WIND TUNNELS
OF THE WESTERN HEMISPHERE

A Report Prepared by the Federal Research Division,
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PREFACE

This catalog is a compilation of data on subsonic, supersonic, and hypersonic wind tunnels in the Western hemisphere used for aeronautical testing. The countries represented in this catalog include Argentina, Brazil, Canada, and the United States. The catalog profiles a total of 104 wind tunnels. A distribution chart following this preface depicts the number and types of wind tunnels operating in each country. The bulk of the catalog is made up of data sheets for each facility, indicating the facility's name; the name of the installation where it is located; its technical parameters, such as size, speed range, temperature range, pressure, operational status, and Reynolds number; its replacement and/or operating cost; its testing capabilities; current programs; planned improvements; contact information; and schematics, if available. The report has four sections, one section for each speed (subsonic, supersonic, and hypersonic) and one section for tunnels of undetermined speed. In addition, cross-reference indexes with page numbers, at the end of the report, provide quick look-up tools. A bibliography is also included. Sources consulted include wind tunnel installation Web sites (in English and/or foreign languages); technical reports on wind tunnels, published by Sverdrup Technology, RAND, and NASA; articles and reports from various technical journals; and information provided by installation managers in response to direct inquiries.

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INTRODUCTION

The wind tunnels in this catalog, classified according to speed regime, are presented in the following order:

- Subsonic
- Supersonic
- Hypersonic

The specific criteria used for each category are as follows:

Wind Tunnel Category	Speed Range (Mach No.)
Subsonic	>0.1
Supersonic	1.2–5.0
Hypersonic	>5.0

EXPLANATION OF WIND TUNNEL DATA SHEETS

The boxes at the top of each data sheet are designed to provide a summary of the facility's most pertinent characteristics, such as name, size, speed, etc. The paragraphs under the boxes provide more details as to the facility's technical parameters, usage, and contact information. The following descriptions correspond to the numbered boxes on the following page:

1. Wind Tunnel Speed Category: subsonic, supersonic, or hypersonic.
2. Country in which the tunnel is located.
3. Name of the installation where the facility is located.
4. Test Section Size: dimensions of the test section (height x width x length) or cross-section diameter.
5. Temperature Range: tunnel's stagnation temperature(s) in ºR or K.
6. Speed Range: in Mach number with feet per second (ft/sec) or meter per second (m/sec) for subsonic tunnels; different speed ranges may be listed for different test sections.
7. Reynolds Number: shown in millions (10^6) per feet or per meter.
8. Name of the facility.
9. Cost: either construction cost or replacement cost.
10. Dynamic Pressure: a range given in psf or kilo-Newtons per square meter (kN/m^2).
11. Operational Status: backlog, inactive, standby, or only on demand basis.
12. Stagnation Pressure: given in atmospheres or bars.
13. Testing Capabilities: information on the performance range or special conditions of the tunnel.
14. Data Acquisition: describes the type of systems used for data gathering, the number of channels available, and the form of output.
15. Current Programs: provides details about the facility, discussing unique features, special instrumentation, and performance capabilities.
16. Date Constructed/Planned Improvements: describes major improvements, rehabilitations, and planned modifications.
17. User Fees: fees charged to use the facility.
18. Contact Information.

1. WIND TUNNEL SPEED CATEGORY **2. COUNTRY**

3. INSTALLATION NAME	**4. TEST SECTION SIZE**	**5. TEMPERATURE RANGE**
	6. SPEED RANGE	**7. REYNOLDS NUMBER**
8. FACILITY NAME	**9. COST**	**10. DYNAMIC PRESSURE**
	11. OPERATIONAL STATUS	**12. STAGNATION PRESSURE**

13. TESTING CAPABILITIES

14. DATA ACQUISITION

15. CURRENT PROGRAMS

16. DATE CONSTRUCTED/PLANNED IMPROVEMENTS

17. USER FEES

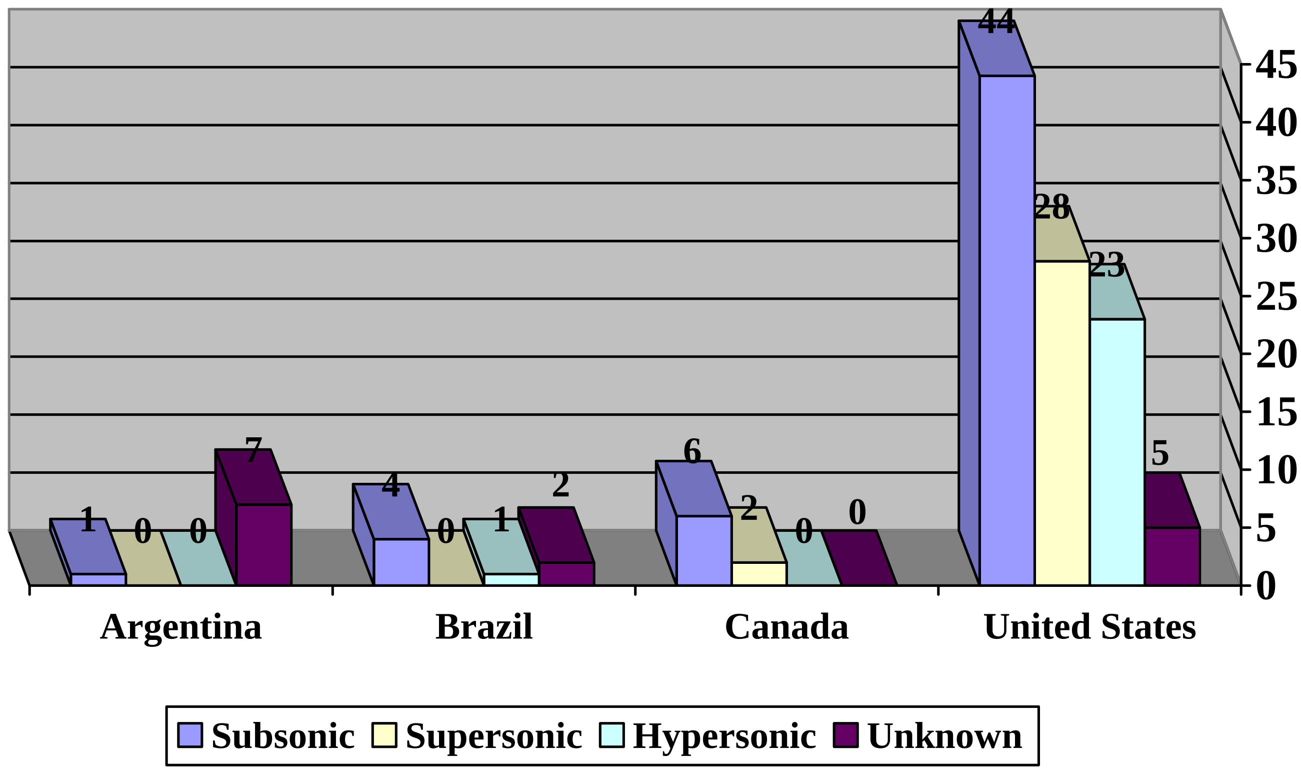
18. CONTACT INFORMATION

TABLE: MAJOR WIND TUNNEL DISTRIBUTION—WESTERN HEMISPHERE

Location	Subsonic	Supersonic	Hypersonic	Unknown	Total
Argentina	1				1
Brazil	4		1	2	7
Canada	6	2			8
United States	44	28	12	5	89
TOTAL	**52**	**30**	**13**	**7**	**102**

CHART: DISTRIBUTION OF WESTERN HEMISPHERE WIND TUNNELS

FIGURE 1: NUMBER OF WIND TUNNELS IN ARGENTINA, BRAZIL, CANADA, AND THE UNITED STATES BY SPEED REGIME



Installation Name	Test Section Size	Temperature Range
National University of La Plata, Faculty of Engineering, Boundary Layer and Environmental Fluid Dynamics Laboratory (LACLYFA), La Plata, Argentina	$1.4 \times 1 \times 7.2$ m^3	
	Speed Range	**Reynolds Number (max)**
	Up to 20m/sec	
Facility Name	**Cost**	**Dynamic Pressure**
Boundary Layer Wind Tunnel		
	Operational Status	**Stagnation Pressure**
	Presumed active as of April 2007.	

Testing Capabilities

Closed section; powered by a 50 hp electric motor; equipped with an axial-flow, variable-velocity, adjustable-pitch blade propeller; wind speed continuously variable by means of an electronic speed control from 10 km/hr to 70 km/hr.

Data Acquisition

Velocity measurements by a 6-channel, Dantec Streamline, constant-temperature, hot-wire anemometer with X-wire probes (DANTEC, 55R51).

Current Programs

Planned Improvements

User Fees

Contact Information

U. Boldes, Laboratorio de Capa Limite y Fluidodinamica, Departamento de Aeronautica, Facultad de Ingenieria, Universidad Nacional de La Plata, Calle 48 y 116, La Plata (1900), Argentina; Tel: 54 (221) 423-6679; Fax: 54 (221) 423-6679 int 143; Email (Main): sec-aero@volta.ing.unlp.edu.ar; Web site: http://www.ing.unlp.edu.ar/aeron/laclyfa/Capetas/equipamiento.htm.

NO IMAGE AVAILABLE

Installation Name	Test Section Size	Temperature Range
Institute of Aeronautics and Space, Aerospace Technical Center, São José dos Campos, Brazil	7 ft, octagonal	Ambient
	Speed Range	**Reynolds Number (max)**
	0.13 Mach	1.2
Facility Name		**Dynamic Pressure**
TA-1 Subsonic Wind Tunnel	**Cost**	
	Operational Status	**Stagnation Pressure**
		Ambient

Testing Capabilities

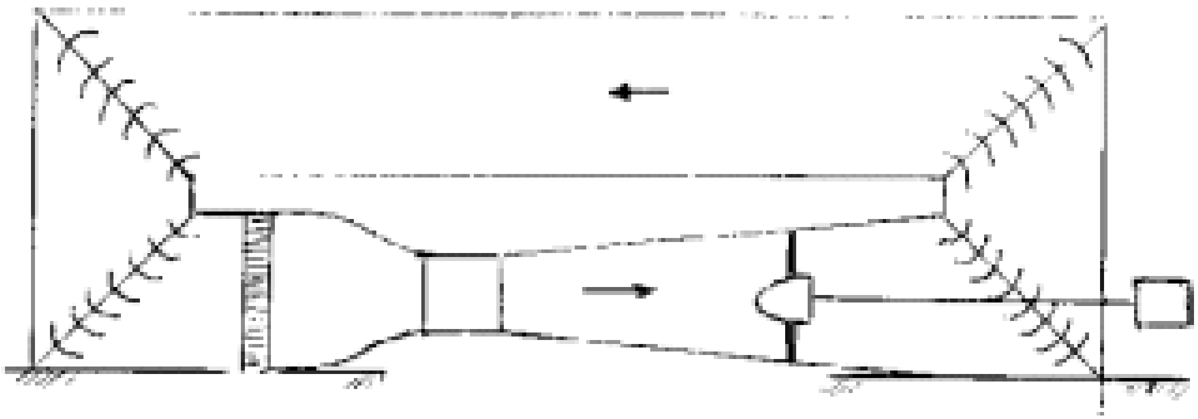
Data Acquisition
Manual

Current Programs
Aeronautics; ground transportation; buildings; towers; ships; submarines; weapons.

Planned Improvements
1930 (constructed).

User Fees

Contact Information
Izabel Cristina Mendes Barros, IAE/ASA-Comando-Geral de Tecnologia Aeroespacial, Praça Marechal Eduardo Gomes, 50, Vila das Acácias - CEP 12228-904, São José dos Campos, Brasil; Tel: (55) 012 3947-6500; Fax: (55) 012 3947-6501; Email (Mendes Barros): comsocial@iae.cta.br; Web site: http://www.iae.cta.br/asa/asa-l/asalaerodinamica.html.



TA-1 Subsonic Wind Tunnel,
Institute of Aeronautics and Space,
Aerospace Technical Center,
São José dos Campos, Brazil

Installation Name	Test Section Size	Temperature Range
Instituto de Aeronáutica e Espaço (IAE-CTA), São José dos Campos, SP, Brazil	7 x 10 ft^2 (2.1 x 3.0 m^2)	
	Speed Range	**Reynolds Number (max)**
	100 m/sec	
Facility Name	**Cost**	**Dynamic Pressure**
Closed Circuit Subsonic Wind Tunnel		
	Operational Status	**Stagnation Pressure**
	Presumed active as of June 2008.	

Testing Capabilities
Closed-circuit; square; powered by 1,200 hp electric motor.

Data Acquisition

Current Programs
Development of new experimental procedures; aerodynamic tests for Brazilian aeronautical industry, including Embraer.

Planned Improvements

User Fees

Contact Information
Instituto de Aeronáutica e Espaço, Praça Marechal Eduardo Gomes, 50 - Campus do CTA - Vila das Acácias, CEP 12228-904 - São José dos Campos - SP - Brasil; Tel: (12) 3947-6555; Fax: (12) 3941-2522; Web site: http://www.iae.cta.br/.

NO SCHEMATIC AVAILABLE

Installation Name	Test Section Size	Temperature Range
Instituto Tecnológico de Aeronáutica (ITA), São José dos Campos, SP, Brazil	1.0 x 1.28 m²	
	Speed Range	**Reynolds Number (max)**
	70 m/sec	0.10
Facility Name	**Cost**	**Dynamic Pressure**
Research Open Circuit Low Speed Wind Tunnel		
	Operational Status	**Stagnation Pressure**
	Presumed active as of 2008.	

Testing Capabilities

Closed-circuit; 200 hp electric motor; boundary-layer control system; blowing slots located at top and bottom walls of test section; low operating cost; complements IAE-CTA wind tunnel; built by teams from Instituto de Aeronáutica e Espaço, University of São Paulo at São Carlos (USP-SC), and Embraer.

Data Acquisition

FLUENT software for numerical simulation of flow.

Current Programs

Engineering testing for Embraer; 2D flow over airfoil models; behavior of wing sections; determination of maximum lift coefficient.

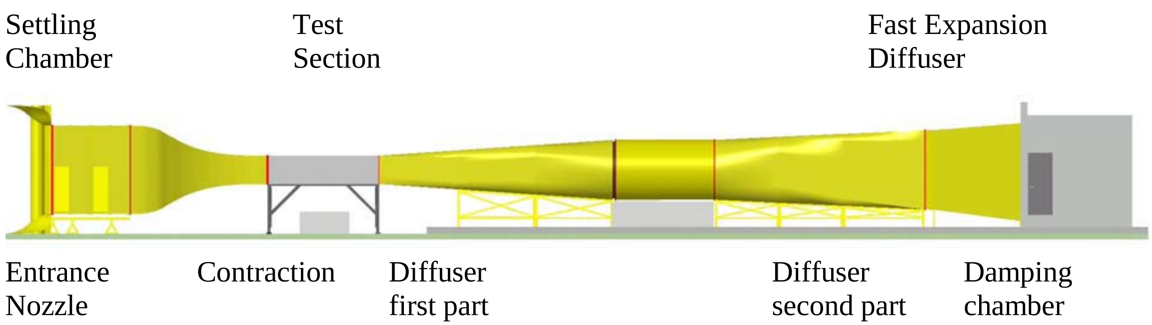
Planned Improvements

February 2003 (commenced operation); planned extension to 3D testing.

User Fees

Contact Information

Praça Marechal Eduardo Gomes 50, Vila das Acácias, 12228-900, São José dos Campos, SP, Brasil; Tel: (55) 12 39475823; Fax: (55) 12 39475024; Email: nide@aer.ita.br; Web site: http://www.ita.br



**Research Open Circuit Low Speed Wind Tunnel,
Instituto Tecnológico de Aeronáutica (ITA),
São José dos Campos, Brazil**

Installation Name	Test Section Size	Temperature Range
University of São Paulo, São Carlos Engineering School, Aerodynamics Laboratory (LAE), São Carlos, SP, Brazil	0.6 x 1.5 m²	
	Speed Range	**Reynolds Number (max)**
	50 m/sec	
Facility Name	**Cost**	**Dynamic Pressure**
Subsonic Wind Tunnel	US$245,000 (approximate construction cost)	
	Operational Status	**Stagnation Pressure**
	Presumed active as of June 2008.	

Testing Capabilities

Square test section.

Data Acquisition

Current Programs

Development of new experimental procedures using scale models of aircraft or aircraft parts; testing the aerodynamic structures of aircraft, automobiles, ships, and civil engineering works.

Planned Improvements

2002 (operational)

User Fees

Contact Information

University of São Paulo, São Carlos Engineering School, Aerodynamics Laboratory (LAE), São Carlos, Av. do Trabalhador Sancarlense 400, 13566- 590 São Paulo, SP. Brazil São Paulo, Brazil; Tel: (16) 3373 9333; Web site: http://www.aeronauticasc.eng.br/.

NO SCHEMATIC AVAILABLE

Installation Name	***Test Section Size***	***Temperature Range***
National Research Council Canada (NRC), Institute for Aerospace Research (IAR), Ottawa, Ontario, Canada	57 x 57 x 183 cm^3	-35° to 40°C
	Speed Range	***Reynolds Number (max)***
Facility Name	Up to 0.5 Mach	
0.57 x 0.57 m Altitude Icing Wind Tunnel (AIWT)		***Dynamic Pressure***
	Cost	
		Stagnation Pressure
	Operational Status	
	Presumed active as of June 2006.	

Testing Capabilities

Data Acquisition

Inputs: 16 TTL-level digital signals (UPC 607); 16 differential or 32 single-ended signals; thermocouples; thermistors; strain gauges; LVDTs; RTDs; resistances; variable reluctance; voltages; outputs: up to 16 TTL-level digital signals; up to four 12-bit resolution +/-10 VDC or 4 to 20 mA analog signals; real-time CRT monitoring, storage, and transfer of data.

Current Programs

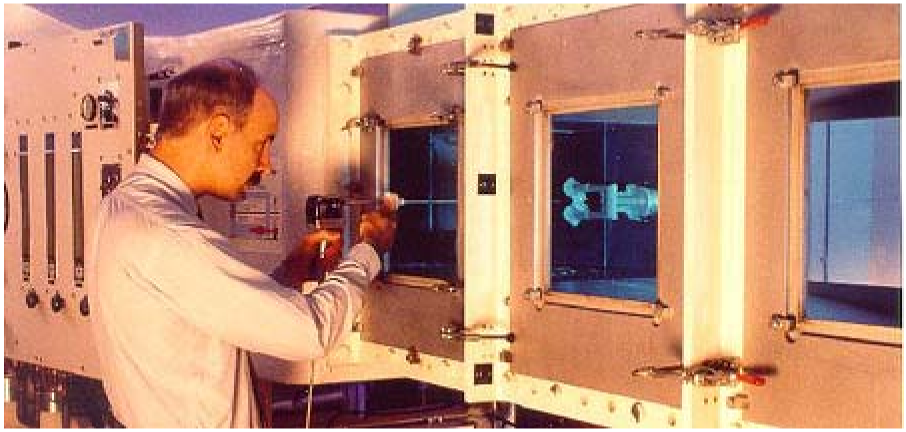
Development, testing, or calibration of aircraft or cloud physics instrumentation; de-icing and anti-icing systems; evaluation of ice accretion on non-protected aircraft components; validation of numerical ice accretion codes; studies on the basic physical processes leading to ice accretion.

Planned Improvements

User Fees

Contact Information

Steven J. Zan, Director, Aerodynamics Laboratory, Institute for Aerospace Research (IAR), National Research Council Canada (NRC), 1200 Montreal Road, Bldg. M-2, Room 129B, Ottawa, ON, Canada, K1A 0R6; Tel: (613) 993-1156; Fax: (613) 957-4309; Email: Steven.Zan@nrc-cnrc.gc.ca; Web site: http://iar-ira.nrc-cnrc.gc.ca/aero/aero_8c_e.html.



0.57 x 0.57 m Altitude Icing Wind Tunnel (AIWT)
National Research Council Canada (NRC),
Institute for Aerospace Research (IAR),
Ottawa, Ontario, Canada

Wind Tunnels of the Western Hemisphere

Subsonic **Canada**

Installation Name	Test Section Size	Temperature Range
National Research Council Canada (NRC), Institute for Aerospace Research (IAR), Ottawa, Ontario, Canada	1.9 x 2.7 x 5.2 m³	
	Speed Range	**Reynolds Number (max)**
	Up to 140 m/sec	9
Facility Name	**Cost**	**Dynamic Pressure**
2 x 3 m Wind Tunnel		11.6 kPa
	Operational Status	**Stagnation Pressure**
	Confirmed active as of December 2006.	1.7 psi

Testing Capabilities

Closed circuit; 9:1 contraction ratio; 1,490 kW fan power; +/-.07% speed uniformity; 0.14% turbulence level; and longitudinal static pressure gradient.

Data Acquisition

A/D channels: 24 and 15 bit @ 100 kHz; custom configurations; redundant tunnel condition sensors; software: test-specific MatLab code, labview; model/probe control: 16-axes, Aerotech; pressure measurements: scanivalve ZOC™Kulite; anemometry: hot-film/hot-wire; balances: internal (TASK, NRC, various) and external (cruciform, various); flow visualization: PIV, acoustic array, PSP laser-light sheet, smoke, surface oil film, fluorescent mini-tuft.

Current Programs

Steady and unsteady aircraft aerodynamics; aero acoustics; surface-vehicle aerodynamics; marine hydrodynamics; separated-flow aerodynamics; wind energy generation.

Planned Improvements

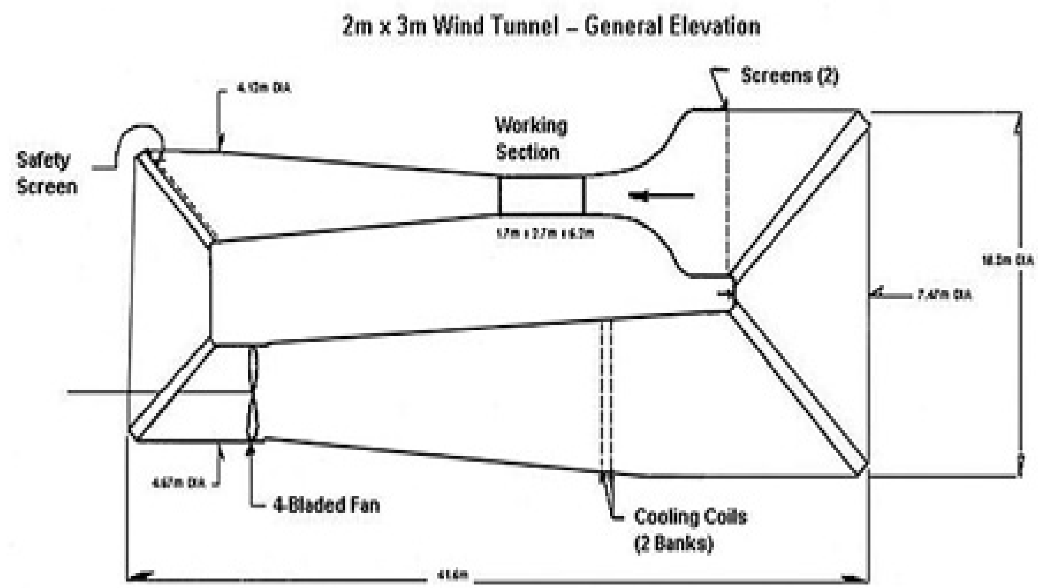
Planned improvements: moving ground, integrated PIV systems.

User Fees

CAN$1,050/hr.

Contact Information

Jason Leuschen, Montreal Road Facilities Manager, Aerodynamics Laboratory, National Research Council (NRC) Institute for Aerospace Research, Building M-2, 1200 Montreal Road, Ottawa, Canada K1A OR6; Tel: (613) 993 2757; Fax: (613) 957 4309; Email: Jason.Leuschen@nrc-cnrc.gc.ca; Web site: http://iar-ira.nrc-cnrc.gc.ca/aero/aero_6_e.html.



2 x 3 m Wind Tunnel,
National Research Council (NRC),
Institute for Aerospace Research (IAR),
Ottawa, Ontario, Canada

Installation Name	Test Section Size	Temperature Range
National Research Council Canada (NRC), Institute for Aerospace Research (IAR), Ottawa, Ontario, Canada	#1: 3.1 x 6.1 x 12.2 m³; #2: 3.1 x 4.9 x 6.4 m³ with insert	
	Speed Range	**Reynolds Number (max)**
	#1: Electric = 40 m/sec, Gas turbine = 54 m/sec; #2: Electric = 50 m/sec, Gas turbine = 67 m/sec	4.3
Facility Name	**Cost**	**Dynamic Pressure**
3 x 6 m Open-Circuit Propulsion Icing Wind Tunnel (PIWT)		2.7 kPa
	Operational Status	**Stagnation Pressure**
	Confirmed active as of December 2006.	0.4 psi

Testing Capabilities

Fan operated electrically but can be accommodated to a gas turbine for high-speed operations; working section floor may be raised to simulate varying ground effects or modify floor-boundary-layer characteristics; floor may be solid or porous.

Data Acquisition

Test specific software: MatLab and LabView; model mounts: pitch-rig and custom mounts available; pressure measurements: scanivalve ZOC™, Kulite; anemometry: hot-film and hot-wire; balances: internal (TASK, NRC, various) and external (cruciform, various); photography: digital DVD, S-VHS, 35 mm; flow visualization: PIV, Acoustic Array, PSP, laser-light sheet, smoke, surface oil, fluorescent mini-tuft.

Current Programs

Icing research; tested Sikorsky S-76 helicopter half-model.

Planned Improvements

2004 (upgrades to icing-spray system and removable test section insert); planned improvements: icing-spray bar upgrades; maximum speed increase; large-engine flow simulator.

User Fees

Low-speed occupancy rate: CAN$750/hr; high-speed occupancy rate: CAN$915/hr; increments: CAN$910/hr.

Contact Information

Jason Leuchen, Montreal Road Facilities Manager, Aerodynamics Laboratory, National Research Council (NRC) Institute for Aerospace Research, Building M-2, 1200 Montreal Road, Ottawa Canada K1A OR6; Tel: (613) 993-2757; Fax: (613) 957-4309; Email: Jason.Leuschen@nrc-cnrc.gc.ca; Web site: http://iar-ira.nrc-cnrc.gc.ca/aero/aero_9_e.html.

NO IMAGE AVAILABLE

Installation Name

National Research Council Canada (NRC), Institute for Aerospace Research (IAR), Ottawa, Ontario, Canada

Facility Name

5 m Vertical Wind Tunnel

Test Section Size

#1: 5 m (diameter) open jet; #2: 3 x 3 m square open jet; #3: 2 x 3 m open jet or solid wall.

Speed Range

Up to 28 m/sec

Cost

Operational Status

Presumed active as of March 2006.

Temperature Range

Reynolds Number (max)

Dynamic Pressure

Stagnation Pressure

Testing Capabilities

Aircraft spin testing; aerodynamic stability; helicopter rotor performance during landing and takeoff from frigates; 1% turbulence level.

Data Acquisition

Current Programs

Planned Improvements

User Fees

Contact Information

Steven J. Zan, Director, Aerodynamics Laboratory, Institute for Aerospace Research (IAR), National Research Council Canada (NRC), 1200 Montreal Road, Bldg. M-2, Room 129B, Ottawa, ON, Canada, K1A 0R6; Tel: (613) 993-1156; Fax: (613) 957-4309; Email: Steven.Zan@nrc-cnrc.gc.ca; Web site: http://iar-ira.nrc-cnrc.gc.ca/aero/aero_8b_e.html.

NO IMAGE AVAILABLE

Subsonic | **Canada**

Installation Name	Test Section Size	Temperature Range
National Research Council Canada (NRC), Institute for Aerospace Research (IAR), Ottawa, Ontario, Canada	9.1 x 9.1 x 23.9 m^3	
	Speed Range	**Reynolds Number (max)**
	Up to 55 m/sec	0 to 1.23
Facility Name	**Cost**	**Dynamic Pressure**
9 x 9 m Low Speed Wind Tunnel		38 psf
	Operational Status	**Stagnation Pressure**
	Confirmed active as of December 2006.	Atmospheric

Testing Capabilities

Continuous-flow, closed-circuit test section; 6.7 MW dc electric motor drive; 6-component, pyramidal, external, mechanical force balance; strut; sting; floor mounting with self-aligning fairings; floor-pad mounting equipped with pressure-taps model support; capabilities: normal, V/STOL, Special Moment, Omega; balance incidence arm range + or - 50°; turntable balance can be rotated from -115° to + 215°; four 150 kW; 2 Danfoss auxiliary electric power; 13.2 cm diameter supply line of 1,700 kPa at 4.5 kg/sec compressed air; HYSCAN ESP system; DSM-3000 electronic pressure scanner.

Data Acquisition

PXI-based control data system with 64-channel A/D and 128 digital I/Os; remote field point with 16-temperature RTD inputs and 8-channel A/D; 12-axis motion control system with programmable PID; client data system: PXI-based with 96 digital I/Os, 64-channel A/D with programmable signal conditioning system.

Current Programs

Aircraft models (including Dash 8) with up to 7 m wing span; half-models of 5 m semi-span (can be mounted on under-floor; external 6-component balance); surface vehicles; ground-based structures; oil rig platforms and wind turbines.

Planned Improvements

1969-70 (commissioned); 1997-98 (new, balanced-weight, beam control system); 1998-2000 (new data acquisition system); 2002-03 (floor boundary suction system); 2003-04 (new fan-drive control system); planned improvements: ground-effect simulation system (GESS) for ground vehicle testing.

User Fees

N/A

Contact Information

Dr. Vinh Nguyen, Reseach Officer, Uplands Facilities Aerodynamics Laboratory, National Research Council Canada (NRC) Institute for Aerospace Research, Building U70, Uplands Campus, ON Ottawa, Canada K1A 0R6; Tel: (613) 998 3123; Fax: (613) 957 4310; Email: Vinh.Nguyen@nrc-cnrc.gc.ca; Web site: http://iar-ira.nrc-cnrc.gc.ca/aero/aero_5_e.html.

9 x 9 m Low Speed Wind Tunnel (LSWT), National Research Council Canada (NRC), Institute for Aerospace Research (IAR), Ottawa, Ontario, Canada

Wind Tunnels of the Western Hemisphere

Subsonic | **Canada**

Installation Name

National Research Council Canada (NRC), Institute for Aerospace Research (IAR), Ottawa, Ontario, Canada

Facility Name

Water Tunnel Orbital Platform Rotary Balance System (OPLEC)

Test Section Size

0.38 x 0.51 x 1.83 m^3

Speed Range

Up to 0.4 m/sec

Cost

Operational Status

Presumed active as of March 2006.

Temperature Range

Reynolds Number (max)

Dynamic Pressure

Stagnation Pressure

Testing Capabilities

Six independent dye streams, 5-component sting balance; 6:1 contraction section area ratio; <1.0% RMS turbulence intensity level; <+/- 2 % velocity uniformity.

Data Acquisition

Lab-view data acquisition and motion-control system; video-imaging system.

Current Programs

Force measurement and flow visualization of aircraft at high angles-of-attack; variety of models, including surface vehicles tested, including the F/A-18 fighter/attack vehicle.

Planned Improvements

1996 (constructed).

User Fees

Contact Information

Steven J. Zan, Director, Aerodynamics Laboratory, Institute for Aerospace Research (IAR), National Research Council Canada (NRC), 1200 Montreal Road, Bldg. M-2, Room 129B, Ottawa, ON, Canada, K1A 0R6; Tel: (613) 993-1156; Fax: (613) 957-4309; Email: Steven.Zan@nrc-cnrc.gc.ca; Web site: http://iar-ira.nrc-cnrc.gc.ca/aero/aero_8f_e.html.

Water Tunnel Orbital Platform Rotary Balance System (OPLEC),
National Research Council Canada (NRC),
Institute for Aerospace Research (IAR),
Ottawa, Ontario, Canada

Installation Name	Test Section Size	Temperature Range
Boeing Technology Services, Seattle, Washington, USA	20 x 20 x 45 ft³	Ambient
	Speed Range	**Reynolds Number (max)**
	215, 230 kn	0 to 2.3
Facility Name	**Cost**	**Dynamic Pressure**
20 x 20 ft Subsonic Wind Tunnel		
	Operational Status	**Stagnation Pressure**
	Presumed active as of March 2006.	Ambient

Testing Capabilities
Closed, slotted, open, and 3/4 in open-construction type; single return; 15,000 hp, 9-bladed fan; internal/external balances; moving belt; fixed-ground plane ground effects; 1,000 psi; 70° to 250°F air-supply system; 20 lb/sec air-mass flow; located in Philadelphia.

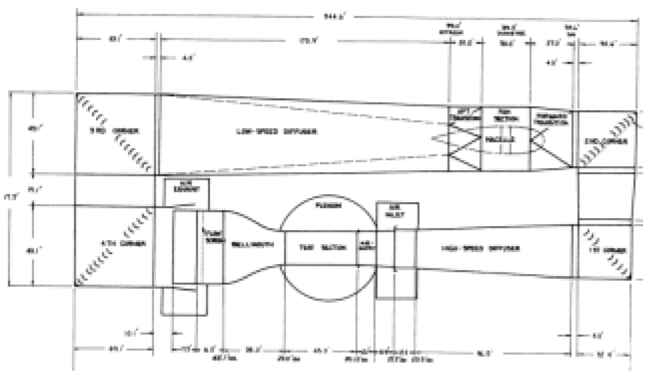
Data Acquisition
HP/LMS VXI; PDP 11/84; VAX 11/780; 190 analog to 100 kHz; 16 digital; 16 pulse count; PSI electronic pressure scanner; scanivalves, discrete static/dynamic transducers.

