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FACILITIES

NASA-TM-109685

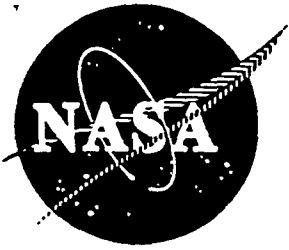
RESEARCH AND TEST FACILITIES

(NASA-TM-109685) RESEARCH AND TEST
FACILITIES (NASA) 102 p

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LANGLEY RESEARCH CENTER

RESEARCH & TEST FACILITIES



0.3-Meter Transonic Cryogenic Tunnel
7- by 10-Foot High Speed Tunnel
8-Foot Transonic Pressure Tunnel
13-Inch Magnetic Suspension & Balance System
14- by 22-Foot Subsonic Tunnel
16-Foot Transonic Tunnel
16- by 24-Inch Water Tunnel
20-Foot Vertical Spin Tunnel
30- by 60-Foot Wind Tunnel
Advanced Civil Transport Simulator(ACTS)
Advanced Technology Research Laboratory
Aerospace Controls Research Laboratory(ACRL)
Aerothermal Loads Complex
Aircraft Landing Dynamics Facility(ALDF)
Avionics Integration Research Laboratory
Basic Aerodynamics Research Tunnel(BART)
Compact Range Test Facility
Differential Maneuvering Simulator(DMS)
Enhanced/Synthetic Vision & Spatial Displays Laboratory
Experimental Test Range(ETR)
Flight Research Facility
General Aviation Simulator(GAS)
High Intensity Radiated Fields Facility
Human Engineering Methods Laboratory
Hypersonic Facilities Complex
Impact Dynamics Research Facility
Jet Noise Laboratory & Anechoic Jet Facility
Light Alloy Laboratory
Low Frequency Antenna Test Facility
Low Turbulence Pressure Tunnel
Mechanics of Metals Laboratory
National Transonic Facility(NTF)
NDE Research Laboratory
Polymers & Composites Laboratory
Pyrotechnic Test Facility
Quiet Flow Facility
Robotics Facilities
Scientific Visualization System
Scramjet Test Complex
Space Materials Research Laboratory
Space Simulation & Environmental Test Complex
Structural Dynamics Research Laboratory
Structural Dynamics Test Beds
Structures & Materials Research Laboratory
Supersonic Low Disturbance Pilot Tunnel
Thermal Acoustic Fatigue Apparatus(TAFA)
Transonic Dynamics Tunnel(TDT)
Transport Systems Research Vehicle
Unitary Plan Wind Tunnel
Visual Motion Simulator(VMS)



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0.3-Meter Transonic Cryogenic Tunnel

DESCRIPTION: The Langley 0.3-Meter Transonic Cryogenic Tunnel (TCT) is used for testing two-dimensional airfoil sections and other models at high Reynolds numbers. The tunnel can operate continuously over a range of Mach numbers from about 0.1 to above 1.2, with a stagnation pressure from 14.7 to 88.0 psia (1 to 6 atmospheres) and a stagnation temperature from -320 to 130 degrees F (78 to 328 degrees K). This results in a maximum Reynolds number capability in excess of 100 million per foot. The adaptive walls, floor and ceiling in the 13- by 13-inch (33 by 33 centimeters) test section, can be moved to the freestream streamline shape, eliminating or reducing the wall effects on the model. The combination of flight Reynolds number capability and minimal wall interference makes the 0.3-Meter TCT a powerful tool for aeronautical research at transonic speeds. The Mach number, pressure, temperature, and adaptive wall shape are automatically controlled. The test section has computer controlled angle of attack and traversing wake survey probe systems. A heat exchanger and alternate gas supply unit have recently been added to the facility adding the capability to use alternate test media; a heavy gas, sulfur hexafluoride (SF6) or air.

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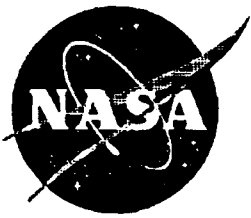
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7- by 10-Foot High-Speed Tunnel



DESCRIPTION: The Langley 7- by 10-Foot High-Speed Tunnel is a closed-circuit, single-return, continuous-flow atmospheric tunnel with a solid-wall test section 6.6 feet high, 9.6 feet wide, and 10 feet long. The Tunnel, which is fan driven and powered by a 14,000-hp electric motor, operates over a Mach number range of 0.2 to 0.9 to produce a maximum Reynolds number of 4 million per foot. In addition to static testing of models to high angles of attack and large sideslip angles, the facility is equipped for both steady-state roll and oscillatory stability testing. The facility is used for a wide range of basic and applied aerodynamic research including advanced vortex lift concepts, drag reduction technology, highly maneuverable aircraft concepts, and the development of improved aerodynamic theories. The flow visualization capability of the facility has been upgraded by installation of a permanent laser vapor screen system.

