by 22 Foot Subsonic Tunnel (14 x 22)		Mach 0 to 0.3 (348 ft/s)	NASA LaRC	0 to 2.2 x 10^6 per ft	14.5' H x 21.75' W x 50' L	Atmospheric	Ambient	Air	Closed Circuit, Open or Closed Test Section	AC, FF, FO, GE, HA, JET, P, R, SG, SS
Flight Dynamics Research Facility (FDRF)		0 to 172 ft/s	NASA LaRC	0 to 1.1 x 10^6 per ft	24' H x 20' W	Atmospheric	Actively Cooled	Air	Closed Circuit, Closed Test Section	FF, FO, HA, SC, PMT, RT, 3D0F
9-by 15 Foot Low Speed Wind Tunnel (LSWT)		Mach 0 to 0.21	NASA Glenn	0 to 1.4 x 10^6 per ft	9' H x 15' W x 33' L	0 to 72 psf	Ambient to 550°R	Air	Atmospheric	Aero, UHB, PIV, PSP
Icing Research Tunnel (IRT)		Mach 0.05 to 0.50	NASA Glenn	0 to 3.6 x 10^6 per ft	6' H x 9' W x 20' L	0 to 230 psf	Ambient to -35°	Air	Closed Return - Atmospheric	In-flight icing tests and simulations
TRANSONIC SPEED REGIME										
Transonic Dynamics Tunnel (TDT)	Air Mode: Heavy Gas Mode:	Mach 0 to 1.2 Mach 0 to 1.2	NASA LaRC	0.01 to 3.0 x 10^6 per ft 0.1 to 9.6 x 10^6 per ft	16' H x 16' W x 30' L	0.5 psia to atmospheric	70° to 130°F	Dry Air R-134a	Closed Circuit	AE, AWS, FO, SC, SS, R
National Transonic Facility (NTF)	Air Mode: Cryogenic Mode:	Mach 0.1 to 1.05 Mach 0.1 to 1.20	NASA LaRC	1 to 23 x 10^6 per ft 4 to 145 x 10^6 per ft	8.2' H x 8.2' W x 25' L	14.7 to 120 psia	+70° to +130°F -250° to +130°F	Dry Air Nitrogen	Closed Circuit	AWS, HA, JET, PT, SC, SS
11-by 11 Foot Transonic Unitary Plan Wind Tunnel (UPWT)		Mach 0.2 to 1.4	NASA Ames	0.3 to 9.6 x 10^6 per ft	11' H x 11' W x 22' L	432-4608 psfa	110 ± 20°F	Air	Closed Circuit	IR, OF, PIV, PSP, PT, SG, SS
SUPERSONIC SPEED REGIME										
4-Foot Supersonic Unitary Plan Wind Tunnel (UPWT)	Test Section 1: Test Section 2:	Mach 1.5 to 2.9 Mach 2.3 to 4.6	NASA LaRC	0.5 to 11.4 x 10^6 per ft 0.5 to 8.4 x 10^6 per ft	4' H x 4' W x 7' L	0 to 10 atmospheres	100° to 300°F	Dry Air	Closed Circuit	AT, FO, HA, JET, PT, SC, SS
9-by 7 Foot Supersonic Unitary Plan Wind Tunnel (UPWT)		Mach 1.55 to 2.55	NASA Ames	0.9 to 5.6 x 10^6 per ft	9' H x 7' W x 18' L	634-3888 psfa	110 ± 20°F	Air	Closed Circuit	IR, OF, PT, SG
10-by 10 Foot Supersonic & Propulsion Wind Tunnel	Aerodynamic Mode: Propulsion Mode:	Mach 0 to 0.36, 2.0 to 3.5	NASA Glenn	0.1 to 3.4 x 10^6 per ft 2.2 to 2.7 x 10^6 per ft	10' H x 10' W x 40' L	100 to 5500 psfa 1400 to 5500 psfa	540 to 750°R 520 to 1140°R	Dry Air, Heating Capability	Open or Closed Circuit, Variable Density	AT, DDS, P, PIV, PT, PSP, SS, SG
8-by 6 Foot Supersonic Wind Tunnel		0 to 0.1 -0.25 to 2.0	NASA Glenn	1.5 to 5.5 x 10^6 per ft	8' W x 6' H x 23.5' L	100 to 1340 psf	520 to 720°R	Air	Open or Closed Circuit, Atmospheric	P, PSP, SS
Propulsion Systems Lab		0 to 3.5' 0 to 6.0 w/ topping heater	NASA Glenn	n/a	12' x 12' x 39'	150 psig	850°F	Air	Non Vitiated	Altitude icing simulations
HYPERSONIC SPEED REGIME										
Langley Aerothermal Dynamics Laboratory (LAL)										
20-Inch Mach 6 Air Tunnel		Mach 6	NASA LaRC	0.5 to 8.0 x 10^6 per ft	20" H x 20.5" W	30 to 475 psia	760° to 940°R	Dry Air	Blow Down	AT, BOS, High AOA, High Speed Schlieren, IR, JET, Oil Flow, PLIF, PSP, TSP
15-Inch Mach 6 High Temperature Tunnel		Mach 6	NASA LaRC	0.5 to 6.0 x 10^6 per ft	14.6" diameter open jet	50 to 450 psia	970°-1250° R	Dry Air	Blow Down	AT, BOS, High AOA, High Speed Schlieren, IR, JET, Oil Flow, PLIF, PSP, TSP
31-Inch Mach 10 Air Tunnel		Mach 10	NASA LaRC	0.5 to 2.2 x 10^6 per ft	31" H x 31" W	150 to 1450 psia	1850°R	Dry Air	Blow Down	AT, BOS, High AOA, High Speed Schlieren, IR, JET, Oil Flow, PLIF, PSP, TSP
8-Foot High Temperature Tunnel (8-ft HTT)		Mach 3.5 Mach 6 Mach 4, 5, and 7	NASA LaRC	0.44 to 5.09 x 10^6 per ft	54.4" diameter 70" diameter 96" diameter	50 to 4000 psia	850° to 4000°R	Air	Blow Down	AT, P