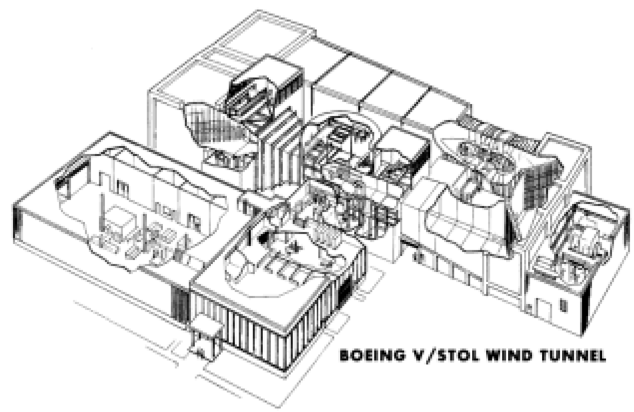
Current Programs
Rotary wing; fixed wing; V/STOL; aerodynamics; ground vehicles; acoustic; hover.

Planned Improvements
1968 (constructed).

User Fees

Contact Information
Ms. LeAnn Diessner (Marketing Manager), Boeing Technology Services, P.O. Box 3707, MC 1W-02, Seattle, Washington 98124-2207; Tel: (206) 662 4287; Email: LeAnn.M.Diessner@boeing.com; Web site: http://www.boeing.com/bts.





20 x 20 ft Subsonic Wind Tunnel,
Boeing Technology Services,
Seattle, Washington USA

Installation Name	Test Section Size	Temperature Range
Boeing Technology Services, Seattle, Washington, USA	9 x 9 x 19.5 ft³	
	Speed Range	**Reynolds Number (max)**
	Up to 200 kn	
Facility Name		**Dynamic Pressure**
9 x 9 ft Subsonic Propulsion Wind Tunnel (PWT)	**Cost**	0 to 130 psf
	Operational Status	**Stagnation Pressure**
	Presumed active as of August 2006.	

Testing Capabilities

Data Acquisition

Current Programs

Planned Improvements

User Fees

Contact Information

Ms. LeAnn Diessner (Marketing Manager), Boeing Technology Services, P.O. Box 3707, MC 1W-02, Seattle, Washington 98124-2207; Tel: (206) 662 4287; Email: LeAnn.M.Diessner@boeing.com; Web site: http://www.boeing.com/bts.

NO IMAGE AVAILABLE

Installation Name	Test Section Size	Temperature Range
Boeing Technology Services, Seattle, Washington, USA	4 x 6 ft² or 5 x 8 ft²	-45° to 100°F
	Speed Range	**Reynolds Number (max)**
	Up to 250 kn (290 mph)	
Facility Name	**Cost**	**Dynamic Pressure**
Boeing Research Aero-Icing Tunnel (BRAIT)		
	Operational Status	**Stagnation Pressure**
	Presumed active as of August 2006.	

Testing Capabilities

Sidewall mounting; heated auxiliary air; 3 x 4 ft uniform cloud; 15 to 40 microns droplet size; 0.25 to 2.25 g/m³ liquid water content; +/-1.0°F uniform temperature distribution; <+/- 1° % velocity variation; <0.5% tests section turbulence.

Data Acquisition

Current Programs

Creates ice shapes and tests de-icing systems; tests aircraft-component sections, rotor-blade sections, engine inlets, and probes.

Planned Improvements

User Fees

Contact Information

Ms. LeAnn Diessner (Marketing Manager), Boeing Technology Services, P.O. Box 3707, MC 1W-02, Seattle, Washington 98124-2207; Tel: (206) 662 4287; Email: LeAnn.M.Diessner@boeing.com; Web site: http://www.boeing.com/bts.

NO IMAGE AVAILABLE

Installation Name	Test Section Size	Temperature Range
Embry-Riddle Aeronautical University, Department of Aerospace Engineering, Wind Tunnel Laboratory, Daytona Beach, Florida, USA	30 x 40 x 60 in^3	Ambient
	Speed Range	**Reynolds Number (max)**
	0.16 Mach (180 ft/sec)	0.115
Facility Name	**Cost**	**Dynamic Pressure**
Open Circuit Wind Tunnel		
	Operational Status	**Stagnation Pressure**
	Confirmed active.	Atmospheric

Testing Capabilities
50 hp drive motor; 6-component Aerolab sting balance; 3/4 in diameter; 62-tube manometer.

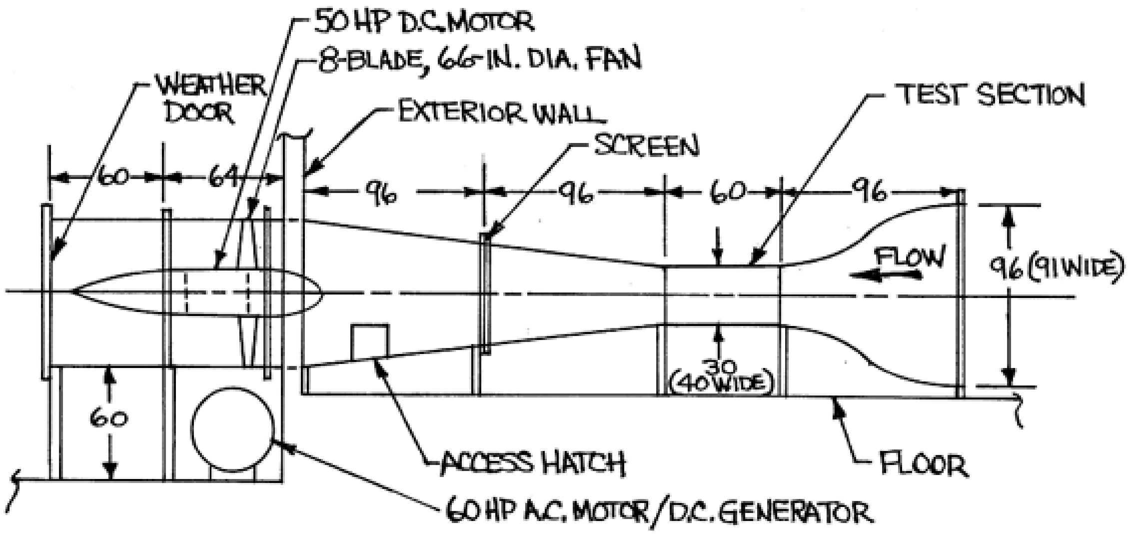
Data Acquisition
486 PC-based data-acquisition system; wind tunnel lab also contains 2D smoke tunnel (2 x 36 in test section); 3D smoke tunnel (18 x 24 in test section); LabView.

Current Programs
Contract wind-tunnel testing for individuals and companies outside the university; occasional short projects for local industry.

Planned Improvements
1989 (constructed).

User Fees
Instructional tunnel; no specific cost structure.

Contact Information
Charles N. Eastlake (Professor), Embry-Riddle Aeronautical University, 600 S. Clyde Morris Blvd, Daytona Beach, FL 32114-3900; Tel: (386) 226 6754; Fax: (386) 226-6747; Email (Eastlake): eastlake@erau.edu; Web site: http://www.erau.edu/omni/db/academicorgs/dbaed/windtunnellab.html.



30x40 INSTRUCTIONAL WIND TUNNEL

FIGURE 1

Open Circuit Wind Tunnel,
Embry-Riddle Aeronautical University,
Department of Aerospace Engineering,
Daytona Beach, Florida USA

Installation Name

Georgia Institute of Technology, Aerospace, Transportation and Advanced Systems Laboratory (ATAS), Atlanta, Georgia, USA

Facility Name

Experimental Research Wind Tunnel

Test Section Size

Speed Range

100 ft/sec

Cost

Operational Status

Presumed active as of January 2007.

Temperature Range

Reynolds Number (max)

Dynamic Pressure

Stagnation Pressure

Testing Capabilities

Easily modified for testing airspeeds; automobile-exterior sections; acoustic measurements; and 2D and 3D advanced aircraft configurations.

Data Acquisition

Current Programs

Planned Improvements

User Fees

Contact Information

Jim McMichael, Georgia Institute of Technology, Aerospace, Transporation and Advanced Systems Laboratory (ATAS), 400 W. 10th Street, N.W., Atlanta, Georgia 30332-0801; Tel (McMichael): (770) 528-7123; Fax (McMichael): (770) 528-3271; Email (McMichael): james.mcmichael@gtri.gatech.edu; Web site: http://www.gtri.gatech.edu/atas/facil_flightsim.html.

NO IMAGE AVAILABLE

Wind Tunnels of the Western Hemisphere

Subsonic | **United States**

Installation Name	Test Section Size	Temperature Range
Georgia Institute of Technology, Aerospace, Transportation and Advanced Systems Laboratory (ATAS), Atlanta, Georgia, USA	1.07 x 1.07 m²	
	Speed Range	**Reynolds Number (max)**
	10 to 78 ft/sec	
Facility Name	**Cost**	**Dynamic Pressure**
Low Speed Wind Tunnel (LSWT)		
	Operational Status	**Stagnation Pressure**

Testing Capabilities

Data Acquisition

Current Programs

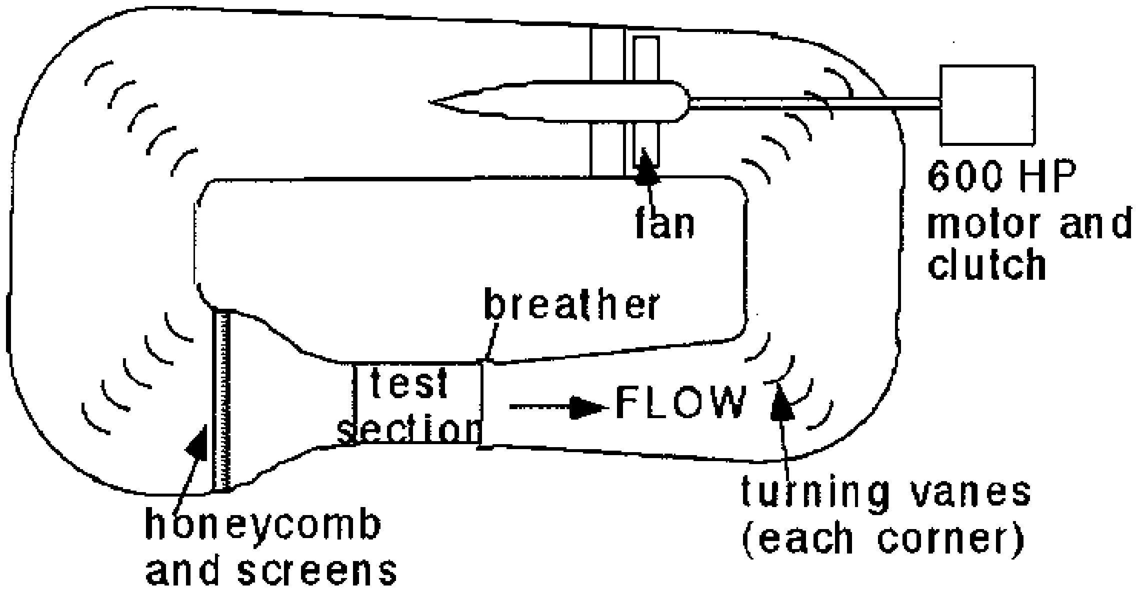
Capabilities include measurements for lift, drag, pitch, roll, yaw, pressure, flow visualization, and particle-image velocimetery.

Planned Improvements

User Fees

Contact Information

Jim McMichael, Georgia Institute of Technology, Aerospace, Transporation and Advanced Systems Laboratory (ATAS), 400 W. 10th Street, N.W., Atlanta, Georgia 30332-0801; Tel (McMichael): (770) 528-7123; Fax (McMichael): (770) 528-3271; Email (McMichael): james.mcmichael@gtri.gatech.edu; Web site: http://www.gtri.gatech.edu/atas/facil_flightsim.html.



Low Speed Wind Tunnel (LSWT),
Georgia Institute of Technology,
Georgia Tech Research Institute (GTRI)
Aerospace, Transportation, and Advanced Systems (ATAS) Laboratory,
Atlanta, Georgia USA

Wind Tunnels of the Western Hemisphere

Subsonic **United States**

Installation Name	Test Section Size	Temperature Range
Georgia Institute of Technology, Aerospace, Transportation, and Advanced Systems Laboratory (ATAS), Atlanta, Georgia, USA	4.3 x 4.3 x 6.1 m³	
	Speed Range	**Reynolds Number (max)**
	Up to 105 m/sec	
Facility Name	**Cost**	**Dynamic Pressure**
Anechoic Flight Simulation Facility		
	Operational Status	**Stagnation Pressure**
	Presumed active as of January 2007.	

Testing Capabilities

Test chamber mounted on springs for isolation; 99% anechoic down to 200 Hz.

Data Acquisition

Current Programs

Simulates flight on supersonic heated jets; conditions affecting propellers, aircraft, automobiles, and other items/vehicles.

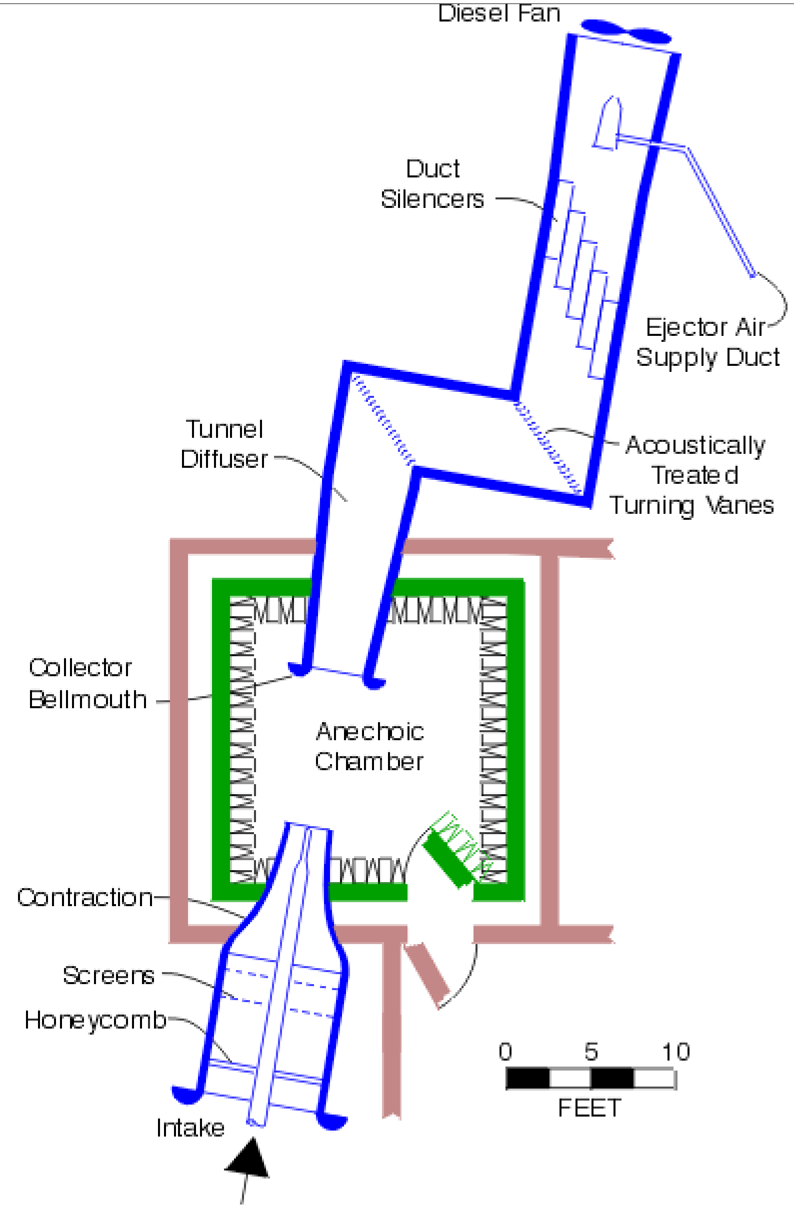
Planned Improvements

User Fees

Contact Information

Jim McMichael, Georgia Institute of Technology, Aerospace, Transporation and Advanced Systems Laboratory (ATAS), 400 W. 10th Street, N.W., Atlanta, Georgia 30332-0801; Tel (McMichael): (770) 528-7123; Fax (McMichael): (770) 528-3271; Email (McMichael): james.mcmichael@gtri.gatech.edu; Web site: http://www.gtri.gatech.edu/atas/facil_flightsim.html.

Anechoic Flight Simulation Facility,
Georgia Institute of Technology, Aerospace,
Transportation, and Advanced Systems Laboratory (ATAS),
Atlanta, Georgia USA



Installation Name	Test Section Size	Temperature Range
Georgia Institute of Technology, Daniel Guggenheim School of Aerospace Engineering, Atlanta, Georgia, USA	7 x 9 ft^2	Ambient
	Speed Range	**Reynolds Number (max)**
	10 to 220 ft/sec	1.2
Facility Name	**Cost**	**Dynamic Pressure**
John J. Harper Low Speed Wind Tunnel		
	Operational Status	**Stagnation Pressure**
	Confirmed active since 1930.	Atmospheric

Testing Capabilities

Closed-circuit tunnel driven by a 600 hp, dc motor; turbulence levels below 0.3%; rotorcraft flow diagnostics; extensively used in rotor-vortex diagnostics and rotor/airframe-interaction research; 6 d.o.f. aircraft-model load tests; laser-Doppler velocimetry; particle-image velocimetry; unsteady pressures/DSP; flow imaging with pulsed NdYaG lasers; wind-driven dynamic manipulator.

Data Acquisition

PC-based, LabView, and custom software; image acquisition/flow visualization by digital video; multichannel A/D and DSP.

Current Programs

Sponsored research at the doctoral level; testing for industry, including rotorcraft aerodynamic interactions and other vortex-flow problems, such as twin-tail buffeting; forebody asymmetry control; development of a multiple-degree-of-freedom, Wind Driven Manipulator; rotor-dynamic stall; rotorcraft hub drag; and Helidyne development.

Planned Improvements

1929 (constructed); 1950s (upgraded closed section); 1983 (upgraded control room and rotor-testing capabilities); 1994 (upgraded office space); 1982 to present (frequent instrumentation upgrades). Planned improvements: new high-advance ratio and dynamic-stall rotor set-up (2007).

User Fees

Contact Information

Dr. Narayanan Komerath (Professor), Georgia Institute of Technology, School of Aerospace Engineering, 225 First Drive, Atlanta, Georgia 30332-0150; Tel (Komerath): (404) 894-3017; Email (Komerath): narayanan.komerath@aerospace.gatech.edu; Web site: http://www.ae.gatech.edu.

NO IMAGE AVAILABLE

Installation Name

Georgia Institute of Technology, Daniel Guggenheim School of Aerospace Engineering, Atlanta, Georgia, USA

Facility Name

Low Speed Aero-Controls Wind Tunnel

Test Section Size

1.07 x 1.07 m² (42 x 42 in²)

Speed Range

10 to 78 ft/sec

Cost

Operational Status

Confirmed active as of January 2007.

Temperature Range

Reynolds Number (max)

Dynamic Pressure

Stagnation Pressure

Testing Capabilities

Test section powered by a 50 hp, Magnetek, frequency-controlled ac motor, with 7 moving blades and 10 stators; mean airspeed: 78 ft/sec; mean turbulence intensity: 16%; background noise at max speed: 90 dB; flow angularity: 1% vertical; similar to Basic Aerodynamics Research Tunnel at NASA Langley Research Center.

Data Acquisition

Current Programs

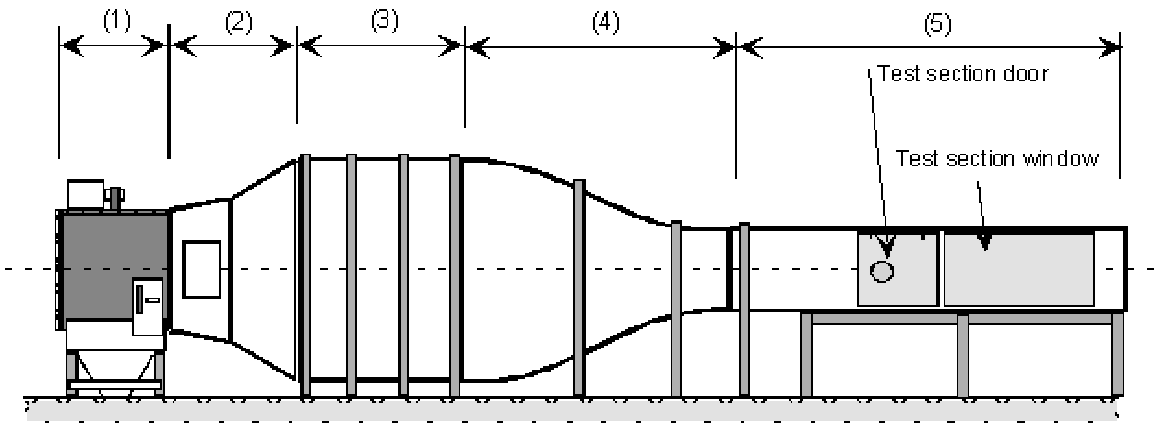
Planned Improvements

1998 (new fan installed); 1999 (tunnel redesigned).

User Fees

Contact Information

Dr. Narayanan Komerath (Professor), Georgia Institute of Technology, School of Aerospace Engineering, 225 First Drive, Atlanta, Georgia 30332-0150; Tel (Komerath): (404) 894-3017; Email (Komerath): narayanan.komerath@aerospace.gatech.edu; Web site: http://www.ae.gatech.edu.



Low Speed Aero-Controls Wind Tunnel,
Georgia Institute of Technology,
School of Aerospace Engineering,
Atlanta, Georgia USA

Installation Name	Test Section Size	Temperature Range
Gevers Aircraft, Inc., Lafayette, Indiana, USA	19 x 27 x 48 in³	
	Speed Range	**Reynolds Number (max)**
	120 mph	
Facility Name		**Dynamic Pressure**
19 x 27 in Wind Tunnel	**Cost**	
	US$500 (construction cost)	**Stagnation Pressure**
	Operational Status	
	Presumed active as of December 2006.	

Testing Capabilities
Inlet Bell (entrance cone); plywood walls; plywood reinforcing ribs.

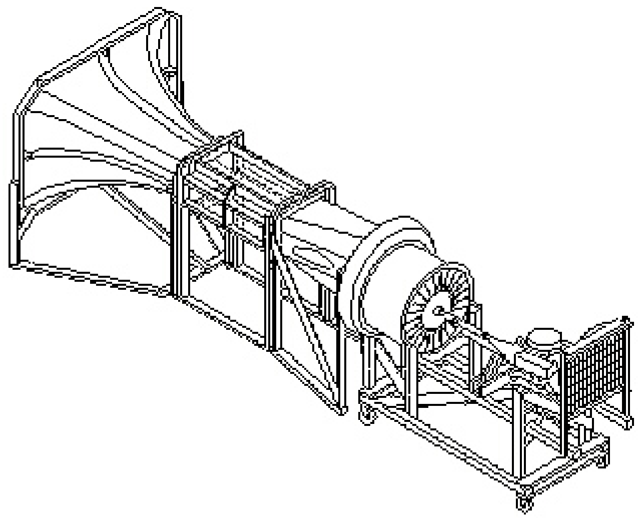
Data Acquisition

Current Programs
Aircraft components; RC models; automotive components; building ventilation systems.

Planned Improvements
1985 (constructed).

User Fees
User fees depend upon types of testing being performed.

Contact Information
Gevers Aircraft, Inc., 2251 Staggerwing Lane, Lafayette, Indiana 47909; Tel: (765) 577 0013; Email: testlab@geversaircraft.com; Web site: http://www.geversaircraft.com.



19 x 27 in Wind Tunnel,
Gevers Aircraft, Inc.,
Lafayette, Indiana USA

Installation Name	Test Section Size	Temperature Range
Gevers Aircraft, Inc., Lafayette, Indiana, USA	5 x 7 x 12 ft^3	
	Speed Range	**Reynolds Number (max)**
	Up to 200 mph	
Facility Name		**Dynamic Pressure**
5 x 7 ft Wind Tunnel	**Cost**	
		Stagnation Pressure
	Operational Status	
	Presumed active as of December 2006.	

Testing Capabilities
10 ft diameter fan with 15 adjustable pitch blades.

Data Acquisition
Six-component scales; fully automated computer data acquisition system.

Current Programs
Aircraft components, RC models, automotive components, building ventilation systems.

Planned Improvements

User Fees
User fees depend upon types of testing being performed.

Contact Information
Gevers Aircraft, Inc., 2251 Staggerwing Lane, Lafayette, Indiana 47909; Tel: (765) 577 0013; Email: testlab@geversaircraft.com; Web site: http://www.geversaircraft.com

NO IMAGE AVAILABLE

Installation Name	Test Section Size	Temperature Range
Lockheed Martin, Wind Tunnel Test Group, Smyrna, Georgia, USA	23 x 16 x 43 ft³ (low speed); 26 x 30 x 63 ft³ (V/STOL)	Ambient, kept at <35°C by cooling
	Speed Range	**Reynolds Number (max)**
	40 to 300 ft/sec (low speed); 20 to 150 (V/STOL)	3.6
Facility Name	**Cost**	**Dynamic Pressure**
Low Speed Wind Tunnel (LSWT)		2 to 105 psf (low speed); 0.5 to 26 (V/STOL)
	Operational Status	**Stagnation Pressure**
	Presumed active as of May 2006.	Ambient

Testing Capabilities

Closed; solid construction; single return; 12,000 hp; 9 MW; internal/external balances; raised floorboard; floor blowing; 330 psi, 2,250 kPa; 20 pps; 45 kg/sec.

Data Acquisition

Main frame VAX 8530; PC I/O peripherals; 128 analog; 32 pulse-digital; scanivalve HYSCAN 2000 for ESPs; Fortran programs used to present raw or reduced data in tabular or plotted form.

Current Programs

Testing of V/STOL or conventional low-speed aerospace models and industrial models, such as automobiles; 6-component reaction forces; model orifice pressure readings; anemometer velocity acquisition; flow visualization (smoke flow, paint, oil and tufts).

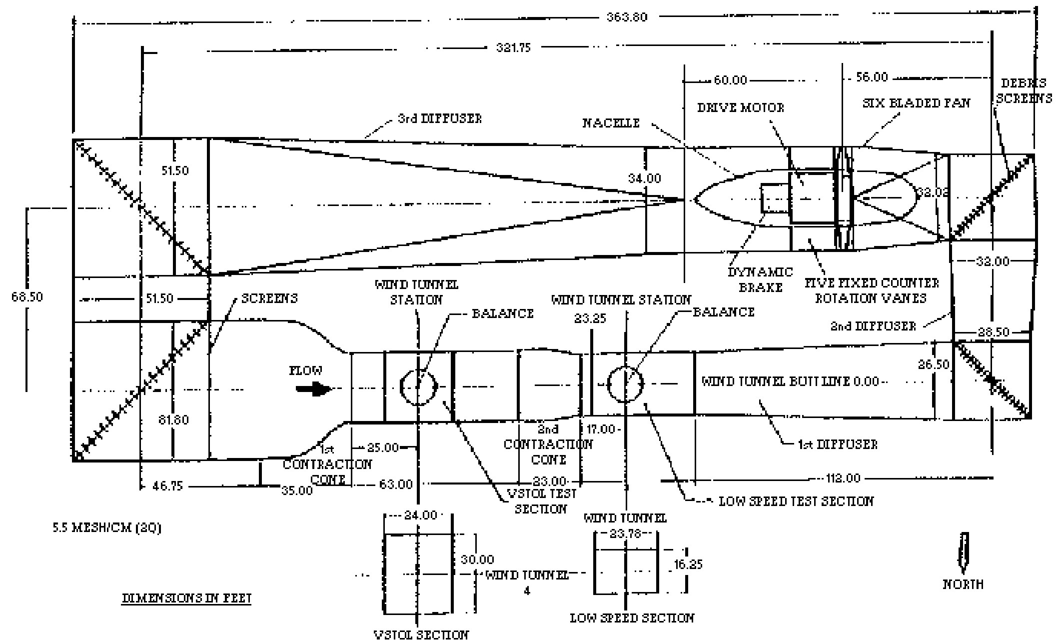
Planned Improvements

1967 (constructed).

User Fees

Contact Information

Joe Patrick (Lead Engineer), Lockheed Martin, Wind Tunnel Test Group, Low Speed Wind Tunnel, 1055 Richardson Rd., Smyrna, GA 30080-1040; Tel: (770) 494-5619; Fax: (770) 494-4790; Email: joe.patrick@lmco.com; Web site: http://www.lockheedmartin.com.



Motor in nacelle
Variable Speed
Scherbius Electronic Control System
with energy recovery
39 ft (11.9 m) diam.
6 blades fan
5 blades fixed
250 rpm max.

Exterior water
spray cooling
7000 US gal./min.
27 m³/min.

Circuit Length
780 ft, 238 m.

Circuit Volume
10^6 ft^3, 16.4×10^3 m^3

Low Speed Wind Tunnel (LSWT),
Lockheed Martin, Wind Tunnel Test Group,
Smyrna, Georgia USA

Installation Name	Test Section Size	Temperature Range
Massachusetts Institute of Technology (MIT), Department of Aeronautics and Astronautics, Cambridge, Massachusetts, USA	7.5 x 10 x 15 ft^3	0 to 100°F
	Speed Range	**Reynolds Number (max)**
	0 to 0.25 Mach	0 to 1.8
Facility Name	**Cost**	**Dynamic Pressure**
Wright Brothers Wind Tunnel (WBWT)	US$3 to 4 million	0 to 67 psf
	Operational Status	**Stagnation Pressure**
	Confirmed active as of January 2007.	83 psf

Testing Capabilities
Closed-return, closed, elliptical test section; 6-component, main, external, mechanical balance for loads up to 3,000 lbs; internal strain-gauge balances for sting mounts; model components for loads up to 100 lbs; auxiliary air supplies for propulsion units; injection; boundary-layer control; continuous-flow rates of 1.5 or 0.5 pps at 60 or 125 psi; intermittently 4 pps at 100 psi and 9 pps at 22 psi.

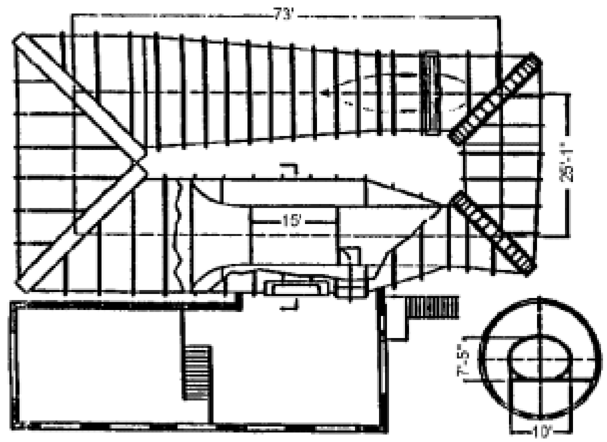
Data Acquisition
32-channel digital data recording; scanivalves and Setra transducer with flat frequency to 800 Hz; flow visualization with surface oils, attached tufts, smoke, and photography.

Current Programs
Aircraft development, unsteady airfoil flow-field study; nacelle-induced vortex generation; ground-plane influence; gust interactions; rotary wings; primary use for student projects, research, and instruction; also available for commercial research and development.

Planned Improvements
1937 (constructed); 2000 (upgrades); planned improvements: computer/instrumentation upgrades, possible main drive upgrades.

User Fees
USD $425/hr, min 4 hrs.

Contact Information
R.F. Perdichizzi, Massachusetts Institute of Technology, Department of Aeronautics and Astronautics, 77 Massachusetts Avenue, Cambridge, MA 02139-4307; Tel: (617) 253 1000; Email (General): wbwt@mit.edu; Email: (Perdichizzi): dickp@mit.edu; Web site: http://mit.edu/aeroastro/www/labs/WBWT.



Wright Brothers Wind Tunnel (WBWT),
Massachusetts Institute of Technology,
Department of Aeronautical Engineering,
Cambridge, Massachusetts USA

Subsonic | **United States**

Installation Name	***Test Section Size***	***Temperature Range***
National Aeronautics and Space Administration (NASA), Ames Research Center, Moffet Field, California, USA	11.3 x 11.3 x 28 ft^3, 12 ft diameter	Up to 540 to 610°R (stagnation)
	Speed Range	***Reynolds Number (max)***
Facility Name	0.05 to 0.55 Mach	0.1 to 12
12 ft Pressure Wind Tunnel	***Cost***	***Dynamic Pressure***
	Operational Status	***Stagnation Pressure***
	Currently in mothball status.	2.0 to 8.0 psia

Testing Capabilities

Closed circuit; single return; variable density; solid wall; low turbulence; rear-sting strut with variable pitch and roll; high-angle-of-attack turntable and dual-strut turntable; semispan mounting; internal, strain-gauge balances; multiple, fluctuating-pressures measurements; temperature-controlled, auxiliary, high pressure (3,000 psi); X-terminal based; core flow quality.

Data Acquisition

Current Programs

High-lift systems for commercial transports and military aircraft; high-angle-of-attack testing of maneuvering aircraft; and high-Reynolds-number research.

Planned Improvements

User Fees

Contact Information

John Holmberg (Facility Manager), Don Nickison (Division Chief), Unitary Wind Tunnels, NASA Ames Research Center, Moffet Field, CA; Tel (General): (650) 604-5000; Tel (Nickison): (650) 604-1748; Fax (Nickison): (650) 604-4357; Email (Nickison): Donald.J.Nickison@nasa.gov; Email (Holmberg): John.L.Holmberg@nasa.gov; Web site: http://aocentral.arc.nasa.gov/12ft1.html.

12 ft Pressure Wind Tunnel,
National Aeronautics and Space Administration (NASA),
Ames Research Center,
Moffet Field, California USA

Installation Name	Test Section Size	Temperature Range
National Aeronautics and Space Administration (NASA), Ames Research Center, National Full-Scale Aerodynamics Complex (NFAC), Moffet Field, California, USA	80 x 120 ft²	485 to 580°R
	Speed Range	**Reynolds Number (max)**
	0 to 0.15 Mach (0 to 100 kn)	0 to 1.2
Facility Name	**Cost**	**Dynamic Pressure**
NFAC 80 x 120 ft Wind Tunnel		33 psf
	Operational Status	**Stagnation Pressure**
		Atmospheric

Testing Capabilities

Larger part of closed-circuit, single-return NFAC wind tunnel; open, indraft, continuous-flow, closed-throat circuit; 135,000 hp; 106 MW power; PSI pressure system; internal balances; no ground effects; 3,000 psi air-supply system; 35 pps air-mass flow; sound-absorbent lining; test section's balance system measures the forces for 6° of freedom.