NOTE: This facility is not currently in operation by NASA. The capability is intact and could be reactivated to support future research and testing.

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8-Foot Transonic Pressure Tunnel

DESCRIPTION: The Langley 8-Foot Transonic Pressure Tunnel (8-Ft TPT) is a variable-pressure, slotted-throat wind tunnel with controls that permit independent variations of Mach number, stagnation pressure and temperature, and dew point. The test section is square with filleted corners and a cross-sectional area approximately equivalent to an 8-foot diameter circle. The floor and ceiling of the test section are axially slotted (approximately 6.9-percent porosity in the calibrated test region) to permit continuous operation through the transonic speed range. The sidewalls are solid and fitted with windows for schlieren flow visualization. The contraction ratio of the test section is 20:1. Tunnel stagnation pressure can be varied from a minimum of about 0.25 atm at all test Mach numbers to about 1.0 atm at a Mach number of 1.2, about 1.5 atm at high subsonic Mach numbers, and about 2.0 atm at Mach numbers of 0.4 or less. Based on both centerline probe and wall pressure measurements, uniform flow is achieved at Mach numbers 0.2 to 1.2. The tunnel is capable of achieving Mach numbers of 1.3 but most testing is limited to a maximum Mach number of 1.2 since the calibrated region of the test section for $M = 1.3$ is further downstream than for lower Mach numbers and requires that models be located further aft in the test section. The test section is instrumented with many ceiling, floor, and sidewall pressure orifices and more may be added easily if desired. With screens and honeycomb in the upstream settling chamber, the quality of the flow in the test section is suitable for performing reliable code validation experiments and laminar flow research. Fixed chokes and test section slot covers are available which permit data to be obtained on both open and closed tunnel configurations, as well as improve the flow quality in the test section by blocking upstream propagation of diffuser noise.

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13-Inch Magnetic Suspension and Balance System



DESCRIPTION: The Langley 13-Inch Magnetic Suspension and Balance System (MSBS) was established to develop wind-tunnel testing technology, free of model-support interference. Four electromagnets, arranged in a "V" configuration above the wind-tunnel test section, provide lift force, pitching moment, side force, and yaw moment. A drag electromagnet opposes the drag force. Motion is controlled in these 5 degrees of freedom with no provision for generation of controlled magnetic roll torque on the model. The 13-Inch MSBS has a lift force capability of approximately 6 pounds, depending on the size and shape of the iron core in the model. The test section passes through the drag electromagnet. The tunnel is a continuous-flow, closed-throat, open-circuit design. The tunnel is capable of speeds up to Mach 0.5. The transparent test section measures approximately 12.6-inches high and 10.7-inches wide.

NOTE: This laboratory is not currently in operation by NASA. The capability is intact and could be reactivated to support future research and testing.

POINT OF CONTACT: Mr. David Dress
 Supersonic/Hypersonic Aerodynamics Branch, Mail Stop 413
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14- by 22-Foot Subsonic Tunnel

DESCRIPTION: The Langley 14- by 22-Foot Subsonic Tunnel (formerly the 4- by 7-Meter Tunnel) is used for low-speed testing of powered and unpowered models of various fixed- and rotary-wing civil and military aircraft. The tunnel is powered by an 8,000-hp electrical drive system, which can provide precise tunnel speed control from 0 to 318 ft/s with the Reynolds number per foot ranging from 0 to $2.1 \times 1,000,000$. The test section is 14.5 ft high, 21.8 ft wide, and approximately 50 ft long. The tunnel can be operated as a closed tunnel with slotted walls or as one or more open configurations, with sidewalls and ceiling removed to allow extra testing capabilities such as flow visualization and acoustic tests. It is equipped with a three-component laser velocimeter system. Boundary-layer suction on the floor at the entrance to the test section and a moving ground belt board, for operation at test section flow velocities to 111 ft/s, can be installed for ground effect tests. The facility also includes a custom-designed laser velocimeter laboratory for setup and maintenance of the three-component laser velocimeter system and a support system. A large model preparation area, adjacent to the wind tunnel is available for model assembly and disassembly. A rotor-test cell is available for assembling and testing rotor models in hovering conditions before entry into the tunnel.

POINT OF CONTACT: Mr. Edgar Waggoner
 Subsonic Aerodynamics Branch, Mail Stop 286
 NASA Langley Research Center
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 Phone: (804) 864-5055 Fax: (804) 864-8192

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REQUIREMENTS FOR NON-GOVERNMENT USE: Industry or individuals can utilize NASA facilities on a space available basis. Should the research to be conducted be of interest to NASA, there would be no charge; however, the results could be published by NASA. Should a company or individual not want the results published by NASA, they would have to pay for the use of the facility.