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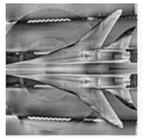
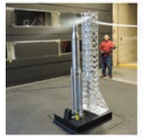
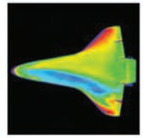
Sample Test Capabilities


IR Infrared Flow Visual


AC Acoustic Testing


AE Aeroelastic Testing


AFL Airfoil Testing to Ground Wind Loads


AT Aerothermal Testing


PSP Pressure Sensitive Paint


FO Forced Oscillation Testing


PMT Pressure Model Test


SC HA Stability and Control High Angle-of-Attack Testing


PAAI Propulsion Airframe Aeroacoustic Integration


P Propulsion System Testing
JET Jet Effects Testing


PT Performance Testing


RT Rotorcraft Testing


SG Shadowgraph Flow Visual


SS Semi-Span Testing

Specialized Test Techniques

The following optical measurement techniques are in routine use at AETC facilities.

IR Thermography

Real-time measurement of surface temperature suitable for measuring heat flux, flow separation, and boundary layer transition location. Adaptive contrast enhancement algorithms are used to aid visualization of subtle temperature features.

Pressure/Temperature-Sensitive Paint

Provides continuous surface pressure and or temperature data using a paint containing fluorescent dyes which are sensitive to oxygen partial pressure as well as temperature. Results can be integrated to determine airloads on wind tunnel models/components. Suitable for temperature mapping as well as boundary layer transition detection. Works in cryogenic conditions where IR thermography is not suitable. Both steady state and dynamic (time resolved) data at up to 10 kHz can be obtained.

High-Speed Schlieren and Shadowgraph

Visualizes flow density variations including shock waves and vortex cores. Images can be recorded at up to 100 kHz. Data are processed to obtain frequency spectra of density fluctuations at arbitrary locations in the flow, or to obtain flow velocity by tracking the movement of turbules.

Background-Oriented Schlieren

Visualizes flow density variations by measuring fluctuations in the position of a speckled background. Able to access areas of the tunnel and viewing angles which traditional schlieren techniques cannot.

Particle Image Velocimetry

A method for measuring velocity in a particle-seeded flow. A double pulsed laser sheet illuminates a two-dimensional particle field.

Non-Optical measurement techniques available

Advanced Force Balance

AETC facilities maintain a comprehensive inventory of balances for force and moment measurements including traditional six-component balances over a wide load range, floor balances for semispan models, rotating balances for turbomachinery, and specialized balances for many unusual applications. In addition to balance services provided during AETC tests, balance loans may also be available.

Dynamic Data Systems

AETC facilities maintain high speed data systems suitable for excitation and readout of many types of unsteady pressure and force sensors and can accommodate tests requiring a large number of channels of unsteady data.

Other techniques, such as Oil-Film Interferometry, Planar Laser Induced Fluorescence, and Femtosecond laser Electronic Excitation and Tagging are also available upon request.

For a full list of test capabilities and specialized test techniques please visit us at:

www.nasa.gov/directorates/armd/aetc/

or Contact Test Technology Manager, James Bell - james.h.bell@nasa.gov