Data Acquisition

Real-time DEC PDP 11/84; main computer DEC VAX 8650; analog recording on 200 channel; max sampling rate 96,000 s/sec; digital on 20 channels, using Teledy.

Current Programs

Low- and medium-speed aerodynamic characteristics of high-performance aircraft, rotorcraft, fixed-wing, powered-lift V/STOL aircraft; size makes it ideal for testing large- or full-scale models and prototypes, including full-scale rotors.

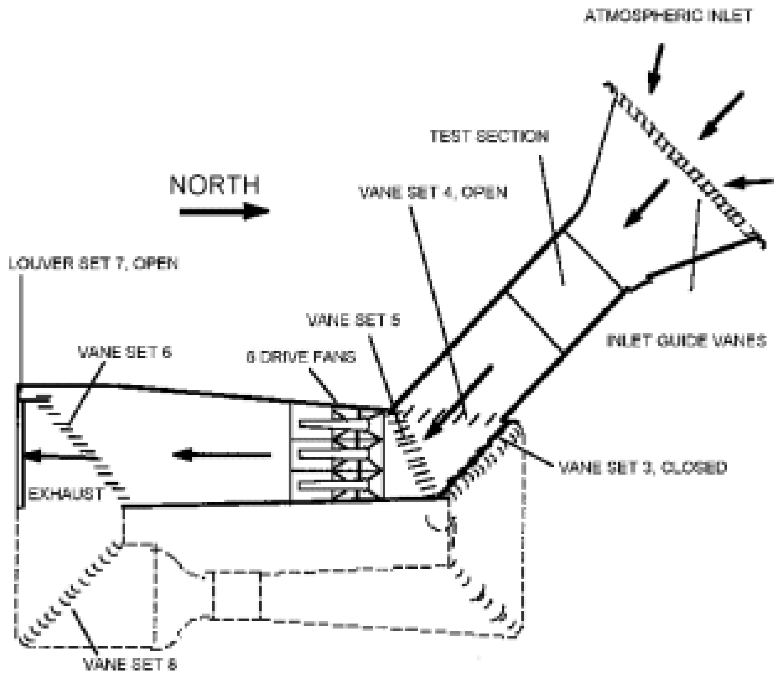
Planned Improvements

1982 (constructed).

User Fees

Contact Information

Don Nickison (Division Chief), John Holmberg (Facility Manager), NASA Ames Research Center, Moffet Field, CA 94035; Tel (General): (650) 604 5000; Tel (Nickison): (650) 604 1748; Fax (Nickison): (650) 604 4357; Email (Nickison): Donald.J.Nickison@nasa.gov; Email (Holmberg): John.L.Holmberg@nasa.gov; Web site: http://windtunnels.arc.nasa.gov/nfac80120.html. To arrange for testing: V. Albert, U.S. Air Force (which now operates the 80 x 120); Email (Albert): valbert@nfac.nasa.gov.



NFAC 80 x 120 ft Wind Tunnel,
National Aeronautics and Space Administration (NASA),
Ames Research Center,
National Full-Scale Aerodynamics Complex (NFAC),
Moffett Field, California USA

Installation Name
National Aeronautics and Space Administration (NASA), Glenn Research Center, Cleveland, Ohio, USA

Facility Name
9 x 15 ft Low Speed Wind Tunnel

Test Section Size
9 x 15 x 28 ft^3

Speed Range
0 to 0.2 Mach

Cost

Operational Status
Presumed active as of March 2007.

Temperature Range
-90°F ambient

Reynolds Number (max)
0 to 1.4

Dynamic Pressure
0 to 72 psf

Stagnation Pressure
Atmospheric

Testing Capabilities
Gaseous hydrogen fuel system; high-pressure air; altitude exhaust; 1,000, 2,000, and 5,000 hp, fan-drive rig systems; Rotor Alone Nacelle System; dynamic-actuation system; and a variety of research-test hardware.

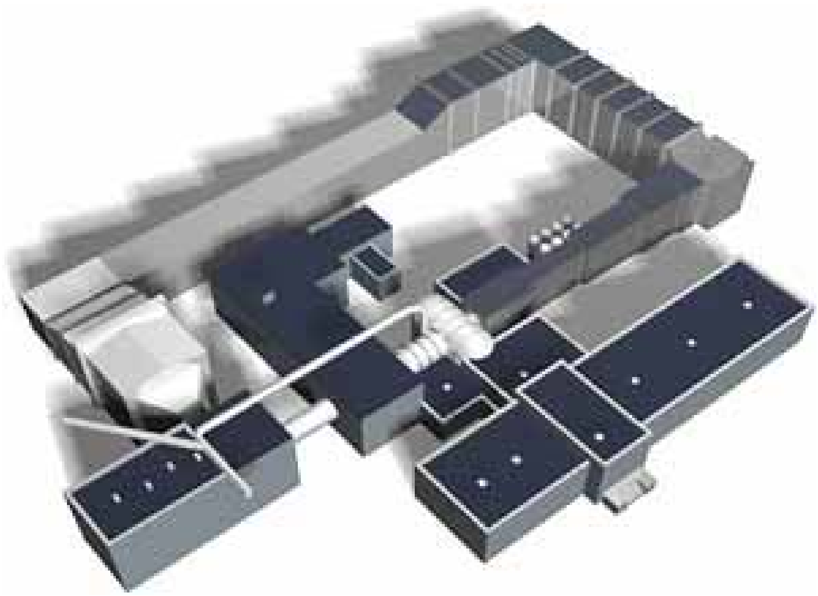
Data Acquisition
1,024-channel, pressure measurement system; ESCORT; dynamic data system; paint; Schlieren systems; sheet laser; oil flow; high-speed video, flow visualizations; test-article controls; and remote-access control room.

Current Programs
Evaluating aerodynamic performance and acoustic characteristics of fans, nozzles, inlets, propellers; testing hot gas-ingestion of advanced, short-takeoff, vertical-landing (STOVL) systems.

Planned Improvements
1968 (constructed).

User Fees

Contact Information
David E. Stark (Facility Manager), 9 x15 Subsonic Wind Tunnel at NASA Glenn Research Center, 21000 Brookpark Rd., Cleveland, OH 44135; Tel (General): (216) 433-4000; Tel (Stark): (216) 433-2922; Fax (Stark): (216) 433-8551; Email (Stark): David.E.Stark@nasa.gov; Web site: http://facilities.grc.nasa.gov.



9 x 15 ft Low Speed Wind Tunnel (LSWT),
National Aeronautics and Space Administration (NASA),
Glenn Research Center,
Cleveland, Ohio USA

Installation Name	**Test Section Size**	**Temperature Range**
National Aeronautics and Space Administration (NASA), Langley Research Center, Wind Tunnel Enterprise, Hampton, Virginia, USA	12 x 12 x 15 ft³	
	Speed Range	**Reynolds Number (max)**
	7 psf	0.492
Facility Name		**Dynamic Pressure**
12 ft Low Speed Tunnel	**Cost**	
		Stagnation Pressure
	Operational Status	
	Confirmed active as of January 2007.	

Testing Capabilities

Atmospheric pressure; open-circuit tunnel with a 60 ft-diameter shere enclosure; test-section airflow produced by a 15.8 ft-diameter, 6-blade drive fan powered by a 280 hp, 600 V, 600 rpm, dc motor; controlled by a 500 hp, ac motor, which drives a field-controlled generator.

Data Acquisition

Unix-based computer system to create and store static or dynamic force, moment, and surface pressure measurement data, rig motion control, data reduction, and plotting; S-VHS video cameras and video tape decks available for recording views of the model and test section while tunnel is operating.

Current Programs

Advanced aerospace technologies and vehicle concepts, including static, dynamic, and free-to-roll characteristics.

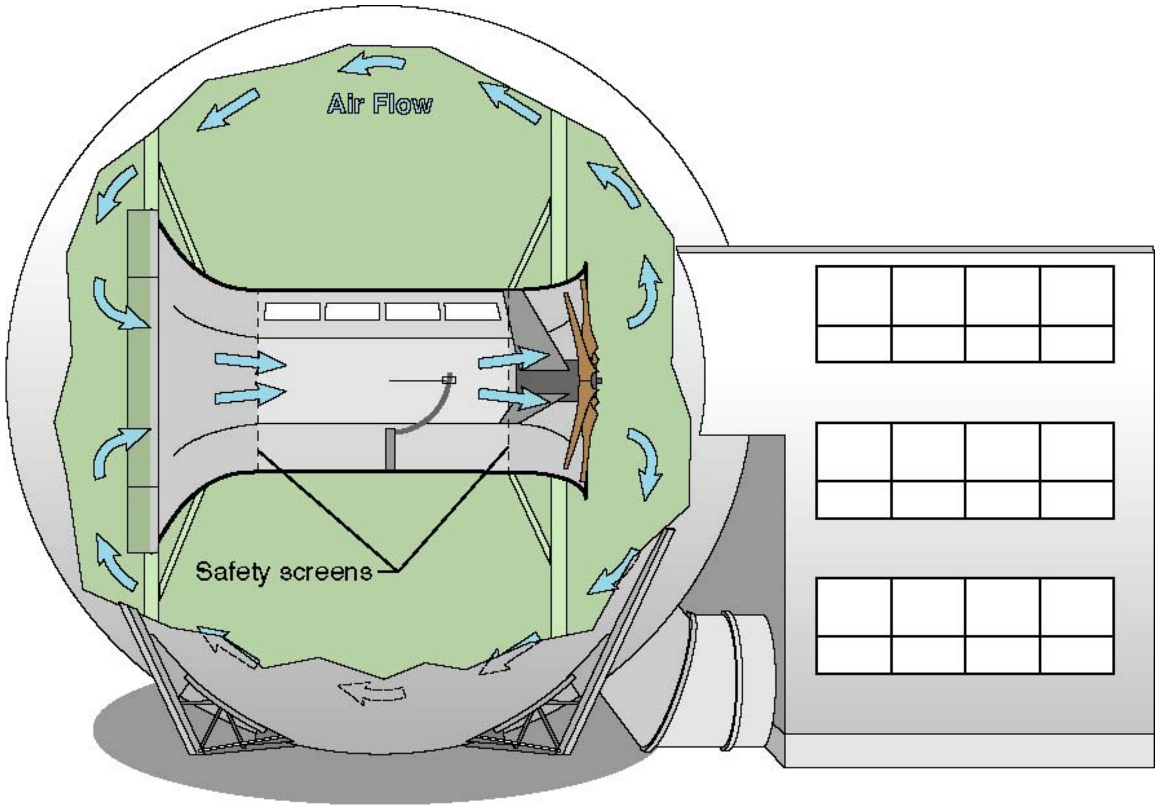
Planned Improvements

User Fees

US$5,000/day.

Contact Information

Raymond D. Whipple, Flight Dynamics Branch, Airborne Systems, NASA Langley Research Center, Mail Stop 308, Hampton, VA 23681-2199; Tel: (757) 864 1194; Fax: (757) 864 7722; Email (Whipple): Raymond.D.Whipple@nasa.gov; Web site: http://windtunnels.larc.nasa.gov/facilities_updated/flight_dynamics/12foot.htm.



12 ft Low Speed Tunnel,
National Aeronautics and Space Administration (NASA),
Langley Research Center,
Wind Tunnel Enterprise,
Hampton, Virginia USA

Installation Name	Test Section Size	Temperature Range
National Aeronautics and Space Administration (NASA), Langley Research Center, Wind Tunnel Enterprise, Hampton, Virginia, USA	14 x 21.74 x 50 ft³	
	Speed Range	**Reynolds Number (max)**
	348 ft/sec	0 to 2.2
Facility Name	**Cost**	**Dynamic Pressure**
14 x 22 ft Subsonic Wind Tunnel		144 psf
	Operational Status	**Stagnation Pressure**
	Presumed active as of March 2007.	

Testing Capabilities

Atmospheric, closed return; models mounted on carts; includes ground-effects, high-angle-of-attack, rotorcraft, forced-oscillation, or semi-span testing; test gas: air; test-section airflow produced by a 40 ft diameter, 9-blade fan, powered by a 12,000 hp, solid-state converter with synchronous motor.

Data Acquisition

Three Open Architecture Data Acquisition Systems (OADAS), 128 analog, 32 digital; up to 2,048 pressures from ESP module channels; 24-bit BCD; binary; datex; tachometer; resolver; RS-232; and GPIB device interfaces (static system); 72 channels; real-time digitization stored on removable disk drives.

Current Programs

Low-speed tests of powered and unpowered models of various fixed- and rotary-wing civil and military aircraft, such as the 757.

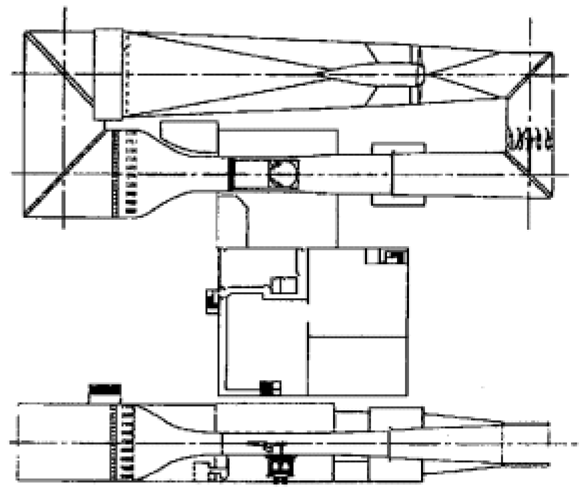
Planned Improvements

1970 (constructed); 1984 (mods to improve flow/expand capabilities for acoustic and rotorcraft testing); 1999 (automation system and new model carts added); 2001 (main drive motor replaced).

User Fees

Contact Information

14 x 22 Foot Subsonic Tunnel Manager, NASA Langley Research Center, Wind Tunnel Enterprise, Hampton, VA 23681-2199; Tel: (757) 864-5068; Fax: (757) 864-8820; Email: wte+fm_14x22@larc.nasa.gov; Web site: http://wte.larc.nasa.gov/facilities_updated/aerodynamics/ 14X22.htm.



14 x 22 ft Subsonic Wind Tunnel,
National Aeronautics and Space Administration (NASA)
Langley Research Center,
Wind Tunnel Enterprise,
Hampton, Virginia USA

Subsonic | **United States**

Installation Name	Test Section Size	Temperature Range
National Aeronautics and Space Administration (NASA), Langley Research Center, Wind Tunnel Enterprise, Hampton, Virginia, USA	20 x 25 ft^2	Ambient
	Speed Range	**Reynolds Number (max)**
	0 to 85 ft/sec	0 to 0.15
Facility Name	**Cost**	**Dynamic Pressure**
20 ft Vertical Spin Tunnel (VST)		0 to 8.5 psf
	Operational Status	**Stagnation Pressure**
	Confirmed active as of January 2007.	

Testing Capabilities

Closed-throat, annular return operating at atmospheric conditions, with 12-sided test section; test-section airflow produced by 3-blade, fixed-pitch fan; 400 hp, dc motor, equipped with control system allowing rapid changes in fan speed; result is maximum-flow accelerations in the test section of -25 ft/sec^2 to 15 ft/sec^2.

Data Acquisition

Vicon Nexus photogrammetry system; PC desktop platforms; Lab Windows.

Current Programs

Spinning, tumbling, and free-fall characteristics of aircraft and spacecraft.

Planned Improvements

1941 (constructed); 1991 (motor rewind); 1992 (new rotary balance system); 2006 (new data acquisition system); planned improvements: replace model-impact protection system, replace honeycomb (2007).

User Fees

US$5,000/day.

Contact Information

Raymond D. Whipple, Flight Dynamics Branch, Airborne Systems, NASA Langley Research Center, Mail Stop 308, Hampton, VA 23681-2199; Tel: (757) 864 1194; Fax: (757) 864 7722; Email (Whipple): Raymond.D.Whipple@nasa.gov; Web site: http://windtunnels.larc.nasa.gov/facilities_updated/flight_dynamics/20foot.htm.

NO IMAGE AVAILABLE

Installation Name	Test Section Size	Temperature Range
National Aeronautics and Space Administration (NASA), Langley Research Center, Wind Tunnel Enterprise, Hampton, Virginia, USA	3 x 7.5 x 7.5 ft^3	60 to 120°F
	Speed Range	**Reynolds Number (max)**
	0.05 to 0.5 Mach	0.4 to 15
Facility Name		**Dynamic Pressure**
Langley Low Turbulence Pressure Tunnel (LTPT)	**Cost**	0.1 to 5.0 psi
	Operational Status	**Stagnation Pressure**
	Presumed active as of March 2007.	14.7 to 150 psia

Testing Capabilities

Single return, closed circuit, continuous run time.

Data Acquisition

128-channel, A/D converter; 40 channels of digital data; Unix computer with separate Unix workstation.

Current Programs

2D and 3D airfoil testing: multielement, high-lift,, basic research and theory validation; 3D model testing: high-lift, model support/balance system; sidewall, boundary-layer control system; excellent flow-quality, boundary-layer, and wake-traverse systems.

Planned Improvements

User Fees

Contact Information

The Low Turbulence Pressure Tunnel Manager, NASA Langley Research Center, Wind Tunnel Enterprise, Hampton, VA 23681-2199; Tel: (757) 864-5068; Fax: (757) 864-8091; Email: wte+fm_ltpt@larc.nasa.gov; Web site: http://wte.larc.nasa.gov/.

NO IMAGE AVAILABLE

Installation Name	Test Section Size	Temperature Range
Naval Surface Warfare Center, Carderock Division (NSWCCD), Bethesda, Maryland, USA	Closed-jet section: 2.4 x 2.4 x 2.7 m³ (8 x 8 x 8.9 ft³); open-jet section: 7.2 x 7.2 x 6.4 m³ (23.5 x 23.5 x 21.1 ft³)	
Facility Name	**Speed Range**	**Reynolds Number (max)**
Anechoic Flow Facility	61 m/sec (200 ft/sec)	
	Cost	**Dynamic Pressure**
	Operational Status	**Stagnation Pressure**
	Confirmed active as of April 2006.	

Testing Capabilities

Atmospheric pressure-type, horizontal-plane, closed-circuit, continuous-flow, low-noise, low-turbulence, anechoic chamber; 3.5 m diameter, 24-blade, vane-axial fan; 10:1 contraction ratio; 1,596 kW (2,140-hp), 600 rpm, synchronous motor.

Data Acquisition

Microphones and associated instrumentation; hot-wire anemometers; digital spectral analyzers; minicomputers for data collection and online analysis; variable-frequency, motor-generator sets: 25 kVA, 0 to 400 Hz, 0.75 VHz or 1.5 VHz (2 units).

Current Programs

Details of flow-excited noise from structures, boundary-layer pressure fluctuations, and noise from model propulsors; commercial uses by automobile and aircraft industries and environmental applications; tests: aerodynamic and acoustic flow investigations in airframe noise; vortices, wakes, laminar and turbulent flows; general flow-noise research, including effects of appendages and protuberances, cavities, surface discontinuities, roughness, pressure gradients on flow and noise; measuring devices on the parameters to be measured.

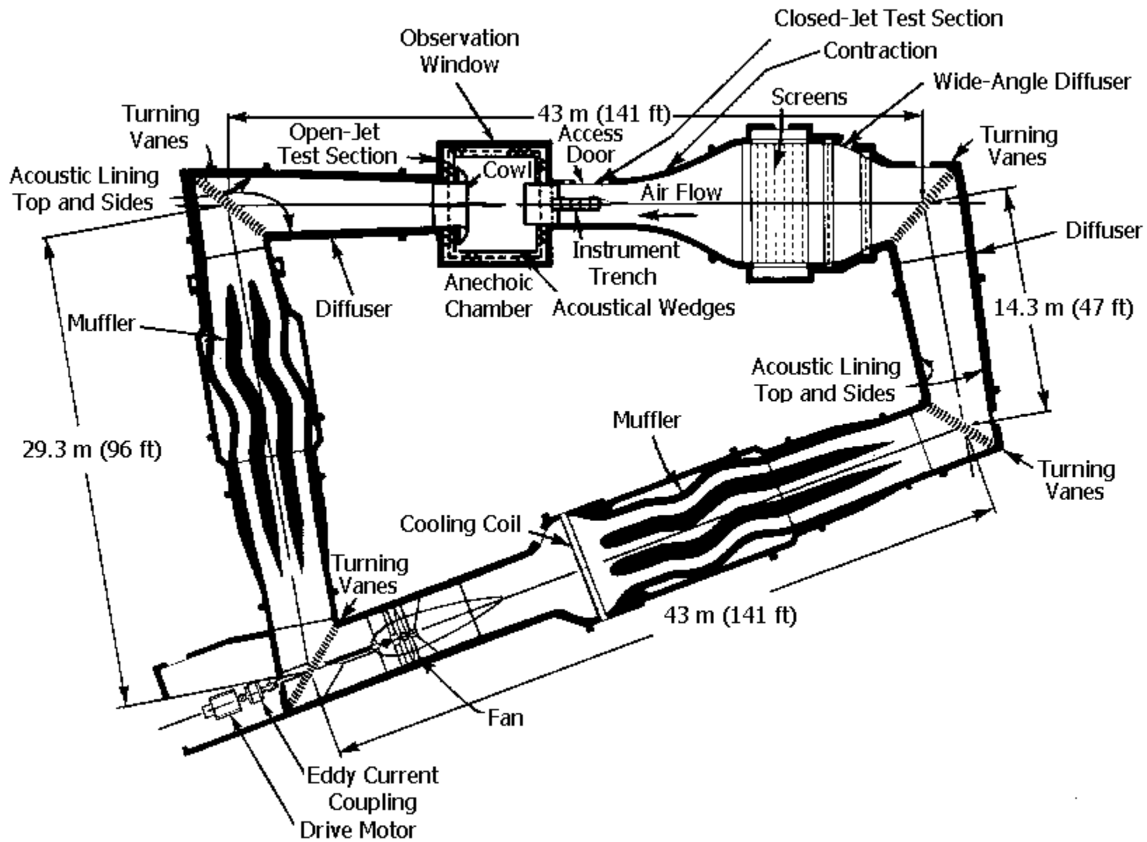
Planned Improvements

1971 (constructed).

User Fees

Contact Information

Anechoic Flow Facility, Carderock Division, Naval Surface Warfare Center, 9500 MacArthur Blvd., West Bethesda, MD 20817-5700; Tel: (301) 227-1251; Email: NSWCCDCode53Web@nswccd.navy.mil; Web site: http://www.dt.navy.mil/hyd/fac/ane-flo-fac/index.html.



Anechoic Flow Facility,
Naval Surface Warfare Center,
Carderock Division (NSWCCD),
Bethesda, Maryland USA

Wind Tunnels of the Western Hemisphere

Subsonic | **United States**

Installation Name	***Test Section Size***	***Temperature Range***
Naval Surface Warfare Center, Carderock Division (NSWCCD), Bethesda, Maryland, USA	8 x 10 x 14 ft³	50 to 100°F
	Speed Range	***Reynolds Number (max)***
Facility Name	10 to 275 ft/sec (80 m/sec, 185 mph, 160 kn/sec)	1.56
Subsonic Wind Tunnel	***Cost***	***Dynamic Pressure***
		0.1 to 90 psf
	Operational Status	***Stagnation Pressure***
	Confirmed active as of April 2006.	Atmospheric

Testing Capabilities

Continuous flow, closed circuit with closed jet test section; strut mounts with external balance or sting mounts with internal strain-gauge balances for model support; adjustable surface planes; welded steel construction with wood test section; full-width floor and ceiling turntables; 1,000 hp, Clymer-type drive, electric-induction motor fan; electric motors, hydraulic power, compressed air available.

Data Acquisition

DEC PDP-11; PCs on LAN; 32 channels; 250 kHz; A/D conversion; flow-visualization techniques include laser light sheet, smoke, liquid crystal, oil and tuft; full-digital data acquisition and reduction.

Current Programs

Quantitative and qualitative aerodynamic investigations of surface ships and components, submerged vehicles and appendages; aircraft and air vehicles; and structures for the U.S. Department of Defense, other U.S. government agencies, and private industry.

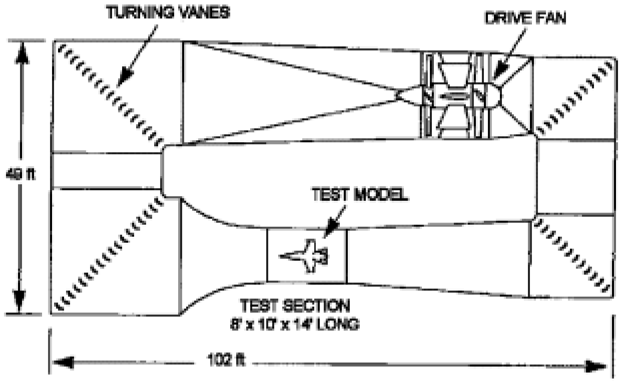
Planned Improvements

1943 (constructed).

User Fees

Contact Information

Subsonic Wind Tunnel, Carderock Division, Naval Surface Warfare Center, 9500 MacArthur Blvd., West Bethesda, MD 20817-5700; Tel: (301) 227 2540; Email: NSWCCDCode53Web@nswccd.navy.mil; Web site: http://www.dt.navy.mil/hyd/fac/sub-win-tun/index.html.



Subsonic Wind Tunnel,
Naval Surface Warfare Center,
Carderock Division (NSWCCD),
Bethesda, Maryland USA

Installation Name	Test Section Size	Temperature Range
Northrop Grumman Integrated Systems, Test Laboratories, El Segundo, California, USA	$10 \times 7 \times 20$ ft^3	
	Speed Range	**Reynolds Number (max)**
	Up to 300 mph	
Facility Name		**Dynamic Pressure**
7 x 10 ft Low Speed Wind Tunnel (NGC LSWT)	**Cost**	Up to 200 psf
	Operational Status	**Stagnation Pressure**
	Deactivated.	Atmospheric

Testing Capabilities

Closed return; 45° corner fillets; low turbulence levels; sting support system with 90° pitch capability; auxiliary air available; excellent visibility; high run-rate capability.

Data Acquisition

NEFF System 620 with 128 channels; controlled by a MicroVAX II computer; Sun workstations and PCs provide plotting and data analysis; high-capacity laser printers for printing plotted and tabulated data; FM mux or Tustin High Speed Acquisition System used to record dynamic data.

Current Programs

Low-speed, fighter-type aircraft, as well as other types of aircraft and unmanned vehicles; types of tests: aerodynamic force and moment, inlet systems, jet effects, and aeroelastic (flutter) testing.

Planned Improvements

1956 (constructed).

User Fees

Contact Information

Craig Norfleet (Contact), El Segundo Western Region Integrated Systems, Northrop Grumman Corporation, One Northrop Grumman Avenue, El Segundo, CA 90245-2804; Tel: (310) 332 1000; Fax: (310) 332 3066; Email: System_Test_Laboratories@ngc.com; Web site: http://www.is.northropgrumman.com/test/test_capabilities/wind_tunnel/wind_tunnel.html.

7 x 10 ft Low Speed Wind Tunnel (NGC LSWT),
Northrop Grumman Corporation,
El Segundo Western Region Integrated Systems,
El Segundo, California USA

Installation Name	***Test Section Size***	***Temperature Range***
Ohio State University, Aeronautical and Astronautical Research Laboratory (AARL), Columbus, Ohio, USA	3 x 5 ft²	
	Speed Range	***Reynolds Number (max)***
Facility Name	150 mph	
3 x 5 ft Subsonic Wind Tunnel		***Dynamic Pressure***
	Cost	
		Stagnation Pressure
	Operational Status	
	Presumed active as of December 2006.	

Testing Capabilities

Data Acquisition

Harris H800 superminicomputer for real-time data acquisition and analysis; two 21 in, grating spectrographs for studies in combustion and high-temperature gas flows; 5 W, argon-ion laser and associated optics for a 2-channel, laser-Doppler anemometer.

Current Programs

Planned Improvements

User Fees

Contact Information

Professor Gerald M. Gregorek (Director), Aero/Astro Research Laboratory, 2300 West Case Road, Columbus, Ohio 43235; Tel: (614) 292 5507 or 5491; Fax: (614) 292 5552; Web site: http://aerospace.eng.ohio-state.edu/research/index.php?contents=research.html.

NO IMAGE AVAILABLE

Installation Name
Ohio State University, Aeronautical and Astronautical Research Laboratory (AARL), Columbus, Ohio, USA

Facility Name
6 x 12 in Transonic/Subsonic Blow Down Wind Tunnel

Test Section Size
6 x 12 in²

Speed Range
0.2 to 1.1 Mach

Cost

Operational Status
Presumed active as of December 2006.

Temperature Range

Reynolds Number (max)
4 to 300

Dynamic Pressure

Stagnation Pressure

Testing Capabilities

Data Acquisition
Harris H800 superminicomputer for real-time data acquisition and analysis; two 21 in, grating spectrographs for studies in combustion and high-temperature gas flows; 5 W, argon-ion laser and associated optics for a 2-channel, laser-Doppler anemometer.

Current Programs

Planned Improvements

User Fees

Contact Information
Professor Gerald M. Gregorek (Director), Aero/Astro Research Laboratory, 2300 West Case Road, Columbus, Ohio 43235; Tel: (614) 292 5507 or 5491; Fax: (614) 292 5552; Web site: http://aerospace.eng.ohio-state.edu/research/index.php?contents=research.html.

NO IMAGE AVAILABLE

Wind Tunnels of the Western Hemisphere

Subsonic | **United States**

Installation Name	Test Section Size	Temperature Range
Ohio State University, Aeronautical and Astronautical Research Laboratory (AARL), Columbus, Ohio, USA	6 x 22 in²	
	Speed Range	**Reynolds Number (max)**
	0.2 to 1.1 Mach	2 to 12
Facility Name	**Cost**	**Dynamic Pressure**
6 x 22 in Transonic/Subsonic Blow Down Wind Tunnel		
	Operational Status	**Stagnation Pressure**
	Presumed active as of December 2006.	

Testing Capabilities

Data Acquisition

Harris H800 superminicomputer for real-time data acquisition and analysis; two 21 in, grating spectrographs for studies in combustion and high-temperature gas flows; 5 W, argon-ion laser and associated optics for a 2-channel, laser-Doppler anemometer.

Current Programs

Planned Improvements

User Fees

Contact Information

Professor Gerald M. Gregorek (Director), Aero/Astro Research Laboratory, 2300 West Case Road, Columbus, Ohio 43235; Tel: (614) 292 5507 or 5491; Fax: (614) 292 5552; Web site: http://aerospace.eng.ohio-state.edu/research/index.php?contents=research.html.

NO IMAGE AVAILABLE

Wind Tunnels of the Western Hemisphere

Subsonic | **United States**

Installation Name	Test Section Size	Temperature Range
Old Dominion University, College of Engineering and Technology, Norfolk, Virginia, USA	30 x 60 x 56 ft³	
	Speed Range	**Reynolds Number (max)**
	5 to 80 mph (0.1 Mach)	
Facility Name	**Cost**	**Dynamic Pressure**
Langley Full Scale Tunnel (LFST)		Atmospheric
	Operational Status	**Stagnation Pressure**
	Confirmed active as of January 2007.	

Testing Capabilities

Closed-circuit, three-quarter open jet; double-return, continuous-flow, quasi-elliptical, test-section cross section; powered by two, 4,000 hp, wound rotor, slip-ring, induction motors; also includes collector section, guide vanes, groundboard, and turntable; LFST located at Langley AFB in Hampton, Virginia; largest university-operated wind tunnel in the world.

Data Acquisition

Multiple, PC-based data systems using LabView software; primary system acquires data from trapeze automotive balance, internal strain-gauge balances, or full-scale balance; reduced data accessible in real time via local area network (LAN); secondary systems employed for acquisition of pressure and vane anemometer data.

Current Programs

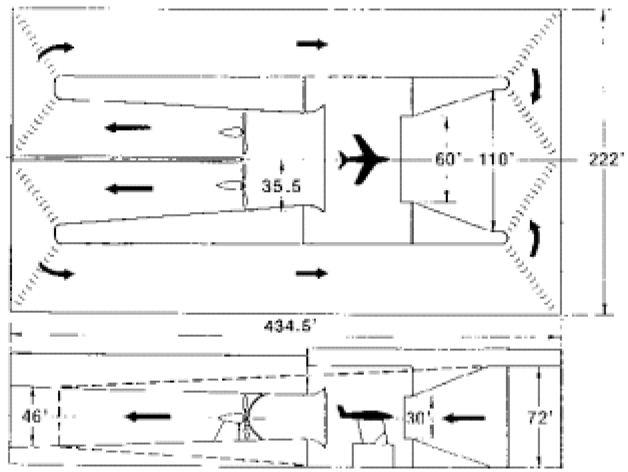
Full-scale/large-scale aerodynamic, airflow management, and acoustic testing; computational, fluid-dynamic simulations and research support; addresses diverse aerospace, surface vehicle, and specialty applications.

Planned Improvements

User Fees

Contact Information

Dr. Colin P. Britcher (Director of Research and Academic Programs), The Langley Full Scale Tunnel, P.O. Box 65309, Langley AFB, Virginia 23665-5309; Tel (Britcher): (757) 766 2266, ext. 102; Fax (Britcher): (757) 766 3104; Email (Britcher): britcher@aero.odu.edu; Web site: http://www.lfst.com.



Langley Full Scale Tunnel (LFST),
Old Dominion University,
College of Engineering and Technology,
Norfolk, Virginia USA

Installation Name
Purdue University, School of Aeronautics and Astronautic Engineering (AAE), Aerospace Sciences Lab (ASL), West Lafayette, Indiana, USA

Facility Name
Boeing Wind Tunnel

Test Section Size
#1: 4 x 6 ft^2, closed; #2: long, adapted for high-lift research

Speed Range
250 mph

Cost

Operational Status
Confirmed active as of November 2006.