REFERENCES:

Gentry, Garl L.; Quinto, P. Frank; Gatlin, Gregory M.; and Applin, Zachary T.: The Langley 14- by 22-Foot Subsonic Tunnel: Description, Flow Characteristics, and Guide for Users. NASA TP-3008, September 1990.



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16-Foot Transonic Tunnel

DESCRIPTION: The Langley 16-Foot Transonic Tunnel is a closed-circuit, single-return, continuous-flow atmospheric tunnel. Speeds up to Mach 1.05 are obtained with the tunnel main-drive fans, and from Mach 1.05 up to Mach 1.30 using a combination of main-drive and test-section plenum suction. The slotted octagonal test section measures 15.5 ft across the flats. The tunnel is equipped with an air exchanger with adjustable exit vanes to provide some temperature control. This facility has a 60,000 hp main-drive system and a 36,000 hp compressor to provide the test section plenum suction. The tunnel is used for force, moment, pressure, and flow visualization studies on propulsion airframe integration models. Model mounting consists of sting, sting-strut, and fixed-strut arrangements. Propulsion simulation studies are made with dry, high-pressure air. A model preparation area is provided for model buildup and calibration.

POINT OF CONTACT: Mr. Charles Mercer
 Propulsion Aerodynamics Branch, Mail Stop 280
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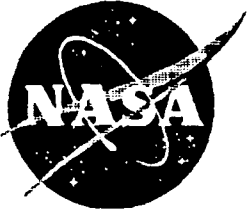
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16- by 24-Inch Water Tunnel

DESCRIPTION: The Langley 16- by 24-Inch Water Tunnel is used for flow visualization studies at low Reynolds numbers. The vertical test section has an effective working length of approximately 4.5 feet, is 16-inches high by 24-inches wide, and all four sidewalls are Plexiglas for optical access. Velocity can be varied from 0 ft/s to 0.75 ft/s. The unit Reynolds number range for water at 78 degrees F for this velocity range is 0 to $7.7 \times 10,000/\text{ft}$. The normal test velocity that produces smooth flow is 0.25 ft/s. Model attitude can be varied in two planes over angle ranges of +/- 33 degrees and +/- 15 degrees. Operator-controlled electric motors are mounted outside of the test section to control the model position. Semispan models are mounted on a splitter plate supported by a sting with a lateral offset. Ordinary food coloring, supplied by three separate pressurized color reservoirs, is used as a dye to visualize the flow. Dye may be ejected from small orifices on the model surface or upstream of the test section. Laser light sheet flow visualization may be performed using fluorescent dye. A three-dimensional laser fluorescence anemometer is available for quantitative studies.

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20-Foot Vertical Spin Tunnel

DESCRIPTION: The Langley 20-Foot Vertical Spin Tunnel is the only operational spin tunnel in the Western Hemisphere and one of only two in the world. All U.S. military fighters, attack airplanes, primary trainers, bombers, and most experimental airplanes are tested in this facility. General aviation airplanes and many foreign designs are also evaluated in this tunnel when required. It is a vertical tunnel with a closed-circuit annular return passage and is used to conduct spin and tumbling research on aerospace vehicles. The test section is 25-feet high x 20-feet across and has 12 sides. Tunnel speed is variable from 0 ft/s to 90 ft/s with accelerations to 15 ft/s. The main drive motor is rated at 400 hp for continuous runs and 1,300 hp for short runs and turns a 20-foot diameter three-bladed fixed-pitch fan. Dynamically scaled models are used to investigate the spinning and tumbling characteristics of airplane configurations. Spin recovery is studied by remote actuation of the aerodynamic controls of the models to predetermined positions. Tests are recorded using high-resolution color video tape with a superimposed time code. A rotary balance apparatus supported by a swinging boom is used for force and moment testing and pressure testing of models under spinning conditions, at angles of attack from 0 to +/-90 degrees, and at spin rates from 0 to +/-90 r/min. Data are recorded in coefficient form on any standard digital medium.