Temperature Range

Reynolds Number (max)

Dynamic Pressure

Stagnation Pressure

Testing Capabilities
First test section equipped with 6-component, motorized, pitch-and-yaw balance system; 400 hp, ac motor, with GE electromechancial controller (war surplus vintage).

Data Acquisition
Two-component, laser-Doppler velocimeter system; computer data acquisition system.

Current Programs
Design testing.

Planned Improvements

User Fees

Contact Information
J.P. Sullivan (Professor), The Boeing Large Subsonic Wind Tunnel, Purdue University, School of AAE, Aerospace Sciences Lab (ASL), 315 N. Grant Street, West Lafayette, Indiana 47907-2023; Tel (General): (765) 494 3343; Tel (Sullivan-office): (765) 494 1279; Tel (Sullivan-lab): (765) 494 3344; Fax: (765) 496 3321; Email (Sullivan): john.p.sullivan.1@purdue.edu; Web site: https://engineering.purdue.edu/AAE/Academics/Courses/Raisbeck/wind_tunnels.htm#.

Boeing Wind Tunnel,
Aerospace Sciences Lab,
School of Aeronautics and Astronautic Engineering
Purdue University,
West Lafayette, IN USA

Subsonic | **United States**

Installation Name	***Test Section Size***	***Temperature Range***
Purdue University, School of Aeronautics and Astronautic Engineering (AAE), Aerospace Sciences Lab (ASL), West Lafayette, Indiana, USA	#1: 18 in (diameter); #2 & 3: 12 x 18 in	
Facility Name	***Speed Range***	***Reynolds Number (max)***
Low Speed Wind Tunnels	#1: 120 ft/sec; #2 & 3: 100 ft/sec	
	Cost	***Dynamic Pressure***
	Operational Status	***Stagnation Pressure***
	Confirmed active as of November 2006.	

Testing Capabilities

#1: Open-return facility; 2-component balance; 2 centrifugal fans with 15 hp electric motor; 25:1 contraction ratio; multiple screens; 10 ft cubic plenum; 0.3% freestream tubulence; 1% flow uniformity; #2 & 3: hot-wire probe.

Data Acquisition

Scanivalve and manometer bank.

Current Programs

Research on: numerical methods in aerodynamics; computational fluid mechanics; separated flow around wings and bodies at high angles-of-attack; aerodynamics of rotors and propellers; boundary layers, wakes and jets in V/STOL applications and aerodynamic noise; experimental measurements using laser systems; laminar-turbulent transition in high-speed boundary layers.

Planned Improvements

User Fees

Contact Information

Professor Thomas Farris, Purdue University, School of AAE, Aerospace Sciences Lab (ASL), 315 N. Grant Street, West Lafayette, IN 47907-2023; Tel: (765) 494 5117; Fax: (765) 494 0307; Email: farrist@purdue.edu; Web site: http://engineering.purdue.edu/AAE.

NO IMAGE AVAILABLE

Installation Name	Test Section Size	Temperature Range
Texas A&M University, Department of Aerospace Engineering, Wind Tunnel Complex, Flight Research Laboratory, College Station, Texas, USA	1.4 x 1.4 x 4.9 m³	
	Speed Range	**Reynolds Number (max)**
	35 m/sec	
Facility Name		**Dynamic Pressure**
Klebanoff-Saric Unsteady Wind Tunnel	**Cost**	
	US$2,500,000.00	**Stagnation Pressure**
	Operational Status	
	Under construction in 2007.	

Testing Capabilities

Ultra-low turbulence; closed-return facility; can generate oscillatory flows; powered by a 12 kW, variable-speed, dc motor and axial blower; also is a conventional low-turbulence wind tunnel; can simulate gusts and lulls of varying amplitude and frontal duration, to vary the intensity and scale of the free-stream turbulence.

Data Acquisition

Current Programs

Oscillatory flows for unsteady problems in low-speed aerodynamics; major sponsors include AFRL, AFOSR, DURIP, Northrop Grumman, Lockheed Martin, DARPA, NSF.

Planned Improvements

1984 (moved from National Bureau of Standards to Arizona State Univ); 1987 (became operational at ASU, upgrades done); 2003 (decommissioned at ASU, relocated to Texas A&M); currently undergoing building construction/tunnel reassembly.

User Fees

Contact Information

Dr. William S. Saric, (Director, Flight Research Laboratory), Texas A&M University, Department of Aerospace Engineering, 602C H.R. Bright Building, 3141 TAMU College Station, TX 77843-3141; Tel (Saric): (979) 862-1749; Fax (Saric): (979) 845-6051; Email: saric@tamu.edu; Web site: http://flight.tamu.edu/tunnel/tunnelcomplex.html.

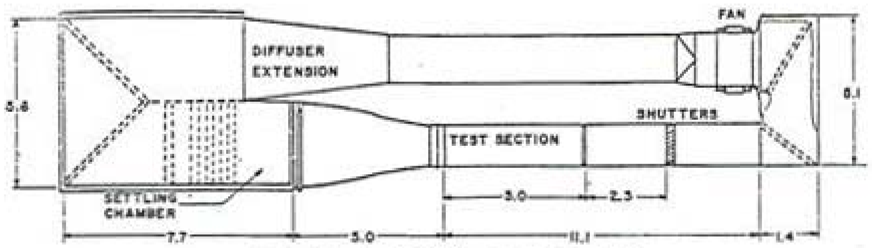


Fig. 1. Plan view of ASU Unsteady Wind Tunnel. All dimensions in meters.

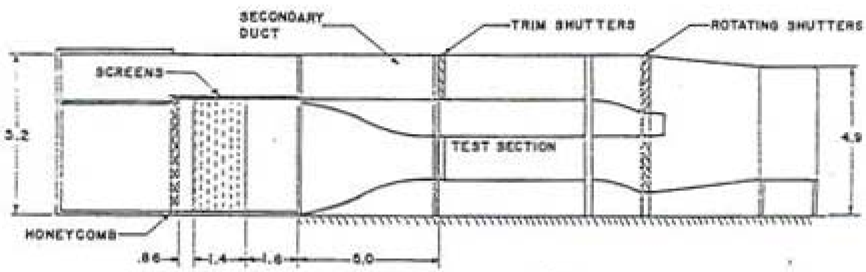


Fig. 2. Elevation of Test-Section Side of ASU Unsteady Wind Tunnel.

Klebanoff-Saric Unsteady Wind Tunnel,
Texas A& M University,
Department of Aerospace Engineering,
College Station, Texas USA

Installation Name	Test Section Size	Temperature Range
Texas A&M University, Department of Aerospace Engineering, Wind Tunnel Complex, Flight Research Laboratory, College Station, Texas, USA	7 x 10 x 12 ft³	Ambient
	Speed Range	**Reynolds Number (max)**
	0.25 Mach	1.8
Facility Name	**Cost**	**Dynamic Pressure**
Oran W. Nicks Low Speed Wind Tunnel		
	Operational Status	**Stagnation Pressure**
	Continuously active since 1980.	100 psf

Testing Capabilities

Solid/vented construction type; return circuit; 1,500 hp, 4-blade propellor; variable pitch; PSI 8400 pressure system; external and internal balances; ground effects; 2,300 psi air-supply system, and 2 pps air-mass flow.

Data Acquisition

Perkin Elmer 3210; HP PC & peripherals; stand-alone mainframe plus PC net; smoke wands, tempera paint, and kerosene; fluorescent oils and high-attitude robotic sting (HARS); traversing mechanism and tare and interference image system.

Current Programs

2D wing/airfoil, aircraft, bicycles, ground vehicles, missiles (for Raytheon, for example); offshore structures (such as oil rigs); power plants, and other structures; data types include force and moment, pressure, dynamics, endurance.

Planned Improvements

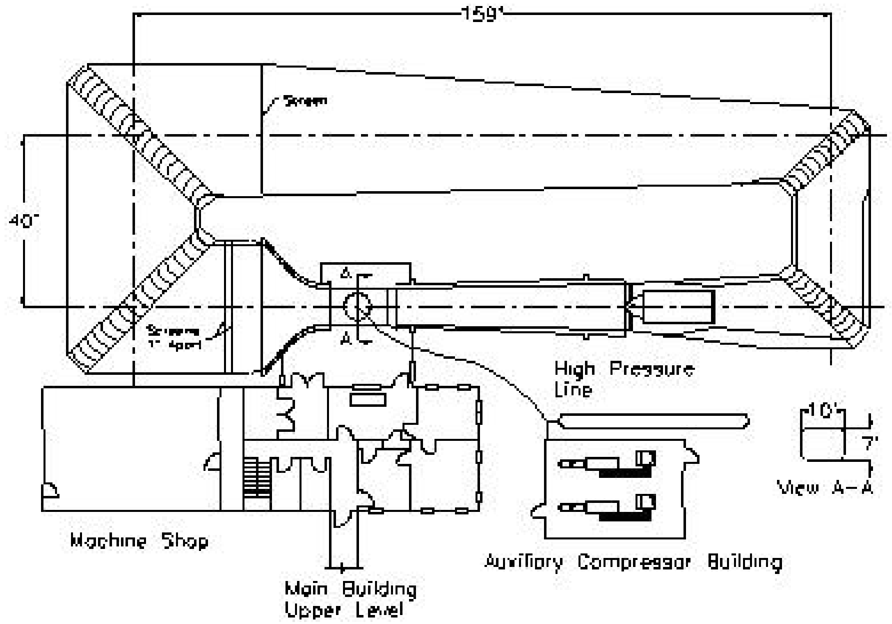
1950 (constructed); 1980 (upgrade).

User Fees

$350/hr (8 hrs/day, 5 days/wk).

Contact Information

Jorge L. Martinez (Director), OWN Low Speed Wind Tunnel, Texas A & M University, 1775 George Bush Drive West, College Station, TX 77845; Tel (Martinez): (979) 845-1028; Fax (Martinez): (979) 845-8191; Email (General): information@wind.tamu.edu; Email (Martinez): jorge.l.martinez@wind.tamu.edu, Web site: http://wind.tamu.edu/.



Oran W. Nicks Low Speed Wind Tunnel,
Texas A & M University,
College Station, Texas USA

Installation Name	Test Section Size	Temperature Range
University of Idaho, Department of Mechanical Engineering, Fluids and Heat Transfer Laboratory, Moscow, Idaho, USA	$18 \times 18 \times 36\ in^3$	Room temperature
	Speed Range	**Reynolds Number (max)**
	1 to 160 mph	
Facility Name	**Cost**	**Dynamic Pressure**
18 in Open Circuit Wind Tunnel	US$50,000	2,700 Pa
	Operational Status	**Stagnation Pressure**
	Confirmed active and in excellent condition as of December 2006.	

Testing Capabilities
Eiffel type; test section made of 3/4 in plexiglass with removable top, bottom, and ports.

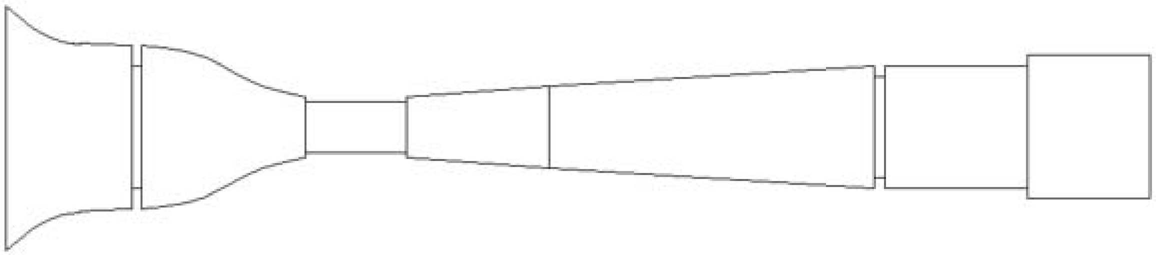
Data Acquisition
Drag force, lift force, airspeed, flow visualization.

Current Programs
Rocket, glider, parachute, electronics cooling, wind loading, human-powered vehicle; education and research.

Planned Improvements
2000 (delivered); 2002 (instrumentation completed); planned improvements: new smoke-wire assembly.

User Fees

Contact Information
Dr. Ralph S. Budwig (Department Chair), University of Idaho, Department of Mechanical Engineering, P.O. Box 440902, Moscow, Idaho 83844-0902; Tel: (208) 885-6579; Fax: (208) 885-9031; Email (Budwig): rbudwig@uidaho.edu; Web site: http://webs1.uidaho.edu.



18 in Open Circuit Wind Tunnel,
University of Idaho,
Department of Mechanical Engineering,
Moscow, Idaho USA

Installation Name	University of Kansas, Department of Aerospace Engineering, Lawrence, Kansas, USA
Facility Name	3 x 4 ft Subsonic Wind Tunnel
Test Section Size	36 x 51 x 72 in³
Speed Range	0.26 Mach (200 mph)
Cost	
Operational Status	Presumed active as of April 2007.
Temperature Range	Ambient
Reynolds Number (max)	2
Dynamic Pressure	90 psf
Stagnation Pressure	Ambient

Testing Capabilities

Data Acquisition

Current Programs

Planned Improvements

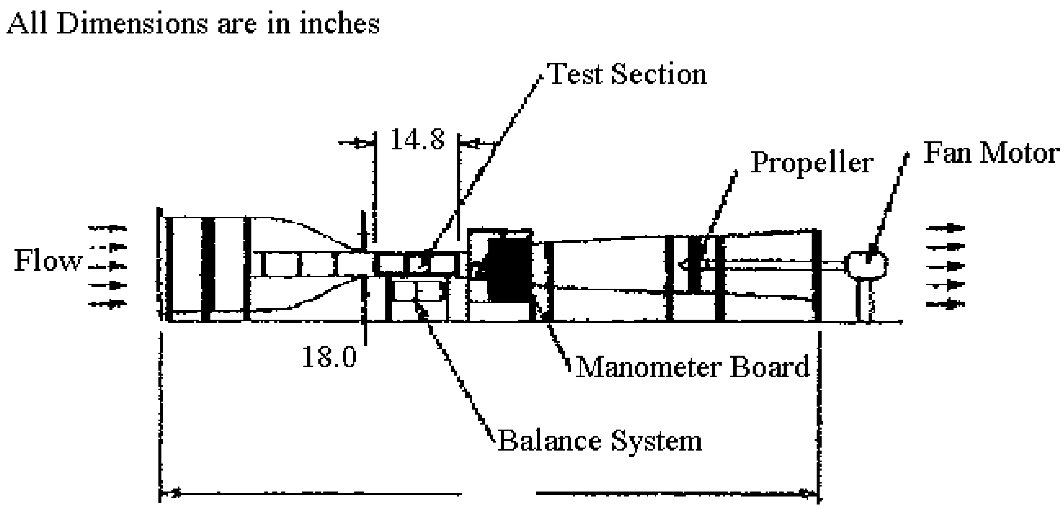
1965 (constructed).

User Fees

US$125/hr test-section occupancy (plus any overtime, report preparation, etc.).

Contact Information

D. Downing (Professor of Aerospace Engineering), The University of Kansas, Department of Aerospace Engineering, 2120 Learned Hall, Lawrence, KS 66045-7621; Tel: (785) 864-4267; Fax: (785) 864-3597; Email (Downing): drdrd@ku.edu; Email (General): aerohawk@ku.edu; Web site: http://www.engr.ku.edu/ae/facilities.htm.



**3 x 4 ft Subsonic Wind Tunnel,
University of Kansas,
Department of Aerospace Engineering,
Lawrence, Kansas USA**

Installation Name	Test Section Size	Temperature Range
University of Maryland, Department of Aerospace Engineering, College Park, Maryland, USA	7.75 x 11.04 x 12.0 ft^3 with corner fillets	Atmospheric (not controlled)
	Speed Range	**Reynolds Number (max)**
	0 to 0.3 Mach	2.2
Facility Name	**Cost**	**Dynamic Pressure**
Glenn L. Martin Wind Tunnel (GLMWT)		130 psf
	Operational Status	**Stagnation Pressure**
	Confirmed active as of January 2007 (daily operation).	Ambient

Testing Capabilities

Closed construction; single return; 2,250 hp fan power; external/internal balances; suction ground effects; 8 atm air supply system; 2.3 pps air-mass flow.

Data Acquisition

HP 9000/7x workstations; HP 743 with VXI Bus, HPIB.

Current Programs

Conventional airplanes; unmanned air vehicles; vertical takeoff and landing aircraft; submarines; ground vehicles; trucks; surface ships; keel and bulb study; antennas; buildings and other structures; military ejection seats and helmets; kites; migratory birds; athletic equipment; basic flow investigations; and turbofan-thrust reverser studies.

Planned Improvements

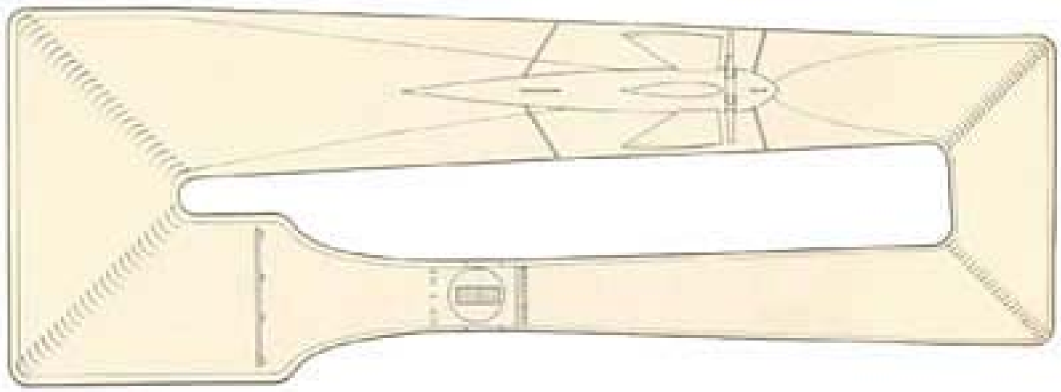
1947 (constructed); planned improvements: many upgrades including data recording and facility control systems; planning to upgrade the data system during the next decade.

User Fees

US$900/hr.

Contact Information

Dr. Jewel B. Barlow (Director), University of Maryland at College Park, Department of Aerospace Engineering, College Park, MD 20742; Tel: (301) 405-6861; Fax: (301) 314-9628; Email (Barlow): barlow@umd.edu; Web site: http://windvane.umd.edu.



Glenn L. Martin Wind Tunnel (GLMWT),
University of Maryland,
Department of Aerospace Engineering,
College Park, Maryland USA

Installation Name
University of Notre Dame, Department of Aerospace and Mechanical Engineering, Hessert Laboratory for Aerospace Research, Notre Dame, Indiana, USA

Facility Name
Anechoic Chamber and Wind Tunnel

Test Section Size
Cross-section of test region: 4 ft (0.37 m)

Speed Range
100 ft/sec (30.5 m/sec)

Cost

Operational Status
Presumed active as of February 2007.

Temperature Range

Reynolds Number (max)

Dynamic Pressure

Stagnation Pressure

Testing Capabilities
Low-turbulence, free-jet, closed test section; cut-off frequency about 100 Hz; energy-absorption level at 0.99 or greater; wind tunnel is removable from the anechoic chamber.

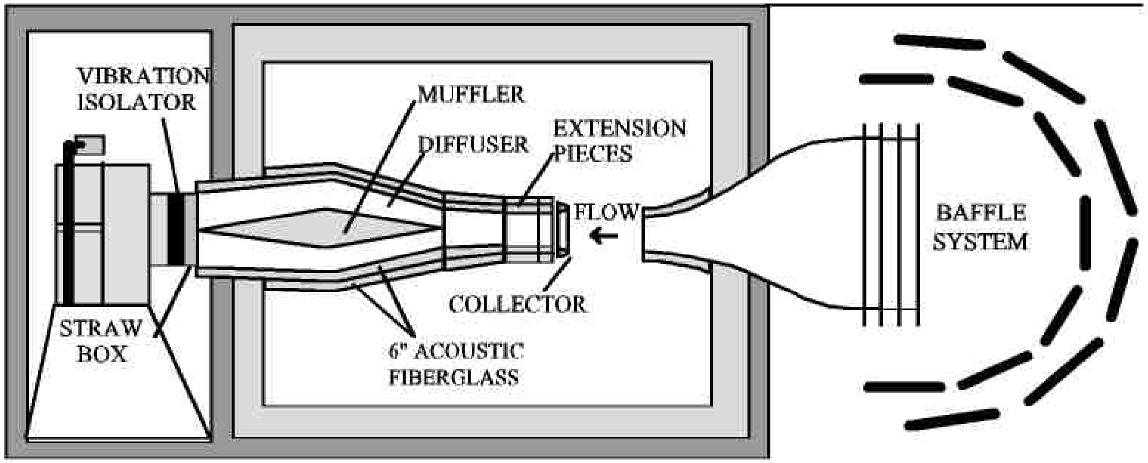
Data Acquisition

Current Programs
Aerodynamic measurements, sound-pressure level, and sound-intensity measurements generated from propellers, fans, pumps, and airfoil configurations; aircraft, automotive, and marine vehicles.

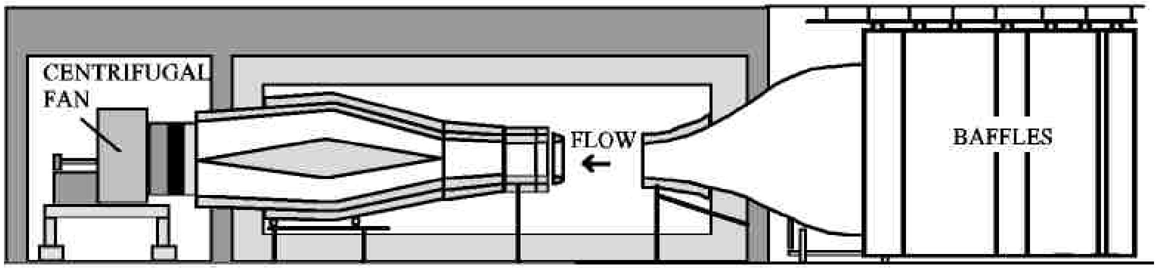
Planned Improvements

User Fees

Contact Information
Anechoic Chamber/Wind Tunnel, University of Notre Dame, Department of Aerospace and Mechanical Engineering, Hessert Laboratory for Aerospace Research, 365 Fitzpatrick Hall, Notre Dame, Indiana 46556-5637; Tel: (574) 631 5430; Fax: (574) 631 8341; Email: amedept@nd.edu; Web site: http://www.nd.edu/~ame/.



a) TOP VIEW



b) SIDE VIEW

Anechoic Chamber and Wind Tunnel,
University of Notre Dame,
Department of Aerospace and Mechanical Engineering,
Hessert Laboratory for Aerospace Research,
Notre Dame, Indiana USA

Installation Name	Test Section Size	Temperature Range
University of Notre Dame, Department of Aerospace and Mechanical Engineering, Hessert Laboratory for Aerospace Research, Notre Dame, Indiana, USA	61 cm x 61 cm x 1.8 m (24 in x 24 in x 1.6 ft)	
	Speed Range	**Reynolds Number (max)**
	67.76 m/sec (150 mph)	
Facility Name		**Dynamic Pressure**
Subsonic Wind Tunnel (2 similar tunnels)	**Cost**	
		Stagnation Pressure
	Operational Status	
	Presumed active as of February 2007.	

Testing Capabilities

Open circuit; square; horizontal; contraction ratio of 20.6:1; reduction cones provide very low turbulence levels in test section; ahead of the reduction cone is a set of 12 anti-turbulence screens; reduction cone and test sections mounted on rollers provide easy means to interchange components; downstream of test section, diffuser is fixed into laboratory wall; diffuser decelerates air, gradually transforming square contour to circle; impeller driven by variable-speed electric motor; glass front panels for smoke visualization.

Data Acquisition

Force balances; LDV; hot-wire anemometry, and pressure-scanning systems.

Current Programs

Flow visualization; Delta wing aerodynamics; aspects of vortex dynamics; low Reynolds number aerodynamics of low-aspect-ratio wings; fundamental studies of high lift systems; bluff body experiments; studies of boundary-layer receptivity to free-stream turbulence, as an indirect measurement of free-stream turbulence in cryogenic wind tunnels.

Planned Improvements

User Fees

Contact Information

Subsonic Wind Tunnel, University of Notre Dame, Department of Aerospace and Mechanical Engineering, Hessert Laboratory for Aerospace Research, 365 Fitzpatrick Hall, Notre Dame, Indiana 46556-5637; Tel: (574) 631 5430; Fax: (574) 631 8341; Email: amedept@nd.edu; Web site: http://www.nd.edu/~ame/.

NO IMAGE AVAILABLE

Wind Tunnels of the Western Hemisphere

Subsonic | **United States**

Installation Name	Test Section Size	Temperature Range
University of Oklahoma, School of Aerospace and Mechanical Engineering, Norman, Oklahoma, USA	1.22 x 1.83 x 3.4 m³ (4 x 6 x 11 ft³)	
	Speed Range	**Reynolds Number (max)**
	70 m/sec (155 mph)	
Facility Name		**Dynamic Pressure**
L.A. Comp Wind Tunnel	**Cost**	
		Stagnation Pressure
	Operational Status	Atmospheric
	Presumed active as of April 2007.	

Testing Capabilities

Closed loop; closed throat; elliptical; driven by 400 hp, constant-speed electric motor and 3-blade, 7 ft propeller; variable-pitch, stepper-motor-driven pilot valve, made of steel, reinforced concrete, and brick; vanes located at tunnel corners; hydraulic piston controlled by a stepper-motor-driven pilot valve; 1% freestream turbulence; pyramidal balance for force and moment measurement:

Data Acquisition

LABVIEW on PCs; tunnel temperature monitored using thermocouple mounted on south wall; no provision for cooling, so tunnel must be allowed to come to thermal equilibrium before data acquisition.

Current Programs

Planned Improvements

1936 (constructed); 1960s (electric motor and a variable-pitch propeller replaced internal combustion engine); 1978 (digital data acquisition system updated).

User Fees

Contact Information

University of Oklahoma, School of Aerospace and Mechanical Engineering, 212 Felgar Hall, 865 Asp Avenue, Norman, OK 73019-1052; Tel: (405) 325-5011; Fax: (405) 325-1088; Email: ame@ou.edu; Web site: http://www.coe.ou.edu/ame/about/windtunnel.htm.

NO IMAGE AVAILABLE

Installation Name	Test Section Size	Temperature Range
University of Washington, Department of Aeronautics and Astronautics, Aeronautical Laboratory (UWAL), Seattle, Washington, USA	8 x 12 x 10 ft³	Depends on ambient conditions; typically 55°F to 110°F, 80°F.
Facility Name	**Speed Range**	**Reynolds Number (max)**
F. K. Kirsten Wind Tunnel	250 mph	1.9
		Dynamic Pressure
		1 to 100 psf
	Cost	**Stagnation Pressure**
	US$140,000 (in 1935)	Ambient
	Operational Status	
	Confirmed active as of November 2006.	

Testing Capabilities

Double-return, closed circuit with corner fillets; rectangular test section; two 500 hp, dc motors that drive two 14 ft, 9 in, 7-blade fans; test section vented to atmosphere; can be viewed from all sides.

Data Acquisition

Dual Pentium III 666-MHz PC with 16-bit A/D converter for data acquisition; Pentiums for data reduction and plotting; 30 analog channels; scanivalve DSM 3,000.

Current Programs

Six-component force tests; pressure tests; flow visualization tests; tests aero vehicles, ground transportation, buildings; academic use.

Planned Improvements

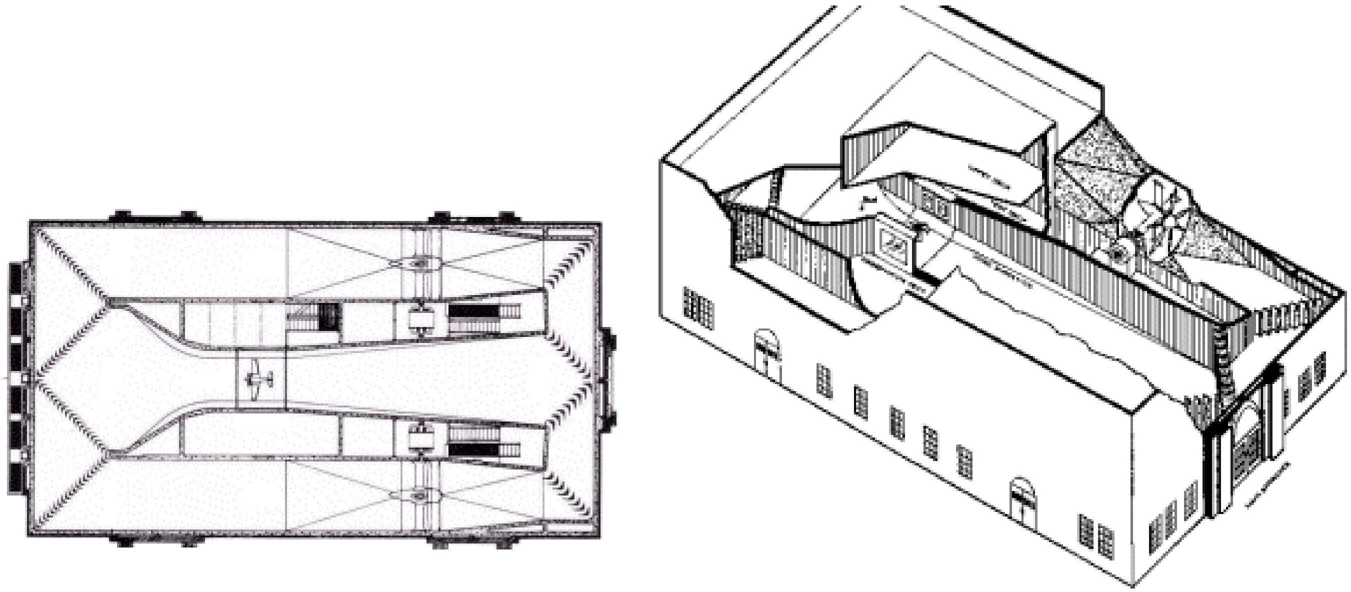
1939 (commenced operation); planned improvements: new flexures for the external balance to increase strength; updated aircraft ground plane; new sting mount.

User Fees

US$395/hr plus incidentals.

Contact Information

Jack Ross (UWAL Business Manager), Kirsten Wind Tunnel, University of Washington, Department of Aeronautics and Astronautics, Box 352400, Seattle, WA 98195-2400; Tel: (206) 543 0439; Fax: (206) 616 2150; Email (Ross): jwross@u.washington.edu; Web site: http://www.uwal.org/uwalinfo/techguide.htm#techguide.



F. K. Kirsten Wind Tunnel,
University of Washington,
Department of Aeronautics & Astronautics,
Aeronautical Laboratory (UWAL),
Seattle, Washington USA

Installation Name	Test Section Size	Temperature Range
ViGYAN Inc., Virginia Langley Research and Development Park, Hampton, Virginia, USA	3 x 4 x 5 ft³ (0.9 x 1.2 x 1.5 m³)	Atmospheric (stagnation)
	Speed Range	**Reynolds Number (max)**
	180 mph (289.7 kph)	1.15
Facility Name	**Cost**	**Dynamic Pressure**
Low Speed Wind Tunnel		
	Operational Status	**Stagnation Pressure**
	Presumed active as of March 2007.	Atmospheric

Testing Capabilities

Conventional, straight-through, open-return-type layout; powered by a variable-pitch, multi-blade axial fan located at the exit; turbulence factor less than 1.05; alternate wall configurations (solid, semi-open, ground-board, etc.) for special test requirements; model attitude can be varied -10 to +90° of pitch and -20 to +20° of yaw, accurate to 0.1°.

Data Acquisition

Multiple PC/Windows 2000 Professional; national instruments LabVIEW software/hardware; 32 analog channels, 32 digital channels; Data Analysis System (DAS) software for plotting and analysis; other software such as Kaleidagraph and MS Excel also available; statistical, process-control procedures monitor data quality.

Current Programs

3D; 2D; static force and pressure; flow visualization; structure; instrument calibration, etc.; supplies NASA Langley, NASA Ames, Juback, Questair, ATI, AFWAL, and Sunstrand.

Planned Improvements

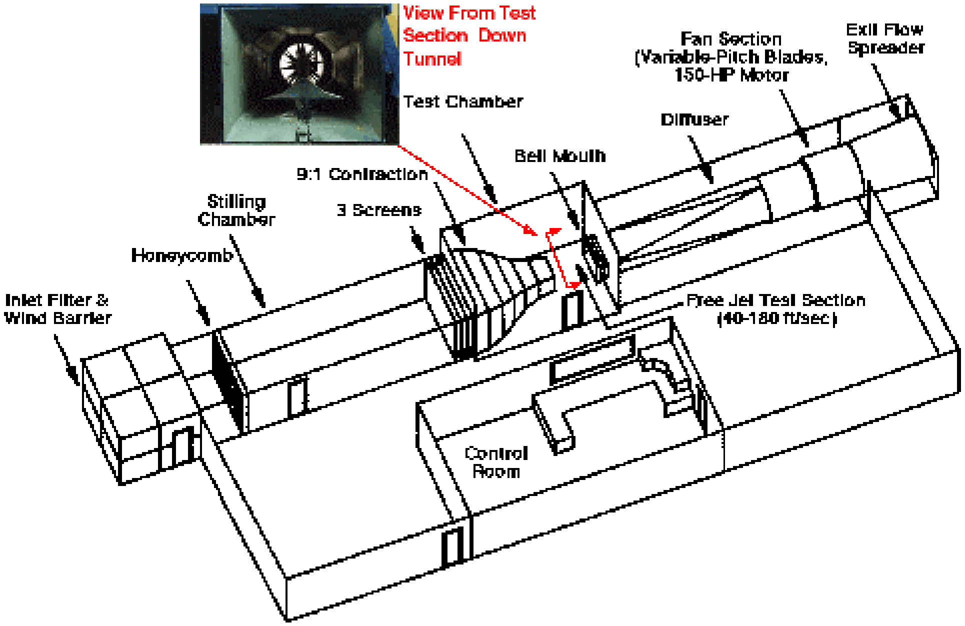
1987-88 (constructed); 1999-2000 (major renovation of model support, electronics, and data acquisition systems).

User Fees

US$300.00/hr (baseline rental rate).

Contact Information

Richard White, Sudhir C. Mehrotra (Technical Support), ViGYAN Inc., Aero-Fluids Laboratory Building, 30 Research Drive, Hampton, VA 23666-1325; Tel: (757) 865-1400; Fax: (757) 865-8177; Email (White): rwhite@vigyan.com; Email (Mehotra): mehotra@vigyan.com; Web site: http://vigyan.com/tunnel.shtml.



**Low Speed Wind Tunnel,
ViGYAN Inc.,
Virginia Langley Research and Development Park,
Hampton, Virginia USA**

Installation Name
Virginia Polytechnic Institute and State University, Department of Aerospace and Ocean Engineering, Blacksburg, Virginia, USA

Facility Name
3 x 2 ft Low Speed Wind Tunnel

Test Section Size
3 x 2 x 20 ft^3

Speed Range
0 to 30 m/sec

Cost

Operational Status
Presumed active as of January 2007.

Temperature Range

Reynolds Number (max)

Dynamic Pressure

Stagnation Pressure

Testing Capabilities
Flow in the test section is very closely uniform and of low turbulence intensity (0.17%).

Data Acquisition
Two-axis, computer-controlled traverse gear; sophisticated, multi-sensor, hot-wire manufacture; repair, calibration, and measurement systems; and directly calibrated, 7-hole, yaw probe system.

Current Programs
Used primarily by graduate and undergraduate students for sponsored research projects in experimental fluid mechanics; recent research includes experiments on wakes, tip vortices, vortex control, and airfoil aerodynamics.

Planned Improvements

User Fees

Contact Information
Dr. William Devenport (Director),Virginia Polytechnic Institute and State University, Department of Aerospace and Ocean Engineering, , 215 Randolph Hall, Blacksburg, VA 24061; Tel: (540) 231 6611; Fax: (540) 231 9632; Email: info@aoe.edu; Email (Devenport): devenport@vt.edu; Web site: http://www.aoe.vt.edu/research/facilities/subsonic.php.

NO IMAGE AVAILABLE

Installation Name	Test Section Size	Temperature Range
Virginia Polytechnic Institute and State University, Department of Aerospace and Ocean Engineering, Blacksburg, Virginia, USA	$3 \times 24\ ft^2$	

Speed Range	Reynolds Number (max)

Facility Name	Cost	Dynamic Pressure
Boundary Layer Research Wind Tunnel and Laboratory		

Operational Status	Stagnation Pressure
Presumed active as of January 2007.	

Testing Capabilities

Low-speed, low-turbulence-intensity, open-loop, pressurized tunnel; feedback-controlled, rotating-blade damper can produce large-amplitude gusts up to 2 Hz; adjustable upper wall permits various streamwise pressure gradients and has active suction; tangential wall-jet boundary controls on non-test walls used to prevent unwanted stalls in strong, adverse-pressure-gradient, and unsteady flows.

Data Acquisition

Controlled rotating-blade damper produces amplitude gusts up to 2 Hz; custom-designed, custom-constructed, laser-Doppler anemometers.

Current Programs

Past: new features of the turbulence structure of turbulent boundary layers and separated flows; turbulent, convective, heat transfer in 3D and separated flows; currently: definition of second-order turbulence structure of 3D flows around hull/appendage and wing/body junctions.

Planned Improvements

1978 (commenced operation).

User Fees

Contact Information

Dr. William Devenport (Director),Virginia Polytechnic Institute and State University, Department of Aerospace and Ocean Engineering, 215 Randolph Hall, Blacksburg, VA 24061; Tel: (540) 231 6611; Fax: (540) 231 9632; Email: info@aoe.edu; Email (Devenport): devenport@vt.edu; Web site: http://www.aoe.vt.edu/research/facilities/bllab.php.

NO IMAGE AVAILABLE

Subsonic | **United States**

Installation Name
Virginia Polytechnic Institute and State University, Department of Aerospace and Ocean Engineering, Blacksburg, Virginia, USA

Facility Name
Open Jet Wind Tunnel

Test Section Size
39 to 72 in (diameter), 3 ft (length), circular

Speed Range
0 to 150 mph

Cost

Operational Status
Presumed active as of April 2007.

Temperature Range

Reynolds Number (max)

Dynamic Pressure

Stagnation Pressure

Testing Capabilities
Open test section; instructional tunnel; made of plywood; corners are 4 sets of straightening vanes; power from 35 hp, dc motor, supplied by motor-generator combination; separate excitation furnished by smaller motor-generator set.

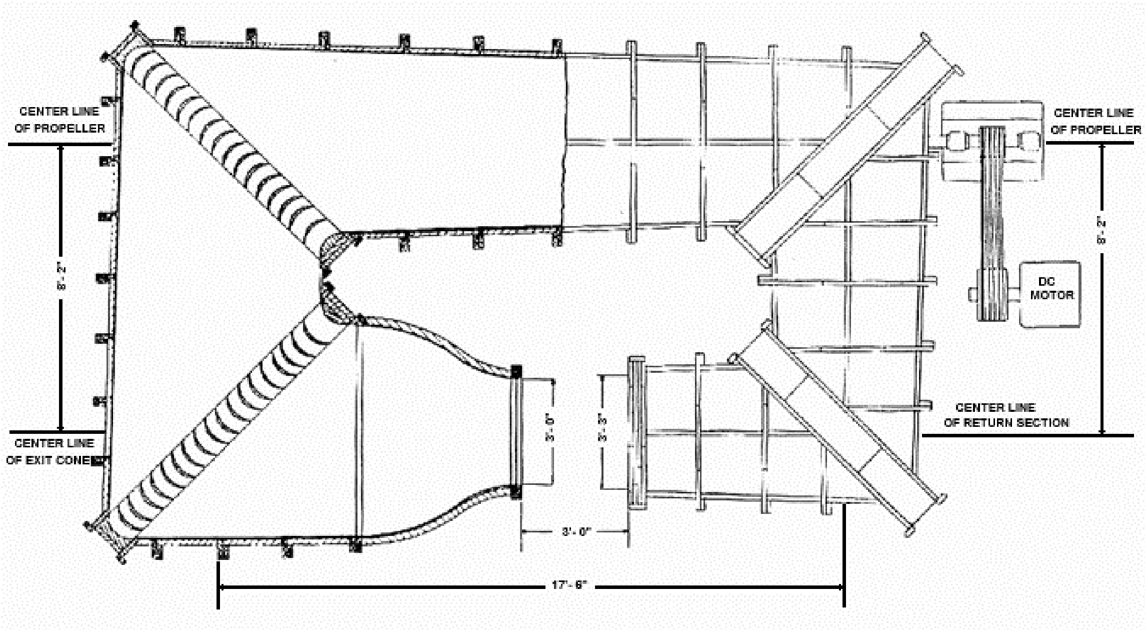
Data Acquisition
Pressures measured using traditional manometer board; forces and moments measured using a strain-gauge, balance system borrowed from other facilities as required; air speed measured by pitot-static tube or a setting manometer.

Current Programs
Undergraduate instruction.

Planned Improvements

User Fees

Contact Information
Dr. William Devenport (Director),Virginia Polytechnic Institute and State University, Department of Aerospace and Ocean Engineering, 215 Randolph Hall, Blacksburg, VA 24061; Tel: (540) 231 6611; Fax: (540) 231 9632; Email: info@aoe.edu; Email (Devenport): devenport@vt.edu; Web site: http://www.aoe.vt.edu/research/facilities/openjet.php.



Open Jet Wind Tunnel,
Virginia Polytechnic and State University,
Virginia Tech Department of Aerospace and Ocean Engineering,
Blacksburg, Virginia USA

Installation Name	Test Section Size	Temperature Range
Virginia Polytechnic Institute and State University, Department of Aerospace and Ocean Engineering, Blacksburg, Virginia, USA	6 x 6 x 24 ft^3	
	Speed Range	**Reynolds Number (max)**
	275 ft/sec	1.66
Facility Name		**Dynamic Pressure**
Stability Wind Tunnel	**Cost**	
		Stagnation Pressure
	Operational Status	
	Presumed active as of April 2007.	

Testing Capabilities

Continuous, closed jet, single return; interchangeable round and square test sections; powered by a 600 hp, dc motor, driving a 14 ft propeller providing max speed of 275 ft/sec.

Data Acquisition

Tunnel speed regulated by custom-designed, Emerson VIP ES-6600 SCR drive, which can interface with the computer data acquisition system; computers: AT-MIO-16-XE-10 data acquisition card; Pentium 133 computer; LabView 4.0; Windows 95; DAQ system; TBX-1328 terminal blocks.

Current Programs

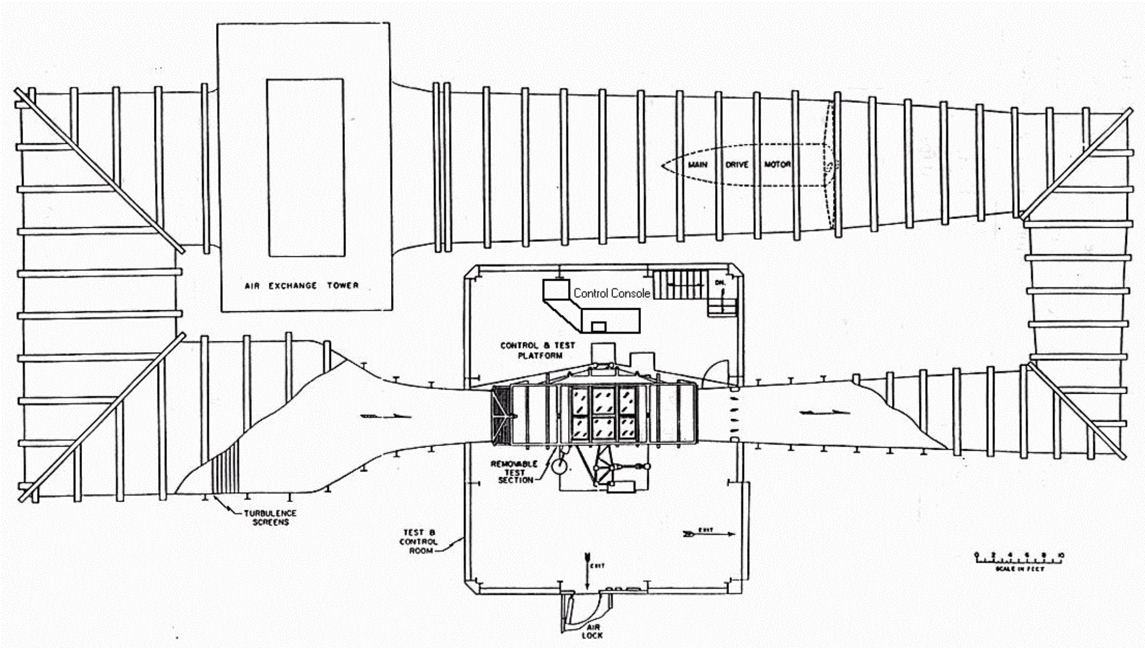
Planned Improvements

1940 (constructed by NASA Langley Aeronautical Lab); 1958 (VPI acquired); 1959-61 (calibration); 1994 (overhaul fan motor); 1996 (new fan blades).

User Fees

Contact Information

Dr. William Devenport (Director), Virginia Polytechnic Institute and State University, Department of Aerospace and Ocean Engineering, 215 Randolph Hall, Blacksburg, VA 24061; Tel: (540) 231 6611; Fax: (540) 231 9632; Email (General): info@aoe.edu; Email (Director): devenport@vt.edu; Web site: http://www.aoe.vt.edu/research/facilities/stab/tunnel_descrip.php.



Stability Wind Tunnel,
Virginia Polytechnic Institute and State University,
Department of Aerospace and Ocean Engineering,
Blacksburg, Virginia USA

Installation Name	Test Section Size	Temperature Range
Wichita State University, National Institute for Aviation Research (NIAR), Wichita, Kansas, USA	7 x 10 x 12 ft^3	Ambient to 110°F
	Speed Range	**Reynolds Number (max)**
	0.3 Mach (empty test section, normal day)	1.8
Facility Name		**Dynamic Pressure**
Walter H. Beech Memorial Wind Tunnel (WBMWT)	**Cost**	120 psf (empty test section)
	Operational Status	**Stagnation Pressure**
	Confimed active as of April 2007.	Ambient

Testing Capabilities

Atmospheric, return type, closed throat; honeycomb structure; glass-paned optical access; under-floor external balance; 6-component, truncated prism; pyramidal balance; test section made of steel, aluminum, and glass.

Data Acquisition

HP 3852 can accept up to 30 cards of signal conditioning; 80 channels of signal conditioning available; PSI 8400 system; smoke-flow visualization; other types of flow visualization include micro tufts, yarn tufts, mini tufts, tempera paint, and oil flow; flow-field surveys; still and video photography.

Current Programs

Aerodynamic drag characteristics and durability of various objects; tests include aircraft and automobile models, motorcycles, bicycles and bicyclists, ski positions, and various other items.

Planned Improvements

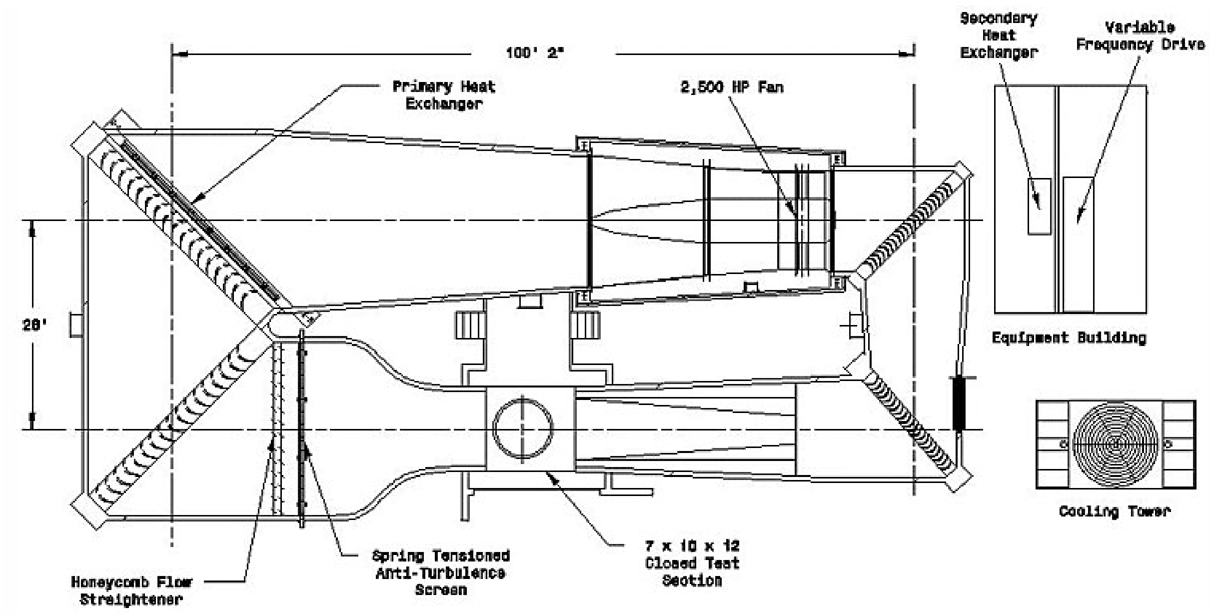
1948 (tunnel completed); 1977 (computer upgrade); 2005 ($6 million renovation: new flow-conditioning equipment; installation of a new 2,500 hp, electric, variable-frequency drive unit; new heat-exchange system; test-section rebuild, etc.).

User Fees

US$375/hr plus overtime, report preparation, etc.

Contact Information

John Laffen (Director), Wichita State University, National Institute for Aviation Research, 1845 N. Fairmount, Wichita, KS 67260-0093; Tel (Laffen): (316) 978-3569; Email (Laffen): john.laffen@wichita.edu; Web site: http://www.niar.wichita.edu/researchlabs/ad_overview. asp.



Walter H. Beech Memorial Wind Tunnel (WBMWT),
Wichita State University,
National Institute For Aviation Research (NIAR),
Wichita, Kansas USA

Installation Name
National Research Council Canada (NRC), Institute for Aerospace Research (IAR), Ottawa, Ontario, Canada

Facility Name
1.5 m Trisonic Blowdown Wind Tunnel

Test Section Size
#1: 1.524 x 1.524 m^2; #2: 0.381 x 1.524 m^2; #3: 1.467 x 1.524 m^2

Speed Range
0.1 to 4.25 Mach

Cost

Operational Status
Presumed active as of March 2006.

Temperature Range

Reynolds Number (max)
#1: Up to 80, #2: Up to 160

Dynamic Pressure

Stagnation Pressure
13.8 bar

Testing Capabilities
Pressurized; intermittent; capable of running subsonic, transonic, and supersonic flow regimes.

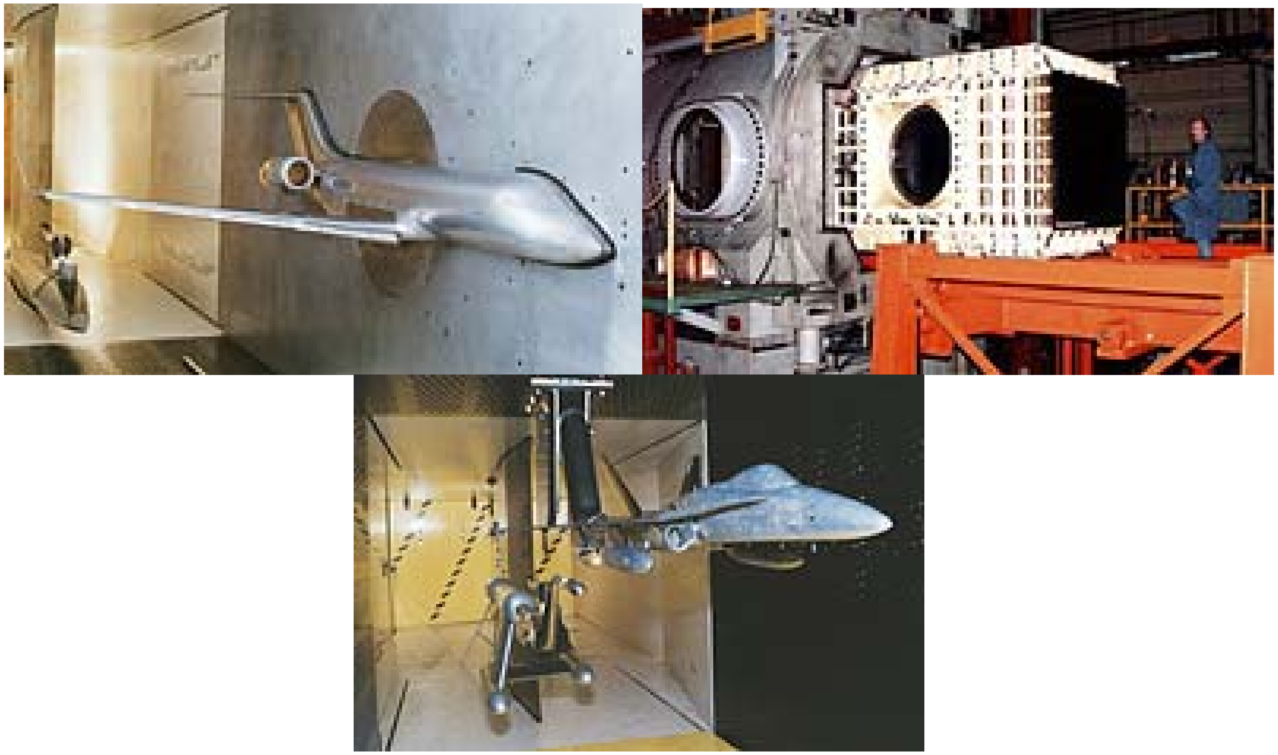
Data Acquisition
DEC PDP 11/55; 98 analog amplifier channels; 5-bit A/D conversion; 60 kHz (low-speed); 192 channels sampled at 38.4 kHz; channel parallel recording at 100 Hz; filtered RMS data; multisource, focusing-type Schlieren system; electronic pressure-scanning system (ESP) capability.

Current Programs

Planned Improvements
1962-63 (commissioned); 1980s (2D test section and half-model testing upgraded; roll-in/roll-out, 2D and 3D test-section system upgraded).

User Fees

Contact Information
Cabot A. Broughton, Group Leader, Uplands Facilities, Institute for Aerospace Research (IAR), National Research Council Canada (NRC), Uplands, Bldg. U-66, Room 217, Ottawa, ON, Canada, K1A 0R6; Tel: (613) 998-9401; Fax: (613) 998-1281; Email: Cabot.Broughton@nrc-cnrc.gc.ca; Web site: http://iar-ira.nrc-cnrc.gc.ca/aero/aero_7_e.html.



**1.5 m Trisonic Blowdown Wind Tunnel,
National Research Council Canada (NRC),
Institute for Aerospace Research (IAR),
Ottawa, Ontario, Canada**

Wind Tunnels of the Western Hemisphere

Supersonic | **Canada**

Installation Name	Test Section Size	Temperature Range
National Research Council Canada (NRC), Institute for Aerospace Research (IAR), Ottawa, Ontario, Canada		
	Speed Range	**Reynolds Number (max)**
Facility Name		
Pilot Blowdown Wind Tunnel		**Dynamic Pressure**
	Cost	
		Stagnation Pressure
	Operational Status	
	Presumed active as of March 2006.	

Testing Capabilities

One-twelfth scale version of the 1.5 m Trisonic Wind Tunnel.

Data Acquisition

Current Programs

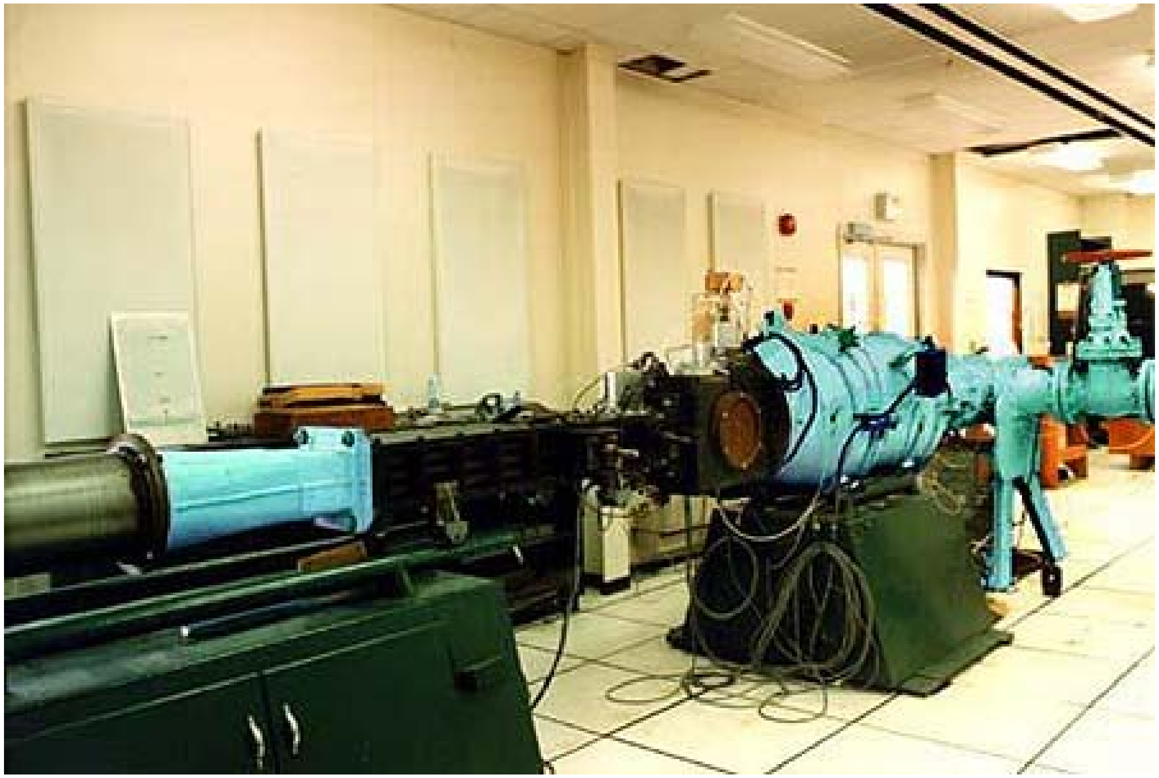
Calibration of flow measurement probes.

Planned Improvements

User Fees

Contact Information

Steven J. Zan, Director, Aerodynamics Laboratory, Institute for Aerospace Research (IAR), National Research Council Canada (NRC), 1200 Montreal Road, Bldg. M-2, Room 129B, Ottawa, ON, Canada, K1A 0R6; Tel: (613) 993-1156; Fax: (613) 957-4309; Email: Steven.Zan@nrc-cnrc.gc.ca; Web site: http://iar-ira.nrc-cnrc.gc.ca/aero/aero_8e_e.html.



Pilot Blowdown Wind Tunnel,
National Research Council (NRC),
Institute for Aerospace Research (IAR),
Ottawa, Ontario, Canada

Supersonic — United States

Installation Name	Test Section Size	Temperature Range
Aero Systems Engineering Inc. (ASE, formerly Fluidyne), St. Paul, Minnesota, USA	13 ½ in	
	Speed Range	**Reynolds Number (max)**
	1.5, 2, 2.5, 3, and 4 Mach	
Facility Name		**Dynamic Pressure**
Channel 2: 13 ½ in Supersonic Wind Tunnel	**Cost**	
		Stagnation Pressure
	Operational Status	
	Presumed active as of April 2007.	

Testing Capabilities

Axisymmetric nozzle block mounted on centerbody model support tube, to obtain desired external flow; Mach number in free-jet test section; model air/simulated, supersonic, external flow supplied from facility air storage system; various Mach numbers available by changing nozzle block on 5 in diameter model support tube.

Data Acquisition

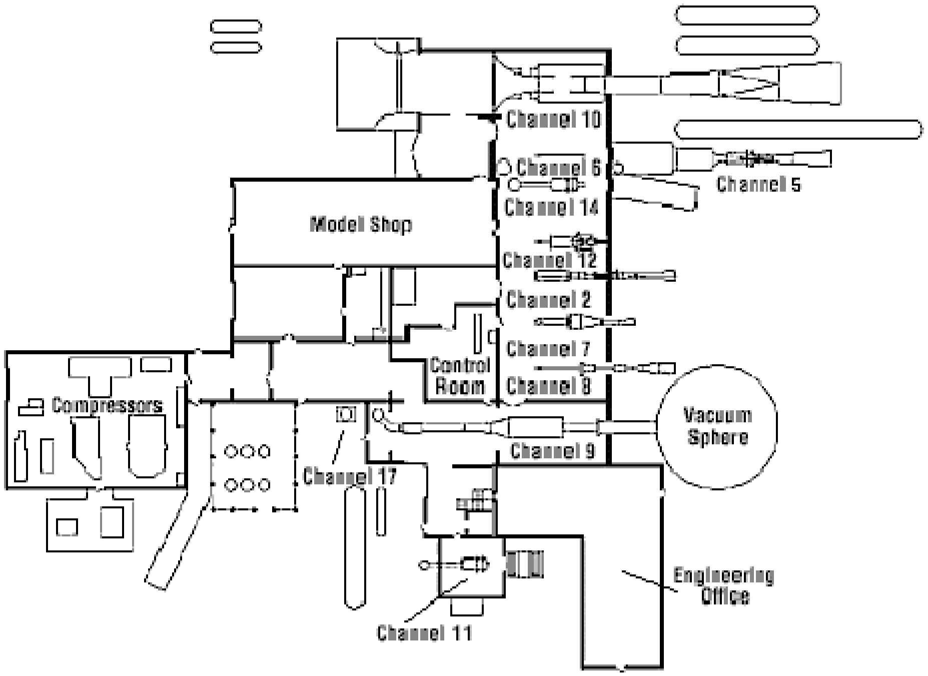
Current Programs

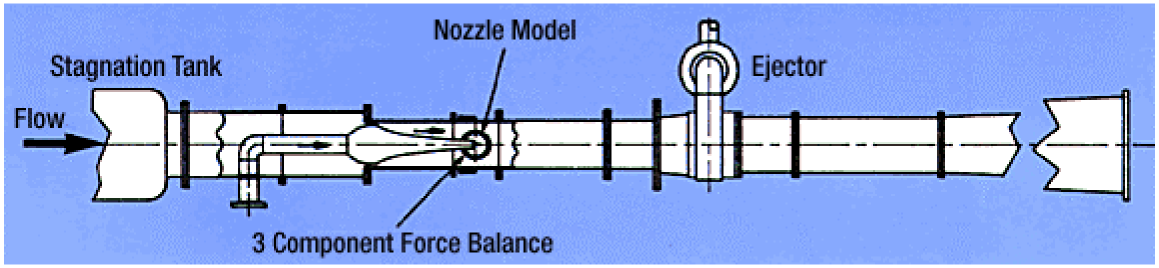
Planned Improvements

User Fees

Contact Information

P. Giese (Wind Tunnel Programs), Aero Systems Engineering, Inc., 358 E. Fillmore Avenue, St. Paul, MN 55107; Tel (General): (651) 227 7515; Fax (General): (651) 227 0519; Email (General): ase@aerosysengr.com; Email (Giese): pgiese@aerosysengr.com; Web site: http://www.aerosysengr.com/Aero_Test_Services/ATCapabilities/.





Channel 2: 13½ in Supersonic Wind Tunnel,
Aero Systems Engineering Inc. (ASE),
St. Paul, Minnesota USA

Installation Name	Test Section Size	Temperature Range
Aero Systems Engineering Inc. (ASE, formerly Fluidyne), St. Paul, Minnesota, USA	22 x 22 in²	Atmospheric
	Speed Range	**Reynolds Number (max)**
	1.15 Mach	
Facility Name	**Cost**	**Dynamic Pressure**
Channel 5: 22 in Transonic Wind Tunnel		
	Operational Status	**Stagnation Pressure**
	Presumed active as of April 2007.	Atmospheric

Testing Capabilities

Induction-type wind tunnel; exhaust nozzle model and force balance system can be supported in the test section by a cantilevered 5 in diameter tube; dried and heated air (obtained from a 500 psi storage system) supplied to model through support tube; high pressure air is throttled, metered, and discharged through the model.

Data Acquisition

Current Programs

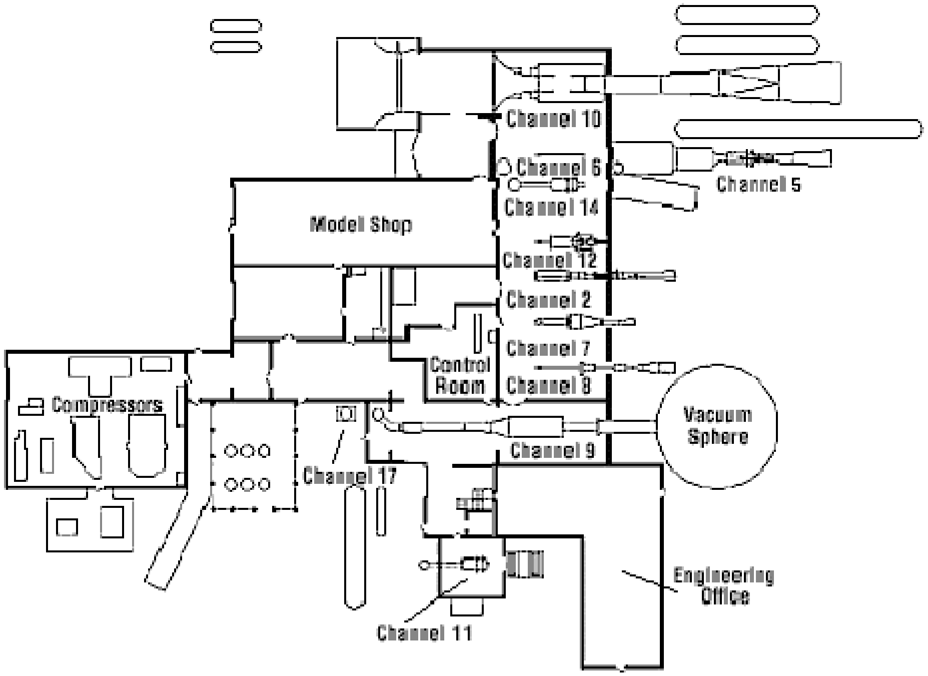
Aerodynamic, nozzle-installed performance; icing tests; exhaust nozzle tests of atmospheric stagnation pressure; Mach numbers to 1.15; 5 in-diameter model support tube; transonic icing tests of run times, 12 min at M 0.8 to 40 min at M 0.25; measures performance degradation from ice accretion; tests de-icing and anti-icing systems; variable liquid water content and droplet size.