POINT OF CONTACT: Mr. Ray Whipple
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30- by 60-Foot Wind Tunnel

DESCRIPTION: The Langley 30- by 60-Foot Wind Tunnel is a continuous-flow open-throat double-return tunnel powered by two 4,000-hp electric motors, each driving a four-blade 35.5-ft diameter fan. The tunnel test section is 30-ft high x 60-ft wide and is capable of speeds to 110 mph. The tunnel is used to study the low-speed aerodynamics of commercial and military aircraft. The large open-throat test section lends itself readily to tests of large-scale models and to unique test methods with small-scale models. Large-scale and full-scale aircraft tests are conducted with the strut mounting system, a test method that can handle airplanes to the size of light twin-engine airplanes. Such tests provide static aerodynamic performance and stability and control data, including the measurement of power effects, wing pressure distributions and flow visualization. Small-scale models can be tested to determine both static and dynamic aerodynamics. For all captive tests, the models are sting mounted with internal strain-gauge balances. Captive test methods include conventional static tests for performance and stability and control, forced-oscillation tests for aerodynamic damping, and rotary tests for spin aerodynamics. Dynamically scaled subscale models, properly instrumented, are also freely flown in the large test section with a simple tether to study their dynamic stability characteristics at low speed and at high angles of attack. A small computer is used in this free-flight test technique to represent the important characteristics of the airplane flight control system. The Langley 12-Foot Low-Speed Tunnel, used for static tests prior to entry in the 30- by 60-Foot Tunnel, is an atmospheric wind tunnel with a 12-ft octagonal cross section for model testing. The tunnel serves as a diagnostic facility for exploratory research, primarily for high-angle-of-attack stability and control studies of various

POINT OF CONTACT: Mr. Frank Jordan
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DESCRIPTION (Cont'd): airplane and spacecraft configurations. Preliminary tests are conducted in the 12-Foot Low-Speed Tunnel on simple models for more efficient test planning and effective use of occupancy time in higher speed facilities with more sophisticated models.

POTENTIAL NON-GOVERNMENT USES:

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Advanced Civil Transport Simulator (ACTS)

DESCRIPTION: The Advanced Civil Transport Simulator (ACTS) is a futuristic aircraft cockpit simulator designed to provide full mission capabilities for researching issues that will affect transport aircraft flight stations and crews by the mid 1990's. The unique desk-top simulator design uses the latest innovations in electronics to help the pilot and crew become effective managers of increasingly complex aircraft systems. The objective is to heighten the pilot's situation awareness through improved information availability and ease of interpretation in order to reduce the possibility of missed signals and misinterpreted data. Traditional columns and wheels have been replaced by sidestick controllers which makes room for the desk-top design. The simulator's five CRT's are designed to display flight information in a logical easy-to-see format.

Specifically, the five 13-inch color CRT's present 10 active displays to the pilot selectable from a menu of over 100 separate displays. The outside screens show flight and navigation data. The center three screens typically show engine and systems status, data linked Mode S transponder system information, weather data, surrounding air traffic information, checklists, and functional systems such as fuel, electrical, and environmental, all controlled by touchpanel overlays. Two monochromatic flat panel control display units with keyboards and touch sensitive screens provide monitoring and modification of aircraft parameters, flight plans, flight computers, and aircraft position. Three collimated visual display units have been installed to provide out-of-the window scenes via the Computer-Generated Image (CGI) system.

POINT OF CONTACT: Mr. Billy Ashworth
 Analysis & Simulation Branch, Mail Stop 125B
 NASA Langley Research Center
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POTENTIAL NON-GOVERNMENT USES: The simulator can be used to study and exploit advanced automation concepts. The major research objectives are to examine needs for transfer of information to and from the flight crew; study the use of advanced controls and displays for all-weather flying; explore ideas for using computers to help the crew in decision making; and study visual scanning and reach behavior under different conditions with various levels of automation and flight deck arrangements.

REQUIREMENTS FOR NON-GOVERNMENT USE:

REFERENCES:

Real-Time Simulation Users Guide edited by Randall D. Grove, NASA Langley Research Center, January 1993.

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Advanced Technology Research Laboratory

DESCRIPTION: The Advanced Technology Research Laboratory houses facilities used to perform a wide range of research activities in support of both space and aeronautics research and development. The Aerothermodynamic Physics Laboratory provides the capability to understand the thermal radiation process of hypervelocity gases interacting with spacecraft and aircraft. The Low Pressure Physical Measurements Laboratory provides the capability to study gas-surface interactions critical to space and aeronautical technology. The Radiation Physics Computer Laboratory is used to perform world-class theoretical research dealing with human radiation exposure and shielding in high-flying aircraft, as well as on advanced space missions. The Micrometeoroid Analysis Laboratory is used to analyze panels returned from space in order to model the micrometeoroid/debris environment of the Earth and the effects of that environment on NASA and commercial spacecraft.

Ultrahigh vacuum and other equipment simulate the space environment and specialized conditions associated with advanced spacecraft. Focus is on:

- Study of reaction cross sections at kinetic energies between 0.5 and 5eV.
- Transport of hydrogen through National Aero-space Plane surfaces.
- Establishment of high-purity high-energy atomic oxygen beams.
- Development of high-purity molecular oxygen for medical purposes.
- Development of methods to extract oxygen from the Martian atmosphere or other gases.