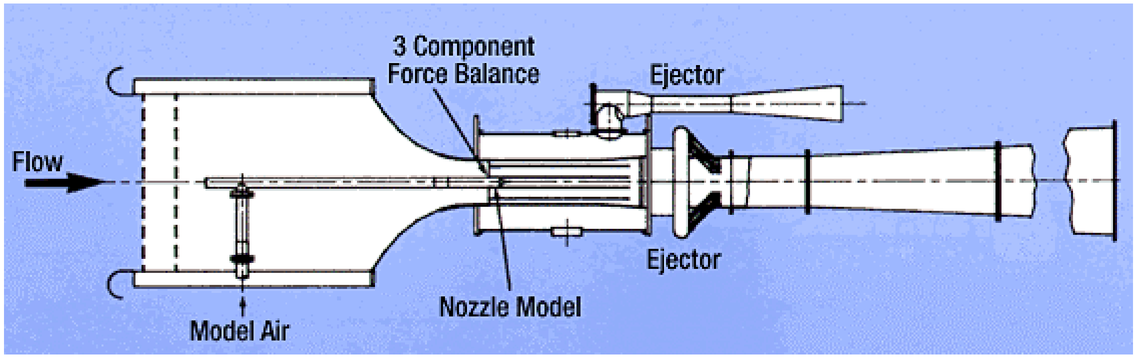
Planned Improvements

User Fees

Contact Information

P. Giese (Wind Tunnel Programs), Aero Systems Engineering, Inc., 358 E. Fillmore Avenue, St. Paul, MN 55107; Tel (General): (651) 227 7515; Fax (General): (651) 227 0519; Email (General): ase@aerosysengr.com; Email (Giese): pgiese@aerosysengr.com; Web site: http://www.aerosysengr.com/Aero_Test_Services/ATCapabilities/atcapabilities.html.





Channel 5: 22 in Transonic Wind Tunnel,
Aero Systems Engineering Inc. (ASE),
St. Paul, Minnesota USA

Installation Name	Test Section Size	Temperature Range
Aero Systems Engineering Inc. (ASE, formerly Fluidyne), St. Paul, Minnesota, USA	5.5 x 5.5 ft², slotted upper and lower walls	100°F at M=1.0
Facility Name	**Speed Range**	**Reynolds Number (max)**
Channels 6 and 10: 66 in Transonic Wind Tunnel	0 to 1.15 Mach	4.2 at M=1.0
	Cost	**Dynamic Pressure**
		1 atm
	Operational Status	**Stagnation Pressure**
	Presumed active as of April 2007.	

Testing Capabilities

Channel 6: static (M=0), wind-tunnel setup and checkout facility used before testing nozzle model in Channel 10; 2,500 psi air-storage system to a sting-mounted, 3- or 5-component, flow-through force balance; channel 10: induction-type wind tunnel; atmospheric air; air ejectors to reduce downstream pressure; test cell supported by cantilevered tube; support stings in 6.25, 8, 10, and 14.5 ft in diameter.

Data Acquisition

Current Programs

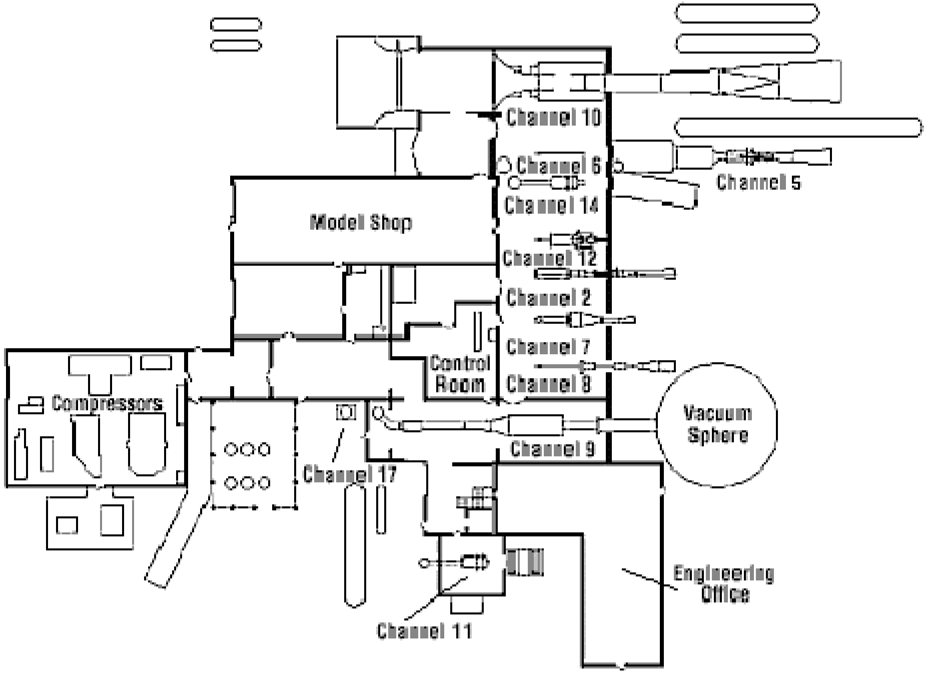
Aircraft components such as ram air turbines; nozzle thrust-minus-drag; afterbody drag; sidewall-mounted wing; inlet drag; parachute decelerator; and profan tests.

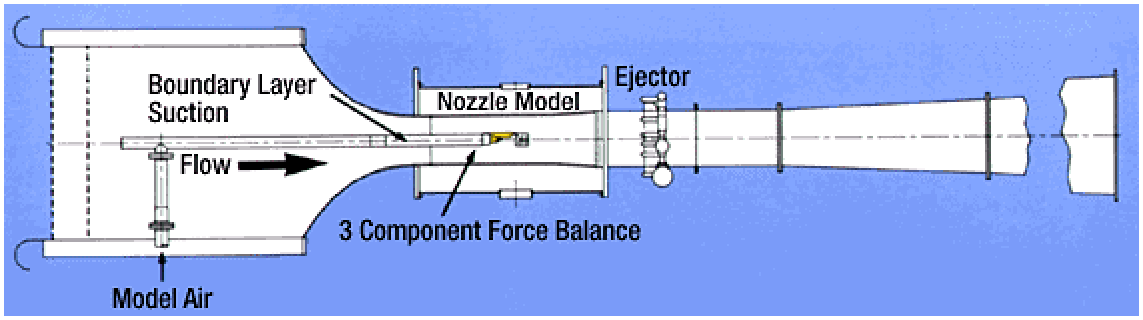
Planned Improvements

User Fees

Contact Information

P. Giese (Wind Tunnel Programs), Aero Systems Engineering, Inc., 358 E. Fillmore Avenue, St. Paul, MN 55107; Tel (General): (651) 227 7515; Fax (General): (651) 227 0519; Email (General): ase@aerosysengr.com; Email (Giese): pgiese@aerosysengr.com; Web site: http://www.aerosysengr.com/.





Channels 6 and 10: 66 in Transonic Wind Tunnel,
Aero Systems Engineering Inc. (ASE),
St. Paul, Minnesota USA

Installation Name	***Test Section Size***	***Temperature Range***
Arnold Engineering Development Center (AEDC), Propulsion Wind Tunnel Facility (PWT), Arnold Air Force Base, Tennessee, USA	16 x 16 x 40 ft^3	540 to 600°R
	Speed Range	***Reynolds Number (max)***
Facility Name	0.06 to 1.60 Mach	0.2 to 6.0
16T Transonic Propulsion Wind Tunnel		***Dynamic Pressure***
	Cost	2 to 1,100 psf
	US$78.7 million (construction cost-4T, 16S, 16T).	***Stagnation Pressure***
	Operational Status	
	Reported active February 2006.	

Testing Capabilities

Data Acquisition

Current Programs

Aerodynamic models; aerothermodynamic models; store/stage/separation; combined aerodynamic/propulsion systems tests; full-scale missile tests (engine performance, airframe aerodynamics); rocket propulsion systems and external aerodynamics; dynamics of clean-store separation; testing of the Navy EA-18G Growler and F-35 Joint Strike Fighter in 2006.

Planned Improvements

1961 (constructed); 1999 (multi-view, pressure-sensitive, paint data acquisition system installed).

User Fees

Contact Information

Arnold Engineering Development Center (AEDC)/DOF, 740 Fourth Street, Arnold AFB, TN 37389-6000; Tel: (931) 454-3767; Fax: (931) 454-3339; Web site: http://www.arnold.af.mil.

NO IMAGE AVAILABLE

Installation Name	Test Section Size	Temperature Range
Arnold Engineering Development Center (AEDC), Propulsion Wind Tunnel Facility (PWT), Arnold Air Force Base, Tennessee, USA	4 x 4 x 12.5 ft³	540 to 600°R
	Speed Range	**Reynolds Number (max)**
	0.2 to 2.0 Mach	2.0 to 7.0
Facility Name		**Dynamic Pressure**
4T Transonic Propulsion Wind Tunnel (PWT)	**Cost**	20 to 1,400 psf
	US$78.7 million (construction cost-4T, 16S, 16T).	**Stagnation Pressure**
	Operational Status	200 to 3,400 psf
	Reported active February 2006.	

Testing Capabilities

Closed loop, continuous flow, variable density; 2 operating modes: Independent Drive System (IDS) mode and Plenum Evacuation System (PES) mode.

Data Acquisition

ESP-2,048 channel (max) from 32 multiplex channels; dynamic pressure data from 64 channels (max); 256 channels total, excluding pressure data; force and moment data from 50 channels (max); analog from 120 channels (max); temperature data from 96 channels (max); data acquisition rate range (move pause mode), 3 to 10 sec/pt; data acquisition range (sweep mode), variable, 1.2 sec/pt.

Current Programs

Aerodynamic performance (lift and drag); lateral and longitudinal static stability; control effectiveness; surface static-pressure mapping; bomb-bay acoustic; heat transfer; aerodynamic loads; inlet performance; duct drag; spin damping; pitch/yaw damping; magnus force and moment; jet interaction/effects; flow visualization; external and internal store separation and jettison; free drop; and flow-field surveys.

Planned Improvements

1961 (constructed).

User Fees

Contact Information

Arnold Engineering Development Center (AEDC)/DOF, 740 Fourth Street, Arnold AFB, TN 37389-6000; Tel: (931) 454-3767; Fax: (931) 454-3339; Web site: http://www.arnold.af.mil.

Propulsion Wind Tunnel Facility
Arnold Engineering Development Center

**4 T Transonic Propulsion Wind Tunnel (PWT),
Arnold Engineering Development Center,
Arnold AFB, Tennessee USA**

Installation Name
Boeing Technology Services, Seattle, Washington, USA

Facility Name
Polysonic Wind Tunnel (PSWT)

Test Section Size
4 x 4 ft²

Speed Range
0.45 to 5.579 Mach

Cost

Operational Status
Presumed active as of August 2006.

Temperature Range

Reynolds Number (max)
1.0 to 48

Dynamic Pressure
100 to 7,500 psf

Stagnation Pressure
0.3 to 30 psia

Testing Capabilities
Two test sections: one for supersonic testing; one for subsonic and transonic testing.

Data Acquisition
64 analog channels, up to 500 KHz/channel; EPS 1,024 channels; 100 KHz aggregate; digital distortion analyzer of 64 channels, up to 500 KHz/channel; flutter analyzers, high-speed video, and closed-circuit TV; data reduction includes Dell Precision Workstation, dual 1.7 GHz Xeon Processors with 2.0 GB RAM, Windows 2000 operating system with Microsoft Visual Studio.

Current Programs
Testing aerospace components; generating scale-model inlet and aerodynamic data; configuring upgrades to existing Boeing product lines.

Planned Improvements
Recent improvements include upgrades to the primary compressor unit and the gas turbine compressor; additional cooling; improved heat exchanger.

User Fees

Contact Information
Ms. LeAnn Diessner (Marketing Manager), Boeing Technology Services, P.O. Box 3707, MC 1W-02, Seattle Washington 98124-2207; Tel: (206) 662 4287; Email: LeAnn.M.Diessner@boeing.com; Web site: http://www.boeing.com/bts.

NO IMAGE AVAILABLE

Installation Name
Boeing Technology Services, Seattle, Washington, USA

Facility Name
Transonic Wind Tunnel

Test Section Size
8 x 12 x 14.5 ft^3

Speed Range
0.3 to 1.1 Mach

Cost

Operational Status
Operational as of August 2006.

Temperature Range
80° to 130°F

Reynolds Number (max)
Varies with Mach number; 4.386/ft at M=1.1and TT=100°F

Dynamic Pressure
0 to 840 psf

Stagnation Pressure

Testing Capabilities
Continuous flow; internal and external balances; sting; swept strut; plate and floor mountings; controllable dew point +3°F or lower; 2 corner fillets.

Data Acquisition
EPS up to 1,536 ports; inventory of EPS modules of load capacity; qualitative and quantitative flow-imaging tools; airflow calibration facility for ducts; flow-through nacelles; powered nacelles.

Current Programs
Calibration of ducts, flow-through nacelles, and powered nacelles.

Planned Improvements

User Fees

Contact Information
Ms. LeAnn Diessner (Marketing Manager), Boeing Technology Services, P.O. Box 3707, MC 1W-02, Seattle Washington 98124-2207; Tel: (206) 662 4287; Email: LeAnn.M.Diessner@boeing.com; Web site: http://www.boeing.com/bts.

NO IMAGE AVAILABLE

Wind Tunnels of the Western Hemisphere

Supersonic | **United States**

Installation Name Calspan Corporation, Buffalo, New York, USA	***Test Section Size*** 8 x 8 x 18.75 ft³ (2.44 x 2.44 x 5.7 m³)	***Temperature Range*** 65° to 140°F
Facility Name Transonic Wind Tunnel (TWT)	***Speed Range*** 0.20 to 1.35 Mach	***Reynolds Number (max)*** 5 (conventional operations); 12.5 (ejector augmentation)
	Cost	***Dynamic Pressure*** 750 psf (conv ops); 2,200 psf (ejector augmentation)
	Operational Status Confirmed active as of August 2006.	***Stagnation Pressure*** 0.25 to 3.25 atm

Testing Capabilities

Continuous-flow, variable-density, closed-circuit facility; shock attenuation and deblocking; TWT provides validation testing; weapons integration testing; semi-span testing; derivative-assessment testing; inlet optimization; and jet effects.

Data Acquisition

Main balance force and moment (F&M) data; model pressures; standard facility instrumentation acquired and transferred via Ethernet to Calspan's data reduction system; uses customer-supplied algorithms as well as Calspan's standard data reduction methodologies; fully corrected data made available in tabular, plotted, and electronic formats minutes after run is completed.

Current Programs

The following have been tested in the Calspan TWT: Lockheed L-1011; DC-8, 9, 10, Boeing 707, 727, 737, 747, 757, 767; Jetstar; Cessna Citation; Learjet 45, 60; Gulfstream I–V; Bombardier Challenger; F-100, P-20A, F-2, F-4, F-5, F-111, F-15, F-16, F-18, F-22, A-6, X-29, LCA, EF-2000, JSF, T-50, AT-2000 fighters; B-52, B-58, B-2 bombers; C-5, C-130 air lifts; Tomahawk, Harpoon, NSM, SLAM-ER, JSOW, JDAM, JASSM, SDB missiles; Saturn V, Space Shuttle, DC-X, Taurus, X-34 space vehicles; customers from Canada, Germany, India, Israel, Italy, Japan, Korea, Sweden, Taiwan.

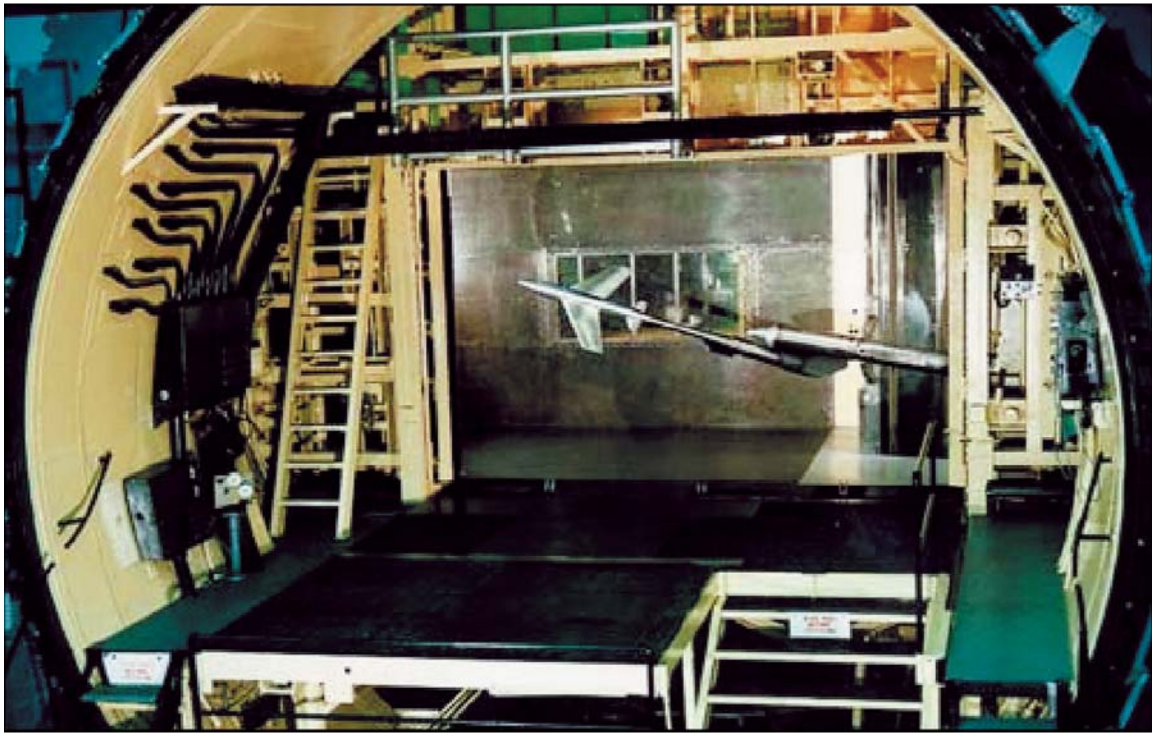
Planned Improvements

1947 (commenced operation).

User Fees

Contact Information

Roman Paryz (Director), Calspan Corporation, 4455 Genesee Street, Buffalo, NY 14225; Tel: (716) 631-6785; Fax: (716) 631-4175; Email (Paryz): roman.paryz@calspancom; Web site: http://www.calspan.com.



Transonic Wind Tunnel (TWT),
Calspan Corporation,
Buffalo, New York USA

Installation Name	Test Section Size	Temperature Range
Lockheed Martin, Missiles and Fire Control (LMMFC), Grand Prairie, Texas, USA	Transonic: 4 x 4 x 6 ft³; supersonic: 4 x 4 x 5 ft³	100°F (no more than a 5°F variation during test runs)
	Speed Range	**Reynolds Number (max)**
	Transonic: 0.3 to 1.8 Mach; supersonic: 1.6 to 4.8	4 to 34
Facility Name		**Dynamic Pressure**
High Speed Wind Tunnel Facility (HSWT)	**Cost**	150 to 1,200 kn
	US$45 million (excluding land acquisition)	**Stagnation Pressure**
	Operational Status	20 to 350 psi
	Operational as of November 2006.	

Testing Capabilities

Blowdown to atmosphere; flexible plate nozzle; model cart; remote roll sting; support stings and adapters; inlet and propulsion testing; flight-dynamics simulator; dynamic stability; spin and magnus testing; instrumented stores testing; flow visualization; bench-test facility; high-pressure nitrogen gas facility; and additional test-support equipment.

Data Acquisition

80 analog data channels; digital data processor; max digital data counts 32,768; 2.5 to 10,000 mV input signal range per channel; 125,000 samples/sec; 8300 XWB instrumentation amplifiers; dynamic data recording; data availability; 6-component, strain-gauge balance.

Current Programs

Aerodynamic force and moment measurements; jet interaction; flutter; store separation/captive trajectory; inlet simulation; spin/roll damping and dynamic stability; in-house model and instrumentation design and support.

Planned Improvements

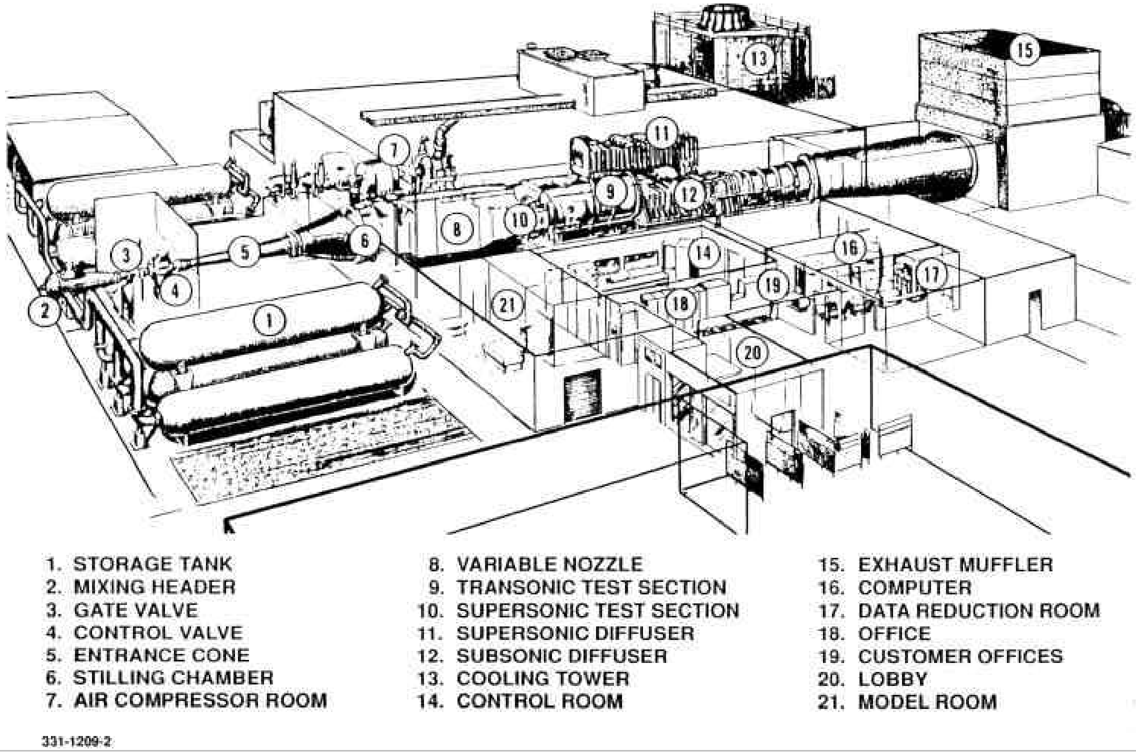
1958 (constructed).

User Fees

Hourly occupancy basis with fixed rate for installation and removal of test type, including pretesting or post testing.

Contact Information

Tim Fennell (Manager), High Speed Wind Tunnel, P.O. Box 531046 Grand Prairie, Texas 75053-1046; Tel: (972) 946 2751; Fax: (972) 946 5466; Email (Fennell): tim.j.fennell@lmco.com; Web site: http://www.lockheedmartin.com/hswt.



High Speed Wind Tunnel (HSWT),
Lockheed Martin Missiles and Fire Control (LMMFC),
Grand Prairie, Texas USA

Installation Name	***Test Section Size***	***Temperature Range***
Lockheed Martin, Wind Tunnel Test Group, Smyrna, Georgia, USA	20 x 28 x 72 in³	
	Speed Range	***Reynolds Number (max)***
	0.20 to 1.1 Mach with sonic nozzle; 1.5 and 2.0 Mach with nozzle inserts.	5 to 50
Facility Name	***Cost***	***Dynamic Pressure***
Compressible Flow Wind Tunnel (CFWT)		
	Operational Status	***Stagnation Pressure***
	Presumed active as of May 2006.	20 to175 psi

Testing Capabilities

Blowdown type; 2D testing; solid sidewalls with variable porosity top and bottom walls; semi-span testing uses solid-reflection plane floor with tunnel boundary-layer bleed, used with variable-porosity side and top walls; complete model testing uses sting-support system with all 4 variable-porosity walls; additional test-section walls available for special test applications.

Data Acquisition

Anemometer velocity acquisition; flow visualization; and data reduction.

Current Programs

Planned Improvements

1970 (commenced operation).

User Fees

Contact Information

Z. Grether (Lead Engineer), D. Arnold (Lead Instrumentation Engineer), Lockheed Martin, Wind Tunnel Test Group, Compressible Flow Wind Tunnel, 1055 Richardson Road, Smyrna, GA 30080-1040; Tel: (770) 494-5619; Fax: (770) 494-4790; Email (Grether): zachary.grether@lmco.com; Email (Arnold): w.d.arnold@lmco.com; Web site: http://www.lockheedmartin.com/.

NO IMAGE AVAILABLE

Supersonic | **United States**

Installation Name	***Test Section Size***	***Temperature Range***
National Aeronautics and Space Administration (NASA), Ames Research Center, Moffet Field, California, USA	11 x 11 ft²	150°F
	Speed Range	***Reynolds Number (max)***
Facility Name	0.20 to 1.45 Mach	0.30 to 9.6
11 ft Transonic Wind Tunnel	***Cost***	***Dynamic Pressure***
	Operational Status	***Stagnation Pressure***
	Presumed active as of August 2006.	3.0 to 32.0 psia

Testing Capabilities

Closed circuit; single return; variable density; continuous flow.

Data Acquisition

Current Programs

Planned Improvements

User Fees

Contact Information

John Holmberg (Facility Manager), Don Nickison (Division Chief), Unitary Wind Tunnels, NASA Ames Research Center, Moffet Field, CA; Tel (General): (650) 604-5000; Tel (Nickison): (650) 604-1748; Fax (Nickison): (650) 604-4357; Email (Nickison): Donald.J.Nickison@nasa.gov; Email (Holmberg): John.L.Holmberg@nasa.gov; Web site: http://aocentral.arc.nasa.gov/11ft1.html.

NO IMAGE AVAILABLE

Installation Name	Test Section Size	Temperature Range
National Aeronautics and Space Administration (NASA), Ames Research Center, Moffet Field, California, USA	9 x 7 ft^2	600°R
	Speed Range	**Reynolds Number (max)**
	1.55 to 2.55 Mach	0.50 to 5.7
Facility Name		**Dynamic Pressure**
9 x 7 ft Supersonic Wind Tunnel	**Cost**	
	Operational Status	**Stagnation Pressure**
	Presumed active as of August 2006.	2.8 to 29.5 psia

Testing Capabilities

Closed circuit; single return; variable density; continuous flow.

Data Acquisition

Schlieren; pressure-sensitive paint; oil flow; tufts; sublimation; skin-friction interferometry; laser vapor screen; and liquid crystal.

Current Programs

Planned Improvements

User Fees

Contact Information

John Holmberg (Facility Manager), Don Nickison (Division Chief), Unitary Wind Tunnels, NASA Ames Research Center, Moffet Field, CA; Tel (General): (650) 604-5000; Tel (Nickison): (650) 604-1748; Fax (Nickison): (650) 604-4357; Email (Nickison): Donald.J.Nickison@nasa.gov; Email (Holmberg): John.L.Holmberg@nasa.gov; Web site: http://aocentral.arc.nasa.gov/11ft1.html.

NO IMAGE AVAILABLE

Installation Name	***Test Section Size***	***Temperature Range***
National Aeronautics and Space Administration (NASA), Glenn Research Center, Cleveland, Ohio, USA	1 x 1 ft²	520 to 1,110°R
	Speed Range	***Reynolds Number (max)***
	1.3 to 6.0 Mach	0.4 to 16.5
Facility Name		***Dynamic Pressure***
1 x 1 ft Supersonic Wind Tunnel (SWT)	***Cost***	80 to 170 psf
	Operational Status	***Stagnation Pressure***
	Presumed active as of March 2007.	165 psia

Testing Capabilities

Data Acquisition

DEC Alpha microprocessor.

Current Programs

Planned Improvements

User Fees

Contact Information

John F. Leone (Acting Facility Manager), 1x1 Supersonic Wind Tunnel at NASA Glenn Research Center, 21000 Brookpark Rd, Cleveland, OH 44135; Tel (General): (216) 433 4000; Tel (Leone): (216) 433 5722; Fax (Leone): (216) 433 8551; Email (Leone): John.F.Leone@grc.nasa.gov; Web site: http://facilities.grc.nasa.gov/1x1/index.html.

1 x 1 ft Supersonic Wind Tunnel (SWT),
National Aeronautics and Space Administration (NASA)
Glenn Research Center,
Cleveland, Ohio USA

Wind Tunnels of the Western Hemisphere

Supersonic | **United States**

Installation Name	***Test Section Size***	***Temperature Range***
National Aeronautics and Space Administration (NASA), Glenn Research Center, Cleveland, Ohio, USA	$8 \times 6 \times 23.5$ ft³	60 to 250°F
	Speed Range	***Reynolds Number (max)***
	0 to 0.1 Mach and 0.25 to 2.0 Mach	3.6 to 4.8
Facility Name		***Dynamic Pressure***
8 x 6 ft Supersonic Wind Tunnel (SWT)	***Cost***	
		Stagnation Pressure
	Operational Status	
	Presumed active as of March 2007.	15.3 to 25 psia

Testing Capabilities

Data Acquisition

Current Programs

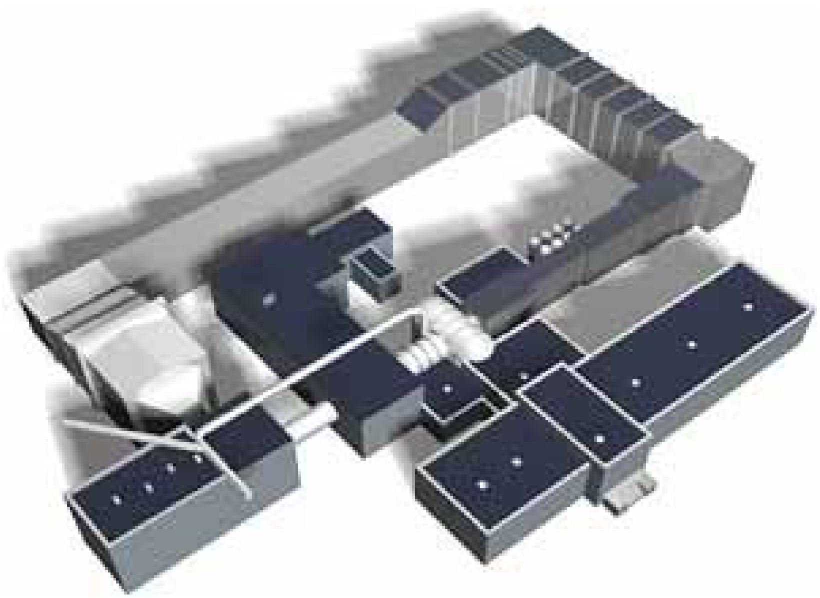
Aircraft and missile development; launch vehicles; jet and rocket engines; national aerospace plane (NASP); joint strike fighter (JSF); advanced ducted propeller (ADP); space shuttle; advanced tactical fighter; high-speed civil transport; orbital space plane (OSP).

Planned Improvements

User Fees

Contact Information

David E. Stark (Facility Manager), 8 x 6 Supersonic Wind Tunnel at NASA Glenn Research Center, 21000 Brookpark Road, Cleveland, OH 44135; Tel (General): (216) 433-4000; Tel (Stark): (216) 433-2922; Fax (Stark): (216) 433-8551; Email (Stark): David.E.Stark@nasa.gov; Web site: http://facilities.grc.nasa.gov.



8 x 6 ft Supersonic Wind Tunnel (SWT),
National Aeronautics and Space Administration (NASA)
Glenn Research Center,
Cleveland, Ohio USA

Wind Tunnels of the Western Hemisphere

Supersonic — **United States**

Installation Name	Test Section Size	Temperature Range
National Aeronautics and Space Administration (NASA), Glenn Research Center, Cleveland, Ohio, USA	10 x 10 x 40 ft³	
	Speed Range	**Reynolds Number (max)**
Facility Name		0.1 to 3.4 (aerodynamic mode); 2.1 to 2.7 (propulsion mode)
Abe Silverstein Supersonic Wind Tunnel (SWT)	**Cost**	**Dynamic Pressure**
	Operational Status	**Stagnation Pressure**
	Presumed active as of March 2006.	

Testing Capabilities

Continuous, closed/open-loop system; tunnel air heater; high-pressure air; altitude-exhaust cooling water; hydraulics; Gust/Mach Plates; liquid and gaseous fuel supplies; model string/struts and adapters; variety of available research-test hardware.

Data Acquisition

ESP; Escort; DEC Alpha microprocessor; multichannel, high-speed, digitized, dynamic data system; paint; Schlieren systems; laser; oil-flow and video-flow visualization; test-article controls and remote-access control room.

Current Programs

Full-scale models; full-scale jet and rocket engines and aircraft components; inlets and nozzles; propulsion system integration; has tested Atlas-Centaur, Saturn, and Atlas-Agena class launch vehicles; vehicle-focused research programs, including testing of high-speed civil transport, national aerospace plane, and joint strike fighter.

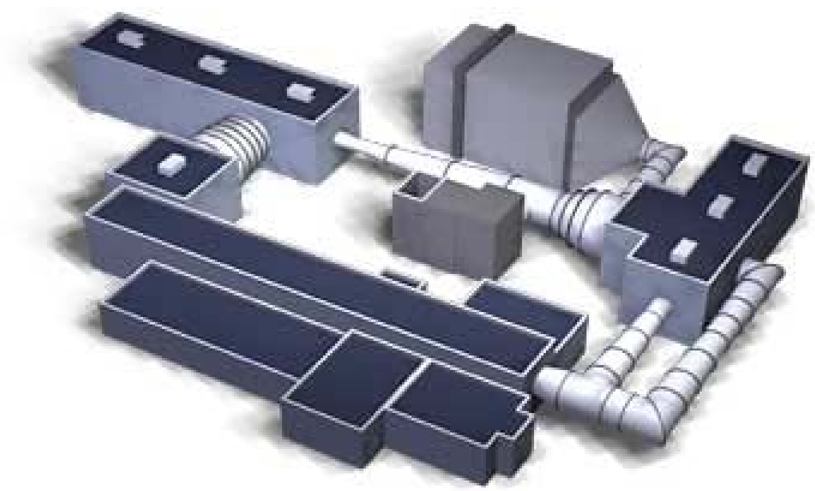
Planned Improvements

1956 (commenced operation).

User Fees

Contact Information

David E. Stark (Facility Manager), Abe Silverstein Supersonic Wind Tunnel at NASA Glenn Research Center, 21000 Brookpark Rd., Cleveland, OH 44135; Tel (General): (216) 433-4000; Tel (Stark): (216) 433-2922; Fax (Stark): (216) 433-8551; Email (Stark): David.E.Stark@nasa.gov; Web site: http://facilities.grc.nasa.gov/10x10/10x10_desc.html.



Abe Silverstein Supersonic Wind Tunnel,
National Aeronautics and Space Administration (NASA),
Glenn Research Center,
Cleveland, Ohio USA

Installation Name	Test Section Size	Temperature Range
National Aeronautics and Space Administration (NASA), Langley Research Center, Wind Tunnel Enterprise, Hampton, Virginia, USA	13 x 13 in² (33 x 33 cm²)	-320 to 130°F
Facility Name	**Speed Range**	**Reynolds Number (max)**
0.3 m Transonic Cryogenic Tunnel (0.3-M TCT)	0.2 to 0.9 Mach	1 to 100
	Cost	**Dynamic Pressure**
	Operational Status	**Stagnation Pressure**
	Presumed active as of March 2007.	14.7 to 88 psia

Testing Capabilities

Data Acquisition

192 analog channels; 32 digital channels; Unix computer; final data reduced on separate Unix workstation.

Current Programs

Two-dimensional, airfoil/aeronautical research; in-house skin-friction measurements; university-sponsored research projects.

Planned Improvements

Planned improvements: electronically scanned pressure system (ESP) recently acquired.

User Fees

Contact Information

The 0.3 m Transonic Cryogenic Tunnel Manager, NASA Langley Research Center, Wind Tunnel Enterprise, Hampton, VA 23681-2199; Tel: (757) 864-5109; Fax: (757) 864-8297; Email: wte+fm_03m@larc.nasa.gov; Web site: http://wte.larc.nasa.gov/facilities_updated/aerodynamics/03m.htm.

NO IMAGE AVAILABLE

Installation Name	Test Section Size	Temperature Range
National Aeronautics and Space Administration (NASA), Langley Research Center, Wind Tunnel Enterprise, Hampton, Virginia, USA	8.2 x 8.2 ft²	-250 to 150°F
	Speed Range	**Reynolds Number (max)**
	0.1 to 1.2 Mach	4 to 145
Facility Name	**Cost**	**Dynamic Pressure**
National Transonic Facility (NTF)		
	Operational Status	**Stagnation Pressure**
	Presumed active as of March 2007.	15 to 130 psia

Testing Capabilities

High pressure, cryogenic, closed circuit; test section has 12 slots and 14 reentry flaps in ceiling and floor; powered by a 100 MW motor; 2 cooling modes; accommodates various types of internal, 6-component, strain-gauge balances; onboard angle-of-attack (AOA); ESP system available in 2.5, 5, 15, 30, and 45 psi pressures.

Data Acquisition

256 analog channels; 32 digital channels; 1 frequency channel; 14-track FM tape recorder; Unix and Macintosh computer; Unix workstation; ultraviolet lighting; temperature-sensitive paint (TSP) and pressure-sensitive paint (PSP); several different flow-visualization techniques.

Current Programs

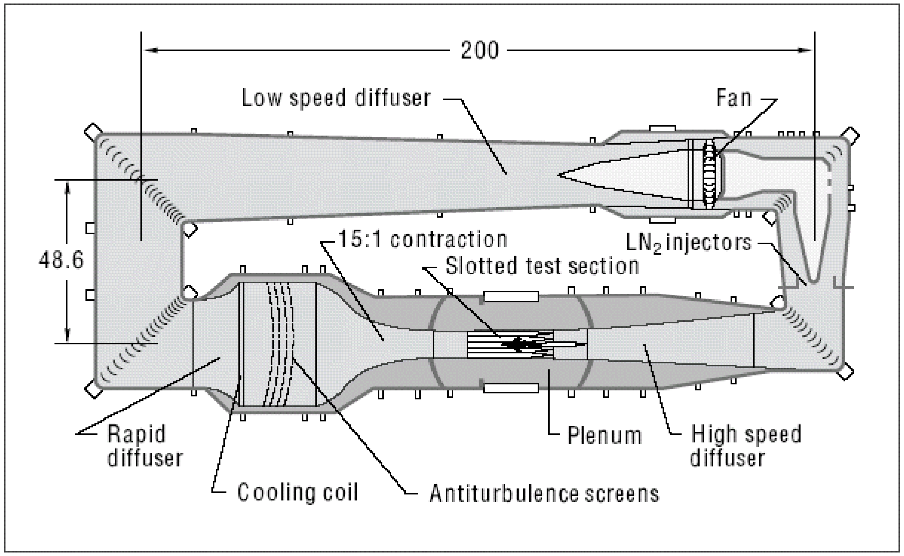
Supports stability and control; cruise performance; stall-buffet onset; configuration-aerodynamics validation for full- and half-span models.

Planned Improvements

User Fees

Contact Information

The National Transonic Facility Manager, NASA Langley Research Center, Wind Tunnel Enterprise, Hampton, VA 23681-2199; Tel: (757) 864-5033; Fax: (757) 864-7892; Email: wte+fm_ntf@larc.nasa.gov; Web site: http://wte.larc.nasa.gov/.



National Transonic Facility (NTF),
National Aeronautics and Space Administration (NASA),
Wind Tunnel Enterprise,
Langley Research Center,
Hampton, Virginia USA

Wind Tunnels of the Western Hemisphere

Supersonic | **United States**

Installation Name
National Aeronautics and Space Administration (NASA), Langley Research Center, Wind Tunnel Enterprise, Hampton, Virginia, USA

Facility Name
Unitary Plan Wind Tunnel (UPWT)

Test Section Size
0.4 x 4 x 7 ft³

Speed Range
1.5 to 4.6 Mach

Cost

Operational Status
Presumed active as of March 2007.

Temperature Range
125 to 175°F

Reynolds Number (max)
0.5 to 11

Dynamic Pressure

Stagnation Pressure

Testing Capabilities
Closed-circuit, continuous-flow, variable-density, 100,000 hp drive system; 6 centrifugal compressors; dry air supply; evacuating system; cooling system; interconnecting ducting.

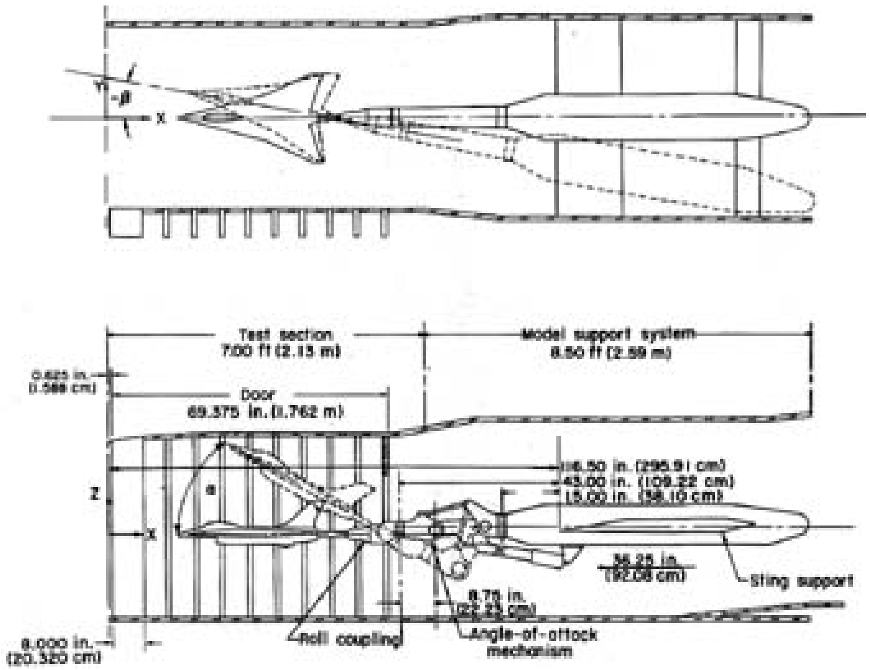
Data Acquisition
128 analog channels; 40 digital channels; Unix, Macintosh, and PC computers; Schlieren system; colored and UV oil flow; laser vapor screen; fluorescent minitufts; PSP and TSP available.

Current Programs
U.S. supersonic military aircraft, missiles, and spacecraft, including supersonic transport program (SST), space shuttle, and national aerospace plane; high-speed research (HSR), advanced-technology demonstrator (X-33), small, reusable booster (X-34), and experimental crew-return vehicle (XCRV or X-38).

Planned Improvements

User Fees

Contact Information
The Unitary Plan Wind Tunnel Manager, NASA Langley Research Center, Wind Tunnel Enterprise, Hampton, VA 23681-2199; Tel: (757) 864-5033; Fax: (757) 864-7892; Email: wte+fm_ntf@larc.nasa.gov; Web site: http://wte.larc.nasa.gov/.



Unitary Plan Wind Tunnel (UPWT),
National Aeronautical and Space Administration (NASA),
Langley Research Center,
Wind Tunnel Enterprise,
Hampton, Virginia USA

Installation Name	Test Section Size	Temperature Range
Ohio State University, Aeronautical and Astronautical Research Laboratory (AARL), Columbus, Ohio, USA	6 x 6 in²	
	Speed Range	**Reynolds Number (max)**
	1.5 to 3 Mach	2 to 20
Facility Name	**Cost**	**Dynamic Pressure**
6 x 6 in Supersonic Blow Down Wind Tunnel		
	Operational Status	**Stagnation Pressure**
	Presumed active as of December 2006.	

Testing Capabilities

Data Acquisition

Harris H800 superminicomputer for real-time data acquisition and analysis; two 21 in, grating spectrographs for studies in combustion and high-temperature gas flows; 5 W, argon-ion laser and associated optics for 2-channel, laser-Doppler anemometer.

Current Programs

Planned Improvements

User Fees

Contact Information

Professor Gerald M. Gregorek (Director), Aero/Astro Research Laboratory, 2300 West Case Road, Columbus, Ohio 43235; Tel: (614) 292 5507 or 5491; Fax: (614) 292 5552; Web site: http://aerospace.eng.ohio-state.edu/research/index.php?contents=research.html.

NO IMAGE AVAILABLE

Installation Name	Test Section Size	Temperature Range
Princeton University, Gas Dynamics Laboratory, Princeton, New Jersey, USA	200 x 200 mm²	
	Speed Range	**Reynolds Number (max)**
	2 and 3 Mach	
Facility Name	**Cost**	**Dynamic Pressure**
8 x 8 in Supersonic Wind Tunnel		
	Operational Status	**Stagnation Pressure**

Testing Capabilities

High Reynolds number, supersonic, blowdown facility with 3 interchangeable test sections and Mach 2 and 3 nozzles; special test sections available; models mounted on the floor, a false plate, or a sting; surveys can be made in the transverse and longitudinal directions; eccentric window arrangement allows detailed examination of 3D flows.

Data Acquisition

Schlieren and shadowgraph systems; 1- and 2-component, automated traverse systems; automated scanivalve pressure-survey equipment; 8 channels of high-frequency pressure transducers; and 6 channels of constant-temperature anemometer equipment.

Current Programs

Suitable for testing over a wide range of Reynolds numbers.

Planned Improvements

User Fees

Contact Information

A. Smits, Princeton University, Gas Dynamics Laboratory, James Forrestal Campus, Princeton, New Jersey 08544-0710; Tel: (609) 258 7634; Tel (Smits): (609) 258 5117; Fax: (609) 258 6109; Email: gasdyn@princeton.edu; Web site: http://gasdyn.princeton.edu/info/e71/supersonic_wind_tunnel.html.

NO IMAGE AVAILABLE

Installation Name
Purdue University, School of Aeronautics and Astronautic Engineering (AAE), Boeing Compressible-Flow Laboratory, West Lafayette, Indiana, USA

Facility Name
2 in Blowdown Tunnel

Test Section Size
2 in

Speed Range
2.5 Mach

Cost

Operational Status
Operational as of November 2006.

Temperature Range

Reynolds Number (max)

Dynamic Pressure

Stagnation Pressure

Testing Capabilities
Can be operated in pressure-vacuum mode.

Data Acquisition

Current Programs
Teaching.

Planned Improvements
1960 (constructed).

User Fees

Contact Information
Steve Schneider (Professor), Purdue University, School of Aeronautics and Astronautic Engineering (AAE), Aerospace Sciences Lab (ASL), 315 N. Grant Street, West Lafayette, IN 47907-2023; Tel (Schneider): (765) 494 3343; Tel (Lab): (765) 494 3343; Fax (Schneider): (765) 496 3321; Email (Schneider): steves@purdue.edu; Web site: http://cobweb.ecn.purdue.edu/~aae519/BAM6QT-Mach-6-tunnel/summary-oct2005.pdf.

NO IMAGE AVAILABLE

Installation Name	Test Section Size	Temperature Range
Purdue University, School of Aeronautics and Astronautic Engineering (AAE), Boeing Compressible-Flow Laboratory, West Lafayette, Indiana, USA	4 x 4 in²	
	Speed Range	**Reynolds Number (max)**
		400,000
Facility Name	**Cost**	**Dynamic Pressure**
Mach 4 Quiet Flow Ludwieg Tube	US$100,000 (roughly)	
	Operational Status	**Stagnation Pressure**
	Confirmed active as of November 2006.	

Testing Capabilities

Data Acquisition

Current Programs

Exclusively for teaching and developing instrumentation for Mach 6 tunnel.

Planned Improvements

1960s (constructed).

User Fees

Contact Information

Steve Schneider (Professor), Purdue University, School of Aeronautics and Astronautic Engineering (AAE), Aerospace Sciences Lab (ASL), 315 N. Grant Street, West Lafayette, IN 47907-2023; Tel (Schneider): (765) 494 3343; Tel (Lab): (765) 494 3343; Fax (Schneider): (765) 496 3321; Email (Schneider): steves@purdue.edu; Web site: https://engineering.purdue.edu/AAE/Research/ResearchFacilities/LabFacilities#aero.

NO IMAGE AVAILABLE

Installation Name
Purdue University, School of Aeronautics and Astronautic Engineering (AAE), Boeing Compressible-Flow Laboratory, West Lafayette, Indiana, USA

Facility Name
Supersonic Jet Apparatus

Test Section Size
1 in

Speed Range

Cost

Operational Status
Presumed active as of April 2007.

Temperature Range

Reynolds Number (max)

Dynamic Pressure

Stagnation Pressure

Testing Capabilities
Can be operated in pressure-vacuum mode; includes a heater and particle filter, to enable supersonic hot-wire calibrations.

Data Acquisition

Current Programs
Nozzle-flow studies; teaching.

Planned Improvements

User Fees

Contact Information
Steve Schneider (Professor), Purdue University, School of Aeronautics and Astronautic Engineering (AAE), Aerospace Sciences Lab (ASL), 315 N. Grant Street, West Lafayette, IN 47907-2023; Tel (Schneider): (765) 494 3343; Tel (Lab): (765) 494 3343; Fax (Schneider): (765) 496 3321; Email (Schneider): steves@purdue.edu; Web site: https://engineering.purdue.edu/AAE/Research/ResearchFacilities/LabFacilities#aero.

NO IMAGE AVAILABLE

Installation Name	***Test Section Size***	***Temperature Range***
Sandia National Laboratories, Engineering Sciences Experimental Facility, Albuquerque, New Mexico, USA	12 x 12 in², square	
	Speed Range	***Reynolds Number (max)***
Facility Name	0.3 to 1.3 (transonic); 1.5 to 3.0 (supersonic)	4 to 17
Trisonic Wind Tunnel (TWT)	***Cost***	***Dynamic Pressure***
		2 to 20 psi
	Operational Status	***Stagnation Pressure***
	Presumed active as April 2007.	

Testing Capabilities

Blowdown-to-atmospheric type; working medium is air; subsonic and transonic flows produced using a converging nozzle with perforated test section walls; supersonic streams produced using any of the converging-diverging nozzle walls with solid-test section walls; run times from 20 to 120 secs at 30 min intervals; model scales typically from 6% to 10% (gravity bombs and missiles).

Data Acquisition

Automatic-control system maintains set stagnation-pressure level; controls movement of the pitch sector (upon which the model is mounted); orientation of models set manually; all other tunnel and data acquisition procedures done remotely from the wind-tunnel control room.

Current Programs

Subsonic, transonic, and supersonic experiments for a wide variety of vehicles; TWT facility is traditionally used for force and moment experiments on bomb and reentry vehicle geometries, to gain aerodynamic performance data for flight-control systems; also used for understanding basic physics of compressible, high-speed flows.

Planned Improvements

User Fees

Contact Information

Robert D. M. Tachau, Steven J. Beresh (User Liaisons), Sandia National Laboratories, P.O. Box 5800, MS-0834, Albuquerque, New Mexico 87185-0834; Tel (Tachau): (505) 845-7157; Tel: (Beresch): (505) 844-4618; Fax (Tachau): (505) 844-9297; Fax (Beresch): (505) 844-4523; Email (Tachau): rdtacha@sandia.gov; Email (Beresch): sjberes@sandia.gov; Web site: http://www.sandia.gov/bus-ops/partnerships/tech-access/facilities/eng-sci.html.

NO IMAGE AVAILABLE

Installation Name

Triumph Aerospace Systems-Newport News, El Segundo, California, USA

Facility Name

North American Trisonic Wind Tunnel (TWT)

Test Section Size

7 x 7 ft²

Speed Range

0.2 to 3.5 Mach

Cost

Operational Status

Presumed active as of January 2007.

Temperature Range

Reynolds Number (max)

Dynamic Pressure

Stagnation Pressure

Testing Capabilities

Continuous, blowdown, with variable wall nozzle; walk-in test section; operated by Allied; owned by University of California, Los Angeles.

Data Acquisition

Internal balances; steady-state pressures; dynamic pressures; high-speed digital video (1,000 ft/sec, B&W, 4 cameras); pressure-sensitive paint (PSP); flow visualization includes Schlieren, 60 in diameter (supersonic, solid-wall test section only); shadowgraph (transonic/subsonic, porous-wall test section only); fluorescent oil flow; and mini-tufts.

Current Programs

Force and moment testing; inlet testing; semi-span testing; auxiliary services include high-pressure air; high-flow compressed air; special-purpose models/equipment; past programs: XB-70, X-15, Apollo, B-1, B-1B, Gripen, Eurofighter, and many Boeing, Douglas, and Lockheed airliners; current customers: U.S. Army and Navy, Boeing, ATK, Bombardier, Cessna, Lockheed Martin, Northrop Grumman, and Raytheon.

Planned Improvements

1950s (constructed).

User Fees

Contact Information

Rick Hughes (Director), Trisonic Wind Tunnel,Triumph Aerospace Systems, 400 Duley Road, El Segundo, CA 90245; Tel: (310) 335 1585; Fax: (310) 640 1056; Email (Hughes): rhughes@triumphgroup.com; Web site: http://www.alliedaerospace.com/WT%20Trisonic.htm.

NO IMAGE AVAILABLE

Installation Name

University of Kansas, Department of Aerospace Engineering, Lawrence, Kansas, USA

Facility Name

Supersonic Wind Tunnel

Test Section Size

2 x 3¼ in²

Speed Range

1.5 to 3.0 Mach

Cost

Operational Status

Presumed active as of April 2007.

Temperature Range

Reynolds Number (max)

Dynamic Pressure

Stagnation Pressure

Testing Capabilities

Blowdown type; property of the state of Kansas.

Data Acquisition

Schlieren system and pressure-measuring equipment.

Current Programs

Planned Improvements

User Fees

Contact Information

D. Downing (Professor of Aerospace Engineering), University of Kansas, Department of Aerospace Engineering, 2120 Learned Hall, Lawrence, KS 66045-7621; Tel: (785) 864-4267; Fax: (785) 864-3597; Email (General): aerohawk@ku.edu; Email (Downing): drdrd@ku.edu; Web site: http://ae.engr.ku.edu/about/facilities.html.

NO IMAGE AVAILABLE

Wind Tunnels of the Western Hemisphere

Supersonic | **United States**

Installation Name
University of Notre Dame, Department of Aerospace and Mechanical Engineering, Hessert Laboratory for Aerospace Research, Notre Dame, Indiana, USA

Facility Name
Three Transonic and Supersonic Wind Tunnels

Test Section Size
40.3 to 161.3 cm² (6.25 to 25 in²)

Speed Range
0.3 to 1.3 Mach

Cost

Operational Status
Presumed active as of February 2007.

Temperature Range

Reynolds Number (max)

Dynamic Pressure

Stagnation Pressure
Atmospheric

Testing Capabilities
Three tunnels independently connected to a common manifold through a series of valves; high-contraction ratio inlets, up to 150:1; 3 vacuum pumps driven by 125 hp, electric motor; continuous, extended-duration operation; each tunnel equipped with high-contraction ratio inlet (up to 150:1); 6% slotted-wall, transonic test section available with adjustable plenum pressure.

Data Acquisition
Schlieren and shadowgraph systems available for flow visualization.

Current Programs
Unsteady forced response of rotor and stator blades; nozzle and base-flow studies and measurements on 2D and 3D configurations; turbulent, compressible-boundary-layer research; smoke-flow visualization using direct smoke injection at transonic and supersonic speeds.

Planned Improvements
Planned improvements: new compressible shear-layer test section to study fluid, optic interactions in weakly compressible, transitional shear-layer flows.

User Fees

Contact Information
Transonic/Supersonic Wind Tunnels, University of Notre Dame, Department of Aerospace and Mechanical Engineering, Hessert Laboratory for Aerospace Research, 365 Fitzpatrick Hall, Notre Dame, Indiana 46556-5637; Tel: (574) 631 5430; Fax: (574) 631 8341; Email: amedept@nd.edu; Web site: http://www.nd.edu/~ame/.

NO IMAGE AVAILABLE

Installation Name
Virginia Polytechnic Institute and State University, Department of Aerospace and Ocean Engineering, Blacksburg, Virginia, USA

Facility Name
Supersonic/Transonic Wind Tunnel

Test Section Size
23 x 23 cm²

Speed Range
2.4 to 4, 0.2 to 0.8 Mach

Cost

Operational Status
Presumed active as of April 2007.

Temperature Range

Reynolds Number (max)
2 to 5

Dynamic Pressure

Stagnation Pressure
3 to 20.5 atm

Testing Capabilities
Three nozzle chambers; 8 to 60 second run durations; total power rate of compressor plant is 500 hp; dewpoint below -40°C; maximum model diameter at M=3 is 9 cm; storage tank volume 23 m³; remote-control model support allowing position changes to vertical plane; maximum air pressure in storage tanks: 51 atm.

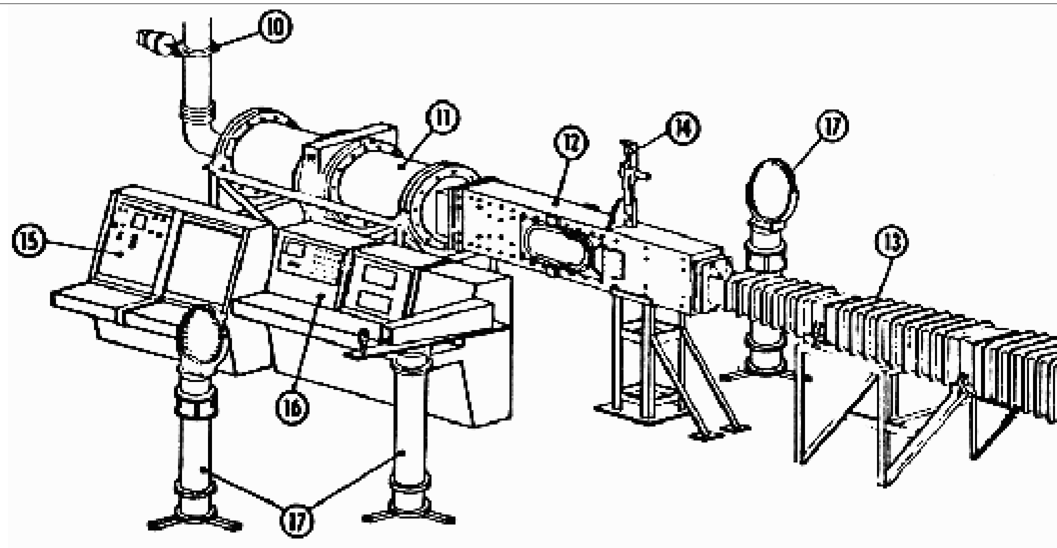
Data Acquisition
All IBM PC-based, using modern software such as LabView; 30 cm Schlieren apparatus; direct shadowgraph system or focused shadowgraph arrangement; interferograms use laser-based, single-plate interferometer system and CCD camera; hycam, high-speed, motion picture camera; 6-component, force and moment balance; main pressure-measuring system includes a PSI Model 780B, electronically scanned pressure system.

Current Programs

Planned Improvements
1958 (purchased from NASA); 1963 (commenced operation); recent changes (modifications to air pumping, tunnel control, and instrumentation equipment).

User Fees

Contact Information
Dr. William Devenport (Director),Virginia Polytechnic Institute and State University, Department of Aerospace and Ocean Engineering, , 215 Randolph Hall, Blacksburg, VA 24061; Tel: (540) 231 6611; Fax: (540) 231 9632; Email: info@aoe.edu; Email (Devenport): devenport@vt.edu; Web site: http://www.aoe.vt.edu/research/facilities/superson.php.



10-Pressure Regulator, 11-Settling Chamber, 12-Test Section, 13-Diffuser, 14-Model Support and Drive System, 15-Tunnel Control Panel, 16-Measurement Panel, 17-Schlieren Apparatus

Supersonic/Transonic Wind Tunnel
Virginia Polytechnic Institute and State University,
Department of Aerospace and Ocean Engineering,
Blacksburg, Virginia USA

Wind Tunnels of the Western Hemisphere

Hypersonic **Brazil**

Installation Name	Test Section Size	Temperature Range
Air Force of Brazil (FAB), General Aerospace Technology Command (CTA), São José dos Campos, Brazil	15 cm (diameter) x 24 m (length)	Up to 7,500°C
Facility Name	**Speed Range**	**Reynolds Number (max)**
T3 Hypersonic Wind Tunnel	8.5 km/sec	
	Cost	**Dynamic Pressure**
	US$1.3 million	
	Operational Status	**Stagnation Pressure**
	Operational beginning in January 2007.	

Testing Capabilities

One of the largest hypersonic wind tunnels in the world; medium: helium.

Data Acquisition

Current Programs

Spacecraft, aircraft, new types of engines.

Planned Improvements

January 2007 (commenced operation).

User Fees

Contact Information

Air Force of Brazil (FAB), General Aerospace Technology Command (CTA), São José dos Campos, Brazil.

NO IMAGE AVAILABLE

Hypersonic | **United States**

Installation Name	***Test Section Size***	***Temperature Range***
Accurate Automation Corporation, Chattanooga, Tennessee, USA	360 x 226 x 200 mm³	290 K (M=2,3,4), 376 K (M=5), 504 K (M=6), 645 K (M=7)
Facility Name	***Speed Range***	***Reynolds Number (max)***
Supersonic-Hypersonic Wind Tunnel	2 to 7 Mach	2.96 (M=2), 3.83 (M=3), 5.92 (M=4), 5.86 (M=5), 5.96 (M=6), and 5.6 (M=7)
	Cost	***Dynamic Pressure***
		0.54 to 1.04
	Operational Status	***Stagnation Pressure***
	Presumed active as of February 2007.	115 to 141

Testing Capabilities
Blowdown; 2.5 second duration; 100 mm flow diameter; 20 kW power; nitrogen gas.

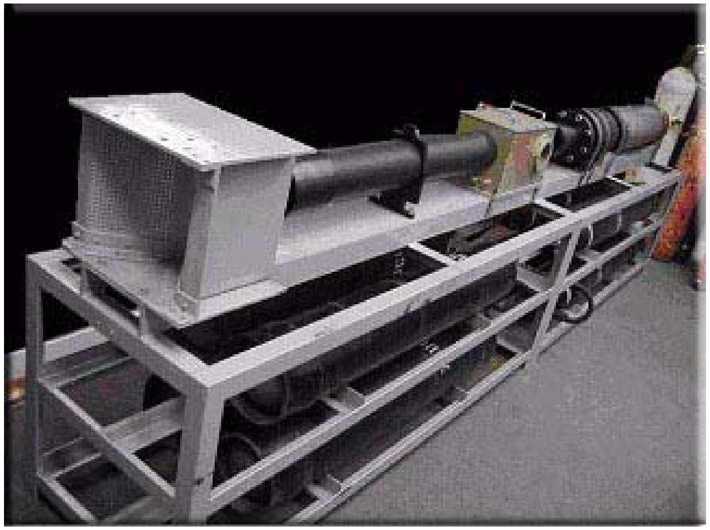
Data Acquisition

Current Programs
Shock-wave modification using plasma on cone models; material performance characterization; hypersonic investigations; company currently supports the Naval Surface Weapons Center, NASA Marshall, NASA Ames, and NASA Langley.

Planned Improvements

User Fees

Contact Information
Accurate Automation Corporation, 7001 Shallowford Road, Chattanooga, TN 37421; Tel: (423) 894 4646; Fax: (423) 894 4645; Email (sales): sales@accurate-automation.com; Web site: http://www.accurate-automation.com/Technology/Wind_Tunnel/wind_tunnel.html.



**Supersonic-Hypersonic Wind Tunnel,
Accurate Automation Corporation,
Chattanooga, Tennessee USA**

Installation Name	Test Section Size	Temperature Range
Aero Systems Engineering Inc. (ASE, formerly Fluidyne), St. Paul, Minnesota, USA	20 in diameter	Exhaust nozzles: 1,200°F; hypersonic inlet: 3,000°F (stagnation)
	Speed Range	**Reynolds Number (max)**
	7, 11, 14 Mach	
Facility Name	**Cost**	**Dynamic Pressure**
Channel 9: High Area Ratio Nozzle Test and Hypersonic Wind Tunnel		
	Operational Status	**Stagnation Pressure**
	Presumed active as of April 2007.	Exhaust nozzles: 1,200 psia; hypersonic inlet: 2,000 psia

Testing Capabilities

Three-component force balance; pressure ratios to 100,000; flow rates to 10 pps; 30-sec run times; currently configured as high-pressure-ratio, exhaust nozzle, thrust stand; model assembly supported by 3-component, strain-gauge force balance, isolated from the facility, piping by an elastic seal.

Data Acquisition

Current Programs

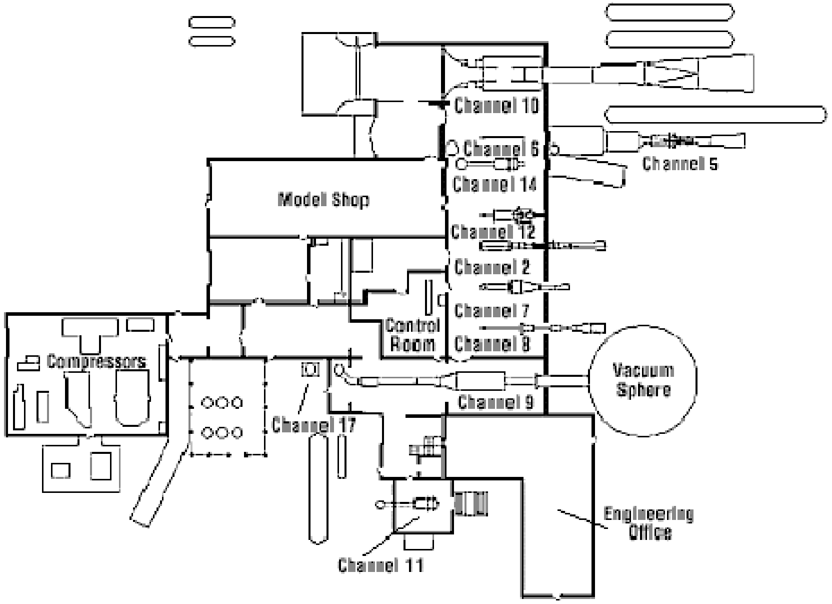
Exhaust nozzles; flow surveys; temperatures; heat-transfer measurements; hypersonic inlet tests; tests of exhaust nozzles with very high area ratios.

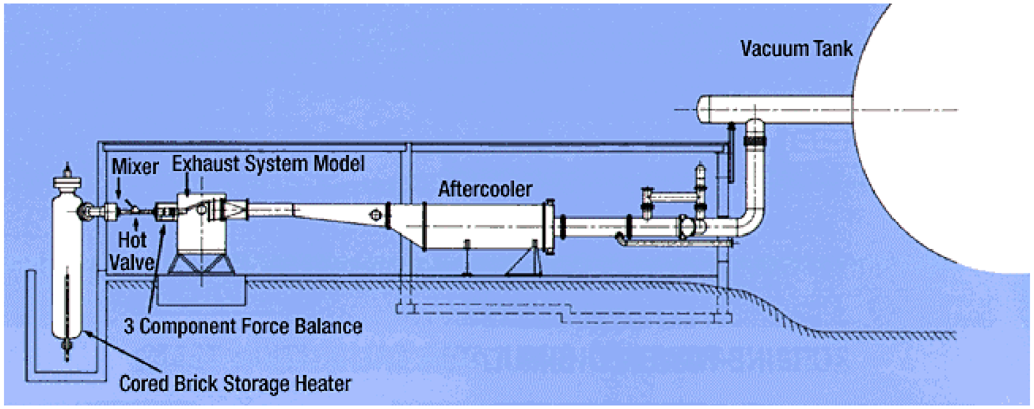
Planned Improvements

User Fees

Contact Information

P. Giese (Wind Tunnel Programs), Aero Systems Engineering, Inc., 358 E. Fillmore Avenue, St. Paul, MN 55107; Tel (General): (651) 227 7515; Fax (General): (651) 227 0519; Email (General): ase@aerosysengr.com; Email (Giese): pgiese@aerosysengr.com; Web site: http://www.aerosysengr.com/.