Laboratory equipment includes:

- Latest computer technology fully integrated into the Center's high-speed data network.
- Large bank of capacitors.
- Two Vortek solar simulators.
- Optical spectrometers.
- 85 cu.m. vacuum tank with a 10,000 cfm vacuum pump.
- Surface analysis equipment.

POINT OF CONTACT: Dr. Ed Conway
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POTENTIAL NON-GOVERNMENT USES:

- Ultrahigh vacuum surface analyses.
- Materials science research; gas-surface interactions.
- Molecular cross-beam experiments.
- Advanced computational analyses.

REQUIREMENTS FOR NON-GOVERNMENT USE: None

REFERENCES:

- Meador, Willard E.; Miner, Gilda A.; and Heinbockel, John H.: Vibrational Relaxation in Hypersonic Flow Fields. NASA Technical Paper No. 3367, 1993.
- Outlaw, Ronald A.; and Davidson, Mark R.: A Small UHV Compatible Hyperthermal Oxygen Atom Generator. Accepted by the Journal of Vacuum Technology.
- Wilson, John W.; Townsend, Lawrence W., Schimmerling, Walter; Khandelwal, Govind S.; Whan, Ferdous; Nealy, John E.; Cucinotta, Francis A.; Simonsen, Lisa C.; Shinn, Jufy L.; and Norbury, John W.: Transport Methods and Interactions for Space Radiations, NASA Reference Publication 1257, December 1991.



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Aerospace Controls Research Laboratory (ACRL)

DESCRIPTION: The Aerospace Control Research Laboratory (ACRL) conducts research and testing of spacecraft control systems, using modern microcomputer facilities for simulations, data acquisition, and real-time control system testing. The facility supports both control-law testing, using structural test articles, and advanced-control system component development. The Large Angle Magnetic Suspension Test Fixture (LAMSTF) allows for research, development, and application of magnetic field modeling, optical sensing and metrology, and advanced control-law design. LAMSTF is a five-coil planar array of air core electromagnets and a permanently magnetized suspended element. Control is achieved using optical sensors, a 486 PC-based computer and in-house modular MATLAB-based software. The advanced sensor and actuator facility supports research in control system components for space systems. Component development currently focuses on optical sensing and computing devices. Two different photogrammetric position tracking systems and an optical holographic image storage device are being developed. The facility includes optics testing equipment, polarizers, splitters, photomultiplier tubes, 5-mW HeNe laser, 35-mW HeNe laser, precision rotary stage, and laser beam steering systems.

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Aerothermal Loads Complex

DESCRIPTION: The Aerothermal Loads Complex consists of four facilities for research in aerothermal loads, high-temperature structures, thermal protection systems, and propulsion systems. Facilities include an 8-Foot High-Temperature Tunnel; a Mach 4, 5, and 7 blowdown-type facility used to study detailed aerothermal-loads flow phenomena; evaluate performance of high-speed and entry-vehicle structural components and engines; 7-Inch High-Temperature Tunnel, a 1/12-scale version of the 8-Ft HTT with the same capabilities, used primarily for designing larger models for the 8-Ft HTT and aerothermal-load testing on subscale models; 20-MW and 5-MW Aerothermal Arc Tunnels, which simulate the flight reentry envelope of high-speed vehicles, such as the Space Shuttle. The 8-Ft HTT is the largest free jet tunnel in the world for testing scramjet engines. A major effort is under way to provide alternate Mach number capability and O₂ enrichment for the test medium, primarily to allow testing of hypersonic air-breathing propulsion systems. The complex of facilities can simulate a variety of temperatures, flow rates, enthalpies and other test conditions, and can handle model sizes ranging from 3 inches in diameter to 14-foot long scramjets.

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REQUIREMENTS FOR NON-GOVERNMENT USE:

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LANGLEY RESEARCH CENTER

FACILITIES



Aircraft Landing Dynamics Facility (ALDF)

DESCRIPTION: The Aircraft Landing Dynamics Facility (ALDF) conducts low-cost testing of aircraft wheels, tires, and advanced landing systems. At ALDF, a high-pressure water jet system propels the test carriage along the 2,800-ft track with a thrust in excess of 2,000,000-lb force. This water jet propulsion force provides a maximum test carriage speed of 220 knots within a 400 foot catapult distance with a peak carriage acceleration of approximately 20 g's. Any landing gear can be mounted on the test carriage, including those exhibiting new or novel concepts, and virtually any runway surface type and condition can be duplicated on the 1,800 foot test section. A Rain Simulation System (RSS) can simulate rainfall intensities as high as 40 in/hr. ALDF has been used to evaluate tire hydroplaning phenomenon, effectiveness of pavement grooving, friction and wear characteristics of the Space Shuttle orbiter main- and nose-gear tires, and to define runway modifications for the John F. Kennedy Space Center Shuttle Landing Facility. Current research includes static and dynamic testing of aircraft tires to develop a national data base of mechanical properties and frictional characteristics for both radial-belted and bias-ply aircraft tires. New pavement surface treatments such as concrete paver blocks and foam arrester bed materials are also under study at this unique, one-of-a-kind test facility.

POINT OF CONTACT: Mr. Tom Yager
 Langley & Impact Dynamics Branch, Mail Stop 497
 NASA Langley Research Center
 Hampton, VA 23681-0001
 Phone: (804) 864-1304 Fax: (804) 864-8090

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FACILITIES

Avionics Integration Research Laboratory
(AIRLAB)



DESCRIPTION: Research is conducted in the Avionics Integration Research Laboratory (AIRLAB) that addresses the issues of conception, design, and assessment of systems that can dramatically improve performance and lower production and maintenance costs while providing a high, measurable level of safety for passengers and flight crews. It serves as a focal point for U.S. Government, industry, and university personnel to identify and develop methods for systematically evaluating and validating highly reliable digital control and guidance systems for advanced aerospace vehicles. Validation research encompasses analytical, simulation, and experimental methods. Analytical studies are conducted to improve the utility and accuracy of reliability and other mathematical models, to integrate reliability and performance models, and to evaluate new modeling concepts. Simulations are used to determine latent fault contributions to electronic system reliability and hence aircraft safety. Experimental testing, including fault injection, simulated lightning transient, and radiated field electromagnetic interference testing, is conducted to uncover problems of new technologies such as fly-by-wire/fly-by-light and to verify analytical methods.

POINT OF CONTACT: Mr. Reuben Williams
System Validation Research Branch, Mail Stop 130
NASA Langley Research Center
Hampton, VA 23681-0001
Phone: (804) 864-6212 Fax: (804) 864-4234

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POTENTIAL NON-GOVERNMENT USES:

REQUIREMENTS FOR NON-GOVERNMENT USE:

REFERENCES:

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
LANGLEY RESEARCH CENTER M/S 480
HAMPTON VA 23665-9985



LANGLEY RESEARCH CENTER FACILITIES



Basic Aerodynamics Research Tunnel (BART)

DESCRIPTION: The Basic Aerodynamics Research Tunnel (BART) is a subsonic flow diagnostic facility dedicated to the task of acquiring detailed data for code validation and investigating fundamental characteristics of complex flow fields. The BART is an open-return wind tunnel with a closed test section 28-inches high, 40-inches wide, and 10-feet long. The maximum test section velocity is 185 feet per second which yields a unit Reynolds number of 1.13×10^6 . Flow conditioners provide a low-turbulence flow in the test section of less than 0.08 percent. BART instrumentation includes a 5 degree-of-freedom probe traverse, an electronic scanning pressure system, three-component hot wire, and a three-component laser velocimeter. Current projects include flow-field velocity and pressure measurements of two HSR projects, a 76-degree delta wing, and a 76-degree/40-degree double delta wing. Other projects include an aerodynamic sensitivity study involving a series of sharp-edged, low aspect ratio delta wings, and a vortex fin interaction investigation using a double-delta wing planform. The experimental data will be used to evaluate and aid in the design of several advanced CFD codes while providing physical insight into the complex flow fields associated with each configuration.

POINT OF CONTACT: Mr. Luther Jenkins
 Experimental Methods Branch, Mail Stop 454
 NASA Langley Research Center
 Hampton, VA 23681-0001
 Phone: (804) 864-8026 Fax: (804) 864-8677

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POTENTIAL NON-GOVERNMENT USES: Experiments involving separation, boundary layers, and flow control.

REQUIREMENTS FOR NON-GOVERNMENT USE: Use by non-Government organizations requires a cooperative agreement.

REFERENCES:

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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LANGLEY RESEARCH CENTER FACILITIES



Compact Range Test Facility

DESCRIPTION: The Compact Range Test Facility is an indoor facility that utilizes a commercially available reflector that was modified with the addition of an elliptical rolled edge for improving the quality and size of the quiet zone. The facility provides a simulated free-space environment for performing antenna and electromagnetic scattering measurements in support of NASA's aerospace research programs.

Antenna or scattering measurements can be conducted over the 2- to 18-GHz frequency range. Quiet zone size is approximately 4-ft high by 8-ft wide by 8-ft long. Model handling is accomplished with a 2,000-lb capacity bridge crane. Model supports include metal pylons and foam columns. Instrumentation is a Hewlett Packard Model 8530 network analyzer based system. Test chamber size is 30-ft high by 28-ft wide by 65-ft long.

POINT OF CONTACT: Mr. Melvin Gilreath
Antenna and Microwave Research Branch, Mail Stop 490
NASA Langley Research Center
Hampton, VA 23681-0001
Phone: (804) 864-1817 Fax: (804) 864-7975

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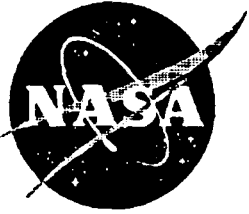
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POTENTIAL NON-GOVERNMENT USES:

- Antenna performance measurements.
- Electromagnetic scattering measurements.

REQUIREMENTS FOR NON-GOVERNMENT USE: Measurements must be scheduled on a noninterference basis with on-going NASA research programs.

REFERENCES:



LANGLEY RESEARCH CENTER FACILITIES



Differential Maneuvering Simulator (DMS)

DESCRIPTION: The Differential Maneuvering Simulator (DMS) provides a means of simulating two piloted aircraft operating in a differential mode with a realistic cockpit environment and a wide-angle external visual scene for each of the two pilots. The system consists of two identical fixed-base cockpits and projection systems, each based in a 40-ft diameter projection sphere. Each projection system consists of two terrain projector scenes, a target image generator and projector, and a laser target projector. The terrain scene, driven by a Computer-Generated Image (CGI) system, provides reference in all six degrees-of-freedom in a manner that allows unrestricted aircraft motions. The resulting sky/earth scene provides full translational and rotational cues. The internal visual scene also provides continuous rotational and bounded (300 ft. to 45,000 ft.) translational reference to the other (target) vehicles in six degrees-of-freedom. The target image, a computer-generated model using a Silicon Graphics 4D/310 VGX IRIS, is presented to each pilot and represents the aircraft being flown by the other pilot. This dual simulator can be tied to a third dome (the General Purpose Fighter Simulator) and provide three aircraft interactions when required.

Each DMS cockpit provides three color displays with a 6.5 inch square viewing area and a wide-angle Heads-Up Display (HUD). Kinesthetic cues in the form of a g-suit pressurization system, helmet loader system, g-seat system, cockpit buffet, and programmable control forces are provided to the pilots consistent with the motions of their aircraft. Controls include a side-arm controller, dual throttles, and a rotorcraft collective. Simulated engine sounds and wind noise add realism.

POINT OF CONTACT: Mr. Billy Ashworth
 Analysis & Simulation Branch, Mail Stop 125B
 NASA Langley Research Center
 Hampton, VA 23681-0001
 Phone: (804) 864-6449 Fax: (804) 864-8837

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POTENTIAL NON-GOVERNMENT USES: Research applications include studies in design of advanced flight control laws, helmet-mounted display concepts, and performance evaluation for new aircraft design concepts for development programs such as F-18 E/F, AX, and F-22.

REQUIREMENTS FOR NON-GOVERNMENT USE:

REFERENCES:

Real-Time Simulation Users Guide edited by Randall D. Graves, NASA Langley Research Center, January 1993.

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LANGLEY RESEARCH CENTER FACILITIES

Enhanced/Synthetic Vision and Spatial Displays Research Laboratory



DESCRIPTION: The NASA Enhanced/Synthetic Vision & Spatial Displays Research Laboratory (ESVSDRL) comprises several facilities which conduct research with advanced aircraft cockpit displays & subsystems for both current & new generation subsonic & supersonic aircraft. These facilities will support flight deck research & development for the High Speed Civil Transport (HSCT). The ESVSDRL comprises: the Advanced Display Evaluation Cockpit (ADEC), a wide-body transport cockpit which is used to evaluate new display media; the Aircraft Cockpit Ambient Lighting Simulation System (ACALSS), which surrounds the ADEC & can provide realistic adverse ambient lighting conditions for evaluating display readability; the Visual Imaging Simulator for Transport Aircraft Systems (VISTAS), a wide-angle display which is used for both panoramic & stereo display research; the Collimated Flight Display Workstations (CFDWS), used for simulated out-the-window displays; & several workstations which are used for part-task studies of synthetic vision sensors & enhanced vision systems. Supporting these facilities are several state-of-the-art graphics computers which are used to generate the displays for each of these facilities. Since the HSCT as conceived will have no forward windows, special sensors & displays will be required. A synthetic vision concept currently being evaluated in the ESVSDRL will provide a forward view of the airport runway environment during approach, landing, & surface operations under all weather conditions. Development & integration of display media, graphics generators, synthetic scene databases, weather-penetrating imaging sensor models, object/obstacle/edge detection techniques, & synthetic vision format concepts incorporating sensor fusion from multiple sources will be required.

POINT OF CONTACT: Mr. Vernon Batson
Cockpit Technology Branch, Mail Stop 152E
NASA Langley Research Center
Hampton, VA 23681-0001
Phone: (804) 864-2015 Fax: (804) 864-8857

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FACILITIES

Experimental Test Range (ETR)



DESCRIPTION: The Experimental Test Range (ETR) is an indoor radio frequency (RF) anechoic test facility that utilizes a Dual Gregorian compact range blended edge reflector system to perform antenna and electromagnetic scattering measurements. The facility provides an RF shielded, simulated free-space environment for performing electromagnetic measurements in support of NASA's aerospace research programs and compact range technology advancement.

Antenna or scattering measurements can be conducted over the 2- to 18-GHz frequency range. Quiet zone size is approximately 6-ft high by 8-ft wide by 8-ft long. Model handling is accomplished with a 4,000-lb capacity bridge crane. Instrumentation includes a pulsed/CW radar and a Tektronix XD 88/30 workstation for data processing. Test chamber size is 40-ft high by 40-ft wide by 65-ft long.

POINT OF CONTACT: Mr. Melvin Gilreath
 Antenna and Microwave Research Branch, Mail Stop 490
 NASA Langley Research Center
 Hampton, VA 23681-0001
 Phone: (804) 864-1817 Fax: (804) 864-7975

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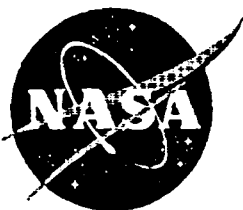
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POTENTIAL NON-GOVERNMENT USES:

- Antenna performance measurements.
- Electromagnetic scattering measurements.

REQUIREMENTS FOR NON-GOVERNMENT USE: Measurements must be scheduled on a noninterference basis with on-going NASA research programs.

REFERENCES:



LANGLEY RESEARCH CENTER FACILITIES



Flight Research Facility

DESCRIPTION: The Langley Flight Research Facility provides state-of-the-art equipment and experienced personnel that can provide end-to-end support for flight testing advanced flight concepts at minimal cost.

The Langley Flight Research Facility includes two large heated hangars providing over 87,000 square feet of floor space, with associated fabrication shops, clean rooms, instrumentation shops, avionics shops, a meteorology office, a flight control room, satellite communications facilities, and office and support spaces. This facility is protected by an automatic deluge fire protection system and provides air conditioning, electrical power conditioning, fuel storage and servicing, pyrotechnic storage, and hydrazine handling facilities.

Other capabilities available to support the Langley Flight Research Facility include in-house Computer Aided Design/Computer Aided Manufacturing capability, Non-Destructive Evaluation/Non-Destructive Inspection capabilities, advanced materials capability, in-house structural test facilities, environmental testing labs, and an extensive instrumentation capability. The flight research capability at Langley is backed up by an array of engineering simulators and wind tunnels which can be used to conduct preflight evaluations of proposed aircraft modifications and supplement flight testing activities.

Large areas of restricted airspace within minutes of Langley Air Force Base permit quick and easy access to protected airspace suitable for flight testing at all altitudes and air-speeds. Langley's support aircraft permit convenient project support at remote facilities, and safety and photo chase over a wide range of airspeeds and altitudes. Flight monitoring and control facilities permit the telemetry, processing, and display of flight data in real time. An NASA-

POINT OF CONTACT: Mr. Harry Verstynen
Aircraft Operations Branch, Mail Stop 255A
NASA Langley Research Center
Hampton, VA 23681-0001
Phone: 804-864-3875 Fax: 804-864-8549

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DESCRIPTION (Cont'd): owned airport at nearby Wallops Island, Virginia, allows the convenient and efficient accomplishment of terminal area flight research and airport surface studies. Radar and laser tracking facilities at Wallops provide truth measurements for new navigation and positioning concepts.

Current flight projects at Langley include civil jet transport flight system and advanced air traffic control compatibility research, high speed civil transport and subsonic transport high-lift research, fighter research, and generic aerodynamic research, specializing in boundary layer physics. Langley has also conducted severe storm research, wind shear research, runway friction studies, atmospheric electric field studies, stall/spin research, atmospheric sampling studies, rotary wing research, and many other flight research projects.

POTENTIAL NON-GOVERNMENT USES: Flight testing of new aerodynamic concepts, sensors, and operational procedures. Validation of new navigation system concepts, runway friction/traction research, and evaluation of advanced Air Traffic Control concepts. Air and particulate sampling. Validation of windtunnel, computational, and simulator results. Testing and validation in the flight environment of advanced aircraft system concepts.

REQUIREMENTS FOR NON-GOVERNMENT USE: Persons serving as crewmembers on Langley aircraft must pass an Federal Aviation Administration Class III physical or obtain a waiver from Langley operations and medical personnel. Invitational travel orders are required. For some aircraft, specialized training such as hypobaric chamber, ejection seat, water survival, and/or egress training may be required. A formal agreement, such as a Memorandum of Understanding, is generally required.

REFERENCES