Channel 9: High Area Ratio Nozzle Test Stand and Hypersonic Wind Tunnel, Aero Systems Engineering Inc. (ASE), St. Paul, Minnesota USA

Installation Name	Test Section Size	Temperature Range
Arnold Engineering Development Center (AEDC), Von Karman Gas Dynamics Facility, Arnold Air Force Base, Tennessee, USA	40 x 40 in²	Up to 290°F
	Speed Range	**Reynolds Number (max)**
	1.5 to 5.5 Mach	
Facility Name	**Cost**	**Dynamic Pressure**
VKF Wind Tunnel A		
	Operational Status	**Stagnation Pressure**
	Reported active February 2006.	

Testing Capabilities

Continuous flow, closed circuit, variable density; computer controls continuous-curvature nozzle that can vary the Mach number; working medium is air supplied by a 9-stage compressor system, driven by electric motors providing up to 92,500 hp.

Data Acquisition

Current Programs

Devoted primarily to study of aerodynamic design; obtains large aerodynamic and aerothermodynamic databases used to develop supersonic and hypersonic flight vehicles, including reentry and tactical vehicles to space capsules, X-planes, and winged vehicles; has tested Boeing X-37 and the space shuttle.

Planned Improvements

1957 (constructed).

User Fees

Contact Information

Arnold Engineering Development Center (AEDC)/DOF, 740 Fourth Street, Arnold AFB, TN 37389-6000; Tel: (931) 454-3767; Fax: (931) 454-3339; Web site: http://www.arnold.af.mil.

NO IMAGE AVAILABLE

Installation Name	*Test Section Size*	*Temperature Range*
Arnold Engineering Development Center (AEDC), Von Karman Gas Dynamics Facility, Arnold Air Force Base, Tennessee, USA	50 x 50 in²	Up to 900°F
	Speed Range	*Reynolds Number (max)*
	6 and 8 Mach	
Facility Name		*Dynamic Pressure*
VKF Wind Tunnel B	*Cost*	
		Stagnation Pressure
	Operational Status	
	Reported active February 2006.	

Testing Capabilities

Continuous flow; working medium is air supplied by 9-stage compressor system driven by electric motors providing up to 92,500 hp; air heated with natural gas-fired heaters.

Data Acquisition

Current Programs

Primarily studies aerodynamic design; obtains large aerodynamic and aerothermodynamic databases used to develop supersonic and hypersonic flight vehicles, including reentry and tactical vehicles to space capsules, X-planes, and winged vehicles.

Planned Improvements

1957 (constructed).

User Fees

Contact Information

Arnold Engineering Development Center (AEDC)/DOF, 740 Fourth Street, Arnold AFB, TN 37389-6000; Tel: (931) 454-3767; Fax: (931) 454-3339; Web site: http://www.arnold.af.mil.

NO IMAGE AVAILABLE

Installation Name
Arnold Engineering Development Center (AEDC), Von Karman Gas Dynamics Facility, Arnold Air Force Base, Tennessee, USA

Facility Name
VKF Wind Tunnel C

Test Section Size

Speed Range
4, 6, and 10 Mach

Cost

Operational Status
Reported active February 2006.

Temperature Range
Up to 1,440°F

Reynolds Number (max)

Dynamic Pressure

Stagnation Pressure

Testing Capabilities
Continuous flow; aerothermal environment for testing materials proposed for space vehicles and aircraft; working medium is air supplied by 9-stage compressor system driven by electric motors providing up to 92,500 hp.

Data Acquisition
Special photographic techniques visualize shock waves and heat patterns.

Current Programs
Subjects flight hardware to combination aerodynamic and thermodynamic effects; engineers study response of aerospace vehicles and materials to combined effects of external heating, internal heat conduction, and pressure loading; obtains large aerodynamic and aerothermodynamic databases used to develop supersonic and hypersonic flight vehicles, including reentry and tactical vehicles for space capsules, X-planes, and winged vehicles.

Planned Improvements
1957 (constructed).

User Fees

Contact Information
Arnold Engineering Development Center (AEDC)/DOF, 740 Fourth Street, Arnold AFB, TN 37389-6000; Tel: (931) 454-3767; Fax: (931) 454-3339; Web site: http://www.arnold.af.mil.

NO IMAGE AVAILABLE

Wind Tunnels of the Western Hemisphere

Hypersonic | **United States**

Installation Name	Test Section Size	Temperature Range
Ohio State University, Aeronautical and Astronautical Research Laboratory (AARL), Columbus, Ohio, USA	12 in	

Facility Name	Speed Range	Reynolds Number (max)
12 in Hypersonic Continuous Flow Wind Tunnel	6 to 15 Mach	0.05 to 3

Cost	Dynamic Pressure

Operational Status	Stagnation Pressure
Presumed active as of December 2006.	

Testing Capabilities

Continuous flow.

Data Acquisition

Harris H800 superminicomputer for real-time data acquisition and analysis; two 21 in, grating spectrographs for studies in combustion and high-temperature gas flows; 5 W, argon-ion laser and associated optics for a 2-channel, laser-Doppler anemometer.

Current Programs

Planned Improvements

User Fees

Contact Information

Professor Gerald M. Gregorek (Director), Aero/Astro Research Laboratory, 2300 West Case Road, Columbus, Ohio 43235; Tel: (614) 292 5507 or 5491; Fax: (614) 292 5552; Web site: http://aerospace.eng.ohio-state.edu/research/index.php?contents=research.html.

NO IMAGE AVAILABLE

Installation Name	Test Section Size	Temperature Range
Ohio State University, Aeronautical and Astronautical Research Laboratory (AARL), Columbus, Ohio, USA	4 in (diameter)	2,800°R
	Speed Range	**Reynolds Number (max)**
	8 to 7 Mach	
Facility Name	**Cost**	**Dynamic Pressure**
Two 4 in diameter Hypersonic Continuous Flow Wind Tunnels		
	Operational Status	**Stagnation Pressure**
	Presumed active as of December 2006.	

Testing Capabilities

Data Acquisition

Harris H800 superminicomputer for real-time data acquisition and analysis; two 21 in, grating spectrographs for studies in combustion and high-temperature gas flows; 5W, argon-ion laser and associated optics for a 2-channel, laser-Doppler anemometer.

Current Programs

Planned Improvements

User Fees

Contact Information

Professor Gerald M. Gregorek (Director), Aero/Astro Research Laboratory, 2300 West Case Road, Columbus, Ohio 43235; Tel: (614) 292 5507 or 5491; Fax: (614) 292 5552; Web site: http://aerospace.eng.ohio-state.edu/research/index.php?contents=research.html.

NO IMAGE AVAILABLE

Installation Name	***Test Section Size***	***Temperature Range***
Princeton University, Gas Dynamics Laboratory, Princeton, New Jersey, USA	9 in (diameter), 6 ft (length), circular	870 K (stagnation)
	Speed Range	***Reynolds Number (max)***
	8 Mach	
Facility Name		***Dynamic Pressure***
Hypersonic Boundary Layer Facility (HyperBLaF)	***Cost***	
	Operational Status	***Stagnation Pressure***
	Presumed active as of November 2006.	10 MPa (1,500 psia)

Testing Capabilities

Run times vary from 2 to 10 mins; 316-L stainless steel used to fabricate the heater coil, nozzle, test section, expansion joint, and diffuser.

Data Acquisition

Current Programs

Fundamental studies of compressible turbulence; shock wave/boundary-layer interactions; shock/shock interactions; configuration studies of hypersonic vehicles.

Planned Improvements

User Fees

Contact Information

Princeton University, Gas Dynamics Laboratory, Olden Street Princeton, NJ 08544; Tel: (609) 258 7634; Fax: (609) 258 6109; Email: mae@princeton.edu; Web site: http://gasdyn.princeton.edu/info/e69/the_hypersonic_boundary_layer_facility.html.

NO IMAGE AVAILABLE

Wind Tunnels of the Western Hemisphere

Hypersonic | **United States**

Installation Name	Test Section Size	Temperature Range
Purdue University, School of Aeronautics and Astronautic Engineering (AAE), Aerospace Sciences Lab (ASL), West Lafayette, Indiana, USA	9.5 in (diameter)	160° to 200°C
	Speed Range	***Reynolds Number (max)***
	6 to 6.1 Mach	13
Facility Name		***Dynamic Pressure***
Boeing Mach 6 Quiet Flow Ludwieg Tube	***Cost***	0.05 to 5 psia
	US$1 to 2 million	
	Operational Status	***Stagnation Pressure***
	Confirmed active as of November 2006.	3 to 300 psia

Testing Capabilities

Ludwieg-tube concept; 4,000 ft³ vacuum tank; sliding sleeve; double-burst diaphram; fixed-sting support; contraction windows; slow gate valve; diffuser; bleed-slot suction; stainless-steel, second-throat section upstream; laminar nozzle, wall boundary layer; 17.5 in driver tube; 122.5-ft long; 6 to 10 sec run time, once/hr.

Data Acquisition

Hot-wires; hot-films; temperature paints; pressure sensors; controlled perturbations for instability.

Current Programs

Studies laminar-turbulent transition and mechanisms; research supports NASA, DoD flight programs, AFOSR, Sandia National Labs.

Planned Improvements

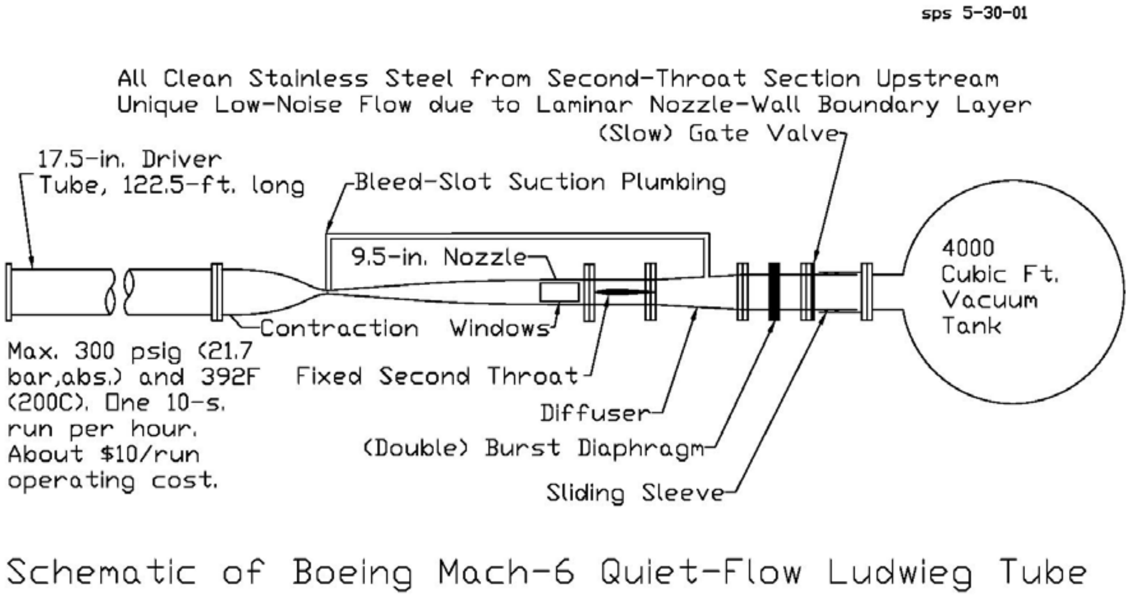
1995-2001 (construction); planned improvements: new sting-support section to start larger models; new throat section to improve quiet flow (presently quiet to a freestream).

User Fees

Operating cost: US$10-$12/test run plus graduate student stipend.

Contact Information

Steve Schneider (Professor), Purdue University, School of Aeronautics and Astronautic Engineering (AAE), Aerospace Sciences Lab (ASL), 315 N. Grant Street, West Lafayette, IN 47907-2023; Tel (Schneider): (765) 494 3343; Tel (Lab): (765) 494 3343; Fax (Schneider): (765) 496 3321; Email (Schneider): steves@purdue.edu; Web site: http://cobweb.ecn.purdue.edu/~aae519/BAM6QT-Mach-6-tunnel/summary-oct2005.pdf.



Boeing Mach 6 Quiet Flow Ludwieg Tube,
Purdue University,
School of Aeronautics and Astronautics Engineering (AAE),
Aerospace Sciences Lab (ASL),
West Lafayette, Indiana USA

Hypersonic | **United States**

Installation Name Sandia National Laboratories, Engineering Sciences Experimental Facility (ESEF), Albuquerque, New Mexico, USA	***Test Section Size*** 14 in (M=8), 18 in (M=5 and 14) (diameter)	***Temperature Range*** 620° to 2,500°R (stagnation)
Facility Name Hypersonic Wind Tunnel (HWT)	***Speed Range*** 5, 8, 14 Mach	***Reynolds Number (max)*** 0.4 to 8
	Cost	***Dynamic Pressure*** 0.2 to 7 psi
	Operational Status Presumed active as April 2007.	***Stagnation Pressure***

Testing Capabilities

Blowdown-to-vacuum type; 45 sec run time; air (M=5) or nitrogen (M=8 and 14) is the working fluid; each test section has 4 glass windows placed 90° apart from each other; model hardware is normally sting-mounted and ranges in size from 6 to 14 in long, with a base diameter of 4 in or less; typical model scales from 6% to 20%.

Data Acquisition

Surface and flow-visualization techniques; average and instantaneous pressure measurements, 6-component balance force and moment data.

Current Programs

High-speed flight of missiles, reentry vehicles, and gravity bombs.

Planned Improvements

User Fees

Contact Information

Robert D. M. Tachau, Steven J. Beresh (User Liaisons), Sandia National Laboratories, P.O. Box 5800, MS-0834, Albuquerque, New Mexico 87185-0834; Tel (Tachau): (505) 845-7157; Tel: (Beresch): (505) 844-4618; Fax (Tachau): (505) 844-9297; Fax (Beresch): (505) 844-4523; Email (Tachau): rdtacha@sandia.gov; Email (Beresch): sjberes@sandia.gov; Web site: http://www.sandia.gov/bus-ops/partnerships/tech-access/facilities/eng-sci.html.

NO IMAGE AVAILABLE

Wind Tunnels of the Western Hemisphere

Hypersonic | **United States**

Installation Name	Test Section Size	Temperature Range
U.S. Air Force, Arnold Engineering Development Center (AEDC), White Oak, Maryland, USA	5 ft (diameter) x 12 ft (length)	3,000°F (M=7); 1,100°F (M=8); 1,350°F (M=10); 2,750°F (M=14); 2,880°F (M=16.5)
Facility Name	**Speed Range**	**Reynolds Number (max)**
Hypervelocity Wind Tunnel 9	7, 8, 10, 14, 16.5 Mach	3.7 to 15.8 (M=7); 4.5 to 50.0 (M=8); 0.86 to 20.0 (M=10); 0.072 to 3.8 (M=14); 3.24 (M=16.5)
	Cost	**Dynamic Pressure**
		Up to 1,430 atm
	Operational Status	**Stagnation Pressure**
	Reported active February 2006.	100 to 21,000 psia

Testing Capabilities
Two test cells; blowdown-type facility; unique storage heater provides supply pressures up to 1,430 atm and supply temperatures up to 3,460°R; sustains long-duration, constant-condition runs.

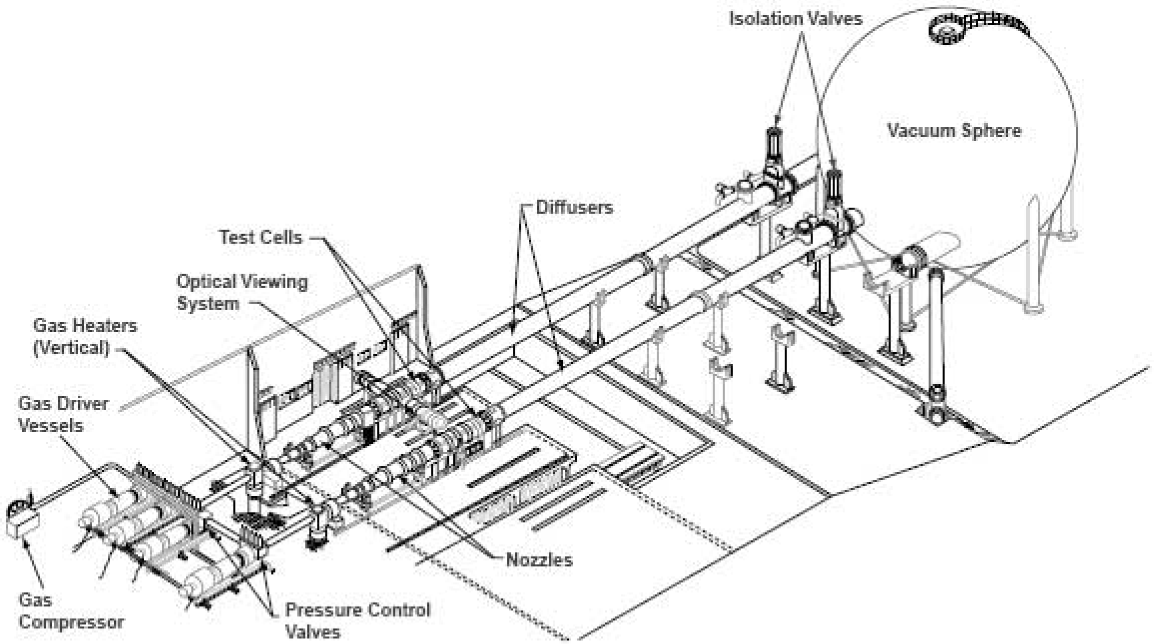
Data Acquisition

Current Programs
Aerodynamic simulation in critical altitude regimes associated with strategic-offensive missile systems; advanced, defensive interceptor systems; reentry vehicles; hypersonic vehicle technologies; experiments support Navy Mk4/Mk5 reentry body development, Ballistic Missile Defense Organization and Army endoatmospheric interceptor programs; Air Force reentry and decoy programs; NASA space shuttle; hypersonic technologies such as waveriders, scramjets, and the national aerospace plane.

Planned Improvements
1976 (commenced operation).

User Fees

Contact Information
AEDC/DOSH White Oak, 10905 New Hampshire Avenue, Silver Spring, MD 20903-1050; Tel: (301) 394-1669; Fax: (301) 394-4631; Email: hypersonics@hap.arnold.af.mil; Web site: http://www.arnold.af.mil/aedc/tunnel9.htm.



Hypervelocity Wind Tunnel 9,
Arnold Engineering Development Center,
White Oak, Maryland USA

Installation Name	Test Section Size	Temperature Range
Virginia Polytechnic Institute and State University, Department of Aerospace and Ocean Engineering, Blacksburg, Virginia, USA	100 mm	720 K (stagnation)
	Speed Range	**Reynolds Number (max)**
	2.0 to 7.0 Mach	1,000 at Mach 7.0
Facility Name	**Cost**	**Dynamic Pressure**
Hypersonic Wind Tunnel		
	Operational Status	**Stagnation Pressure**
	Presumed active as of January 2007.	20 Mpa

Testing Capabilities
Plenum chamber charged with bottled air; heater for raising pressure further and preventing condensation; operated by turning actuator handle through 90°; facility can be easily recharged and run 5 or 6 times/hr; atmospheric exhaust; produces very uniform flowfield.

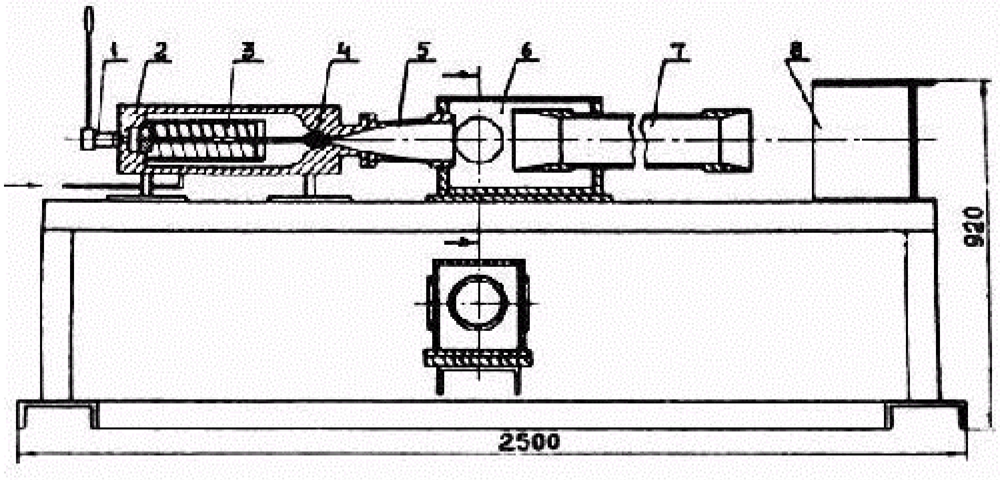
Data Acquisition

Current Programs
Academic instruction and research of high-speed flows.

Planned Improvements
constructed for Theoretical and Applied Mechanics of the Russian Academy of Sciences in Novosibirsk by Dr. V. Zvegintsev; made available through a joint venture of the Virginia-Siberia Trading Co., Inc.

User Fees

Contact Information
Dr. William Devenport (Director),Virginia Polytechnic Institute and State University, Department of Aerospace and Ocean Engineering, 215 Randolph Hall, Blacksburg, VA 24061; Tel: (540) 231 6611; Fax: (540) 231 9632; Email: info@aoe.edu; Email (Devenport): devenport@vt.edu; Web site: http://www.aoe.vt.edu/research/facilities/hyperson.php.



1-Valve actuator, 2-Plenum chamber, 3-Heater, 4-Plug valve, 5-Nozzle, 6-Test chamber, 7-Diffuser and 8-Exhaust deflector

Hypersonic Wind Tunnel,
Virginia Polytechnic Institute and State University,
Department of Aerospace and Ocean Engineering,
Blacksburg, Virginia USA

Wind Tunnels of the Western Hemisphere

Unknown **Brazil**

Installation Name	Test Section Size	Temperature Range
Air Force of Brazil (FAB), General Aerospace Technology Command (CTA), São José dos Campos, Brazil	6 m long	
	Speed Range	**Reynolds Number (max)**
Facility Name		**Dynamic Pressure**
T1	**Cost**	
		Stagnation Pressure
	Operational Status	

Testing Capabilities

Data Acquisition

Current Programs

Planned Improvements

User Fees

Contact Information

Air Force of Brazil (FAB), General Aerospace Technology Command (CTA), São José dos Campos, Brazil.

NO IMAGE AVAILABLE

Wind Tunnels of the Western Hemisphere

Unknown | **Brazil**

Installation Name	Test Section Size	Temperature Range
Air Force of Brazil (FAB), General Aerospace Technology Command (CTA), São José dos Campos, Brazil	14 m long	
	Speed Range	**Reynolds Number (max)**
Facility Name		
T2	**Cost**	**Dynamic Pressure**
	Operational Status	**Stagnation Pressure**

Testing Capabilities

Data Acquisition

Current Programs

Planned Improvements

User Fees

Contact Information

Air Force of Brazil (FAB), General Aerospace Technology Command (CTA), São José dos Campos, Brazil.

NO IMAGE AVAILABLE

Wind Tunnels of the Western Hemisphere

Unknown | **United States**

Installation Name
Aero Systems Engineering Inc. (ASE, formerly Fluidyne), St. Paul, Minnesota, USA

Facility Name
Channels 7 and 8: Altitude Test Cell for Exhaust Nozzle Model Tests

Test Section Size

Speed Range

Cost

Operational Status
Presumed active as of April 2007.

Temperature Range

Reynolds Number (max)

Dynamic Pressure

Stagnation Pressure

Testing Capabilities
Cold flow, high pressure ratio, static-thrust stands; ability to exhaust either into atmosphere or sealed test cabin connected to vacuum system; model supported by 3-component or 6-component, strain-gauge force balance; model isolated from facility piping by an elastic seal; tests can be conducted at specific combinations of pressure ratio, rotor speed, and inlet stagnation > 1 atm.

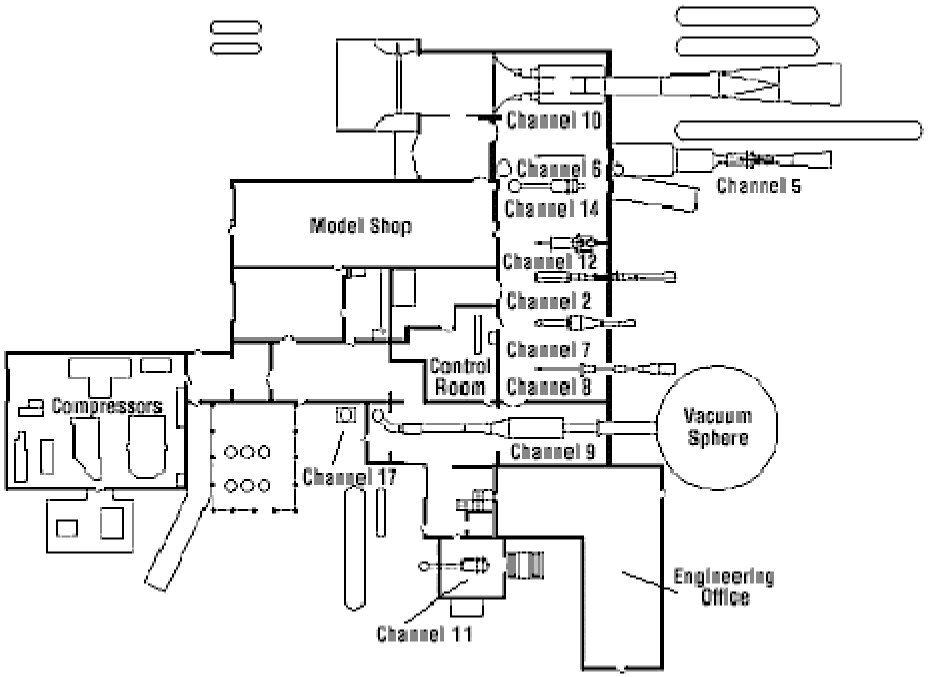
Data Acquisition

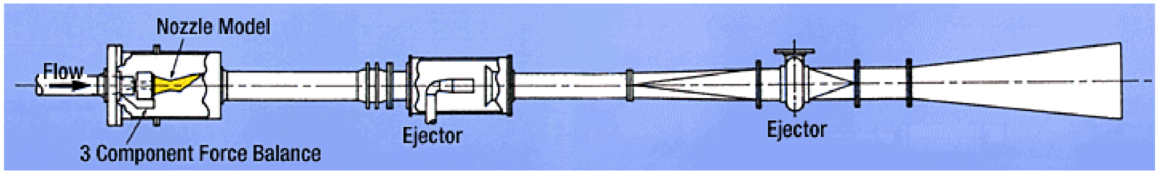
Current Programs
Measurements of axial and normal balance forces; model total and static pressures; ambient pressure and the upstream ASME meter pressures; temperature necessary to calculate a flow rate and stream thrust entering the metric portion of a model assembly; calibration of turbine-powered simulator (TPS) systems.

Planned Improvements

User Fees

Contact Information
P. Giese (Wind Tunnel Programs), Aero Systems Engineering, Inc, 358 E. Fillmore Avenue, St. Paul, MN 55107; Tel (General): (651) 227 7515; Fax (General): (651) 227 0519; Email (General): ase@aerosysengr.com; Email (Giese): pgiese@aerosysengr.com; Web site: http://www.aerosysengr.com/.





Channels 7 and 8: Altitude Test Cell For Exhaust Nozzle Model Tests,
Aero Systems Engineering Inc. (ASE),
St. Paul, Minnesota USA

Unknown | **United States**

Installation Name	Test Section Size	Temperature Range
Aero Systems Engineering Inc. (ASE, formerly Fluidyne), St. Paul, Minnesota, USA		
	Speed Range	**Reynolds Number (max)**
Facility Name		
Static Test Stands	**Cost**	**Dynamic Pressure**
	Operational Status	**Stagnation Pressure**
	Presumed active as of April 2007.	

Testing Capabilities

High-pressure dried air from 500 psi storage system is throttled, metered through an ASME long-radius metering nozzle, and discharged through the test model to the atmosphere; model supported by a 3-component or 6-component, strain-gauge force balance; model is isolated from facility piping by an elastic seal.

Data Acquisition

Current Programs

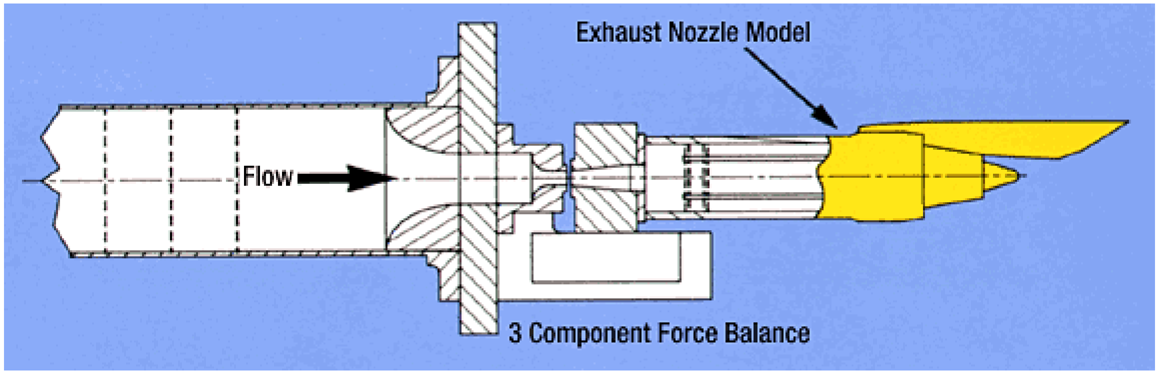
Measurements of axial and normal balance forces; model total and static pressures; ambient pressure; upstream ASME meter pressures and temperature; calculates flow rate/stream thrust entering the metric portion of a model assembly.

Planned Improvements

User Fees

Contact Information

P. Giese (Wind Tunnel Programs), Aero Systems Engineering, Inc, 358 E. Fillmore Avenue, St. Paul, MN 55107; Tel (General): (651) 227 7515; Fax (General): (651) 227 0519; Email (General): ase@aerosysengr.com; Email (Giese): pgiese@aerosysengr.com; Web site: http://www.aerosysengr.com/.



Static Test Stands,
Aero Systems Engineering Inc., (ASE),
St. Paul, Minnesota USA

Unknown | **United States**

Installation Name	Test Section Size	Temperature Range
Purdue University, School of Aeronautics and Astronautic Engineering (AAE), Boeing Compressible-Flow Laboratory, West Lafayette, Indiana, USA	4 in	
	Speed Range	**Reynolds Number (max)**
Facility Name		
4 in Shock Tube	**Cost**	**Dynamic Pressure**
	Operational Status	**Stagnation Pressure**

Testing Capabilities

Data Acquisition

Current Programs

Teaching purposes.

Planned Improvements

User Fees

Contact Information

Steve Schneider (Professor), Purdue University, School of Aeronautics and Astronautic Engineering (AAE), Aerospace Sciences Lab (ASL), 315 N. Grant Street, West Lafayette, IN 47907-2023; Tel (Schneider): (765) 494 3343; Tel (Lab): (765) 494 3343; Fax (Schneider): (765) 496 3321; Email (Schneider): steves@purdue.edu; Web site: https://engineering.purdue.edu/AAE/Research/ResearchFacilities/Lab Facilities#aero.

NO IMAGE AVAILABLE

Installation Name
University of California-Davis, Department of Mechanical and Aeronautical Engineering, Davis, California, USA

Facility Name
UC Davis Aeronautical Wind Tunnel (AWT)

Test Section Size
33.6 in x 48 in x 12 ft

Speed Range

Cost

Operational Status
Presumed active as of December 2006.

Temperature Range

Reynolds Number (max)

Dynamic Pressure

Stagnation Pressure

Testing Capabilities
Contraction ratio 7.5:1; aluminum honeycomb 6 in deep with 0.25 cells; 20 x 20 in mesh, stainless-steel, anti-turbulence screens; pyramidal balance system with parallel sides, 4 tapered fillets, aluminum floor and ceiling; side walls are clear, plexiglass panels hinged at the top to provide four 64 in wide doors, centered on the two 36 in turntables.

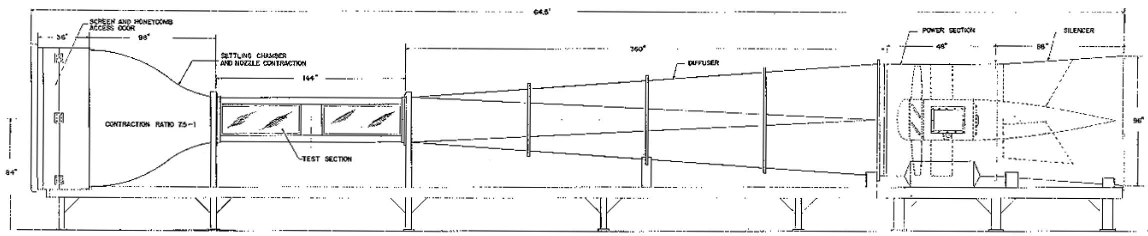
Data Acquisition
Pentium 166 with LabVIEW and instrument control/data acquisition boards; probe-traversing mechanism currently can be controlled via LabVIEW.

Current Programs
Full-span, semi-span, and full-span-vertically-mounted general aviation aircraft; multielement airfoil; fluorescent oil-film method of boundary-layer visualization; performance of a Gurney Flap; active load control and lift enhancement using MEM Translational Tabs; turbulence determined through turbulence spheres.

Planned Improvements
1997 (installed); planned improvements: interface of other systems with LabVIEW.

User Fees

Contact Information
C.P. van Dam (Director of Engineering), University of California-Davis, Department of Mechanical and Aeronautical Engineering, One Shields Avenue, Davis, CA 95616-5294; Tel (van Dam): (530) 752 7741; Fax (van Dam): (530) 752 4158; Email (van Dam): cpvandam@ucdavis.edu; Web site: http://windtunnel.engr.ucdavis.edu.



UC Davis Aeronautical Wind Tunnel Facility (AWT),
University of California, Davis,
Department of Mechanical and Aeronautical Engineering,
Davis, California USA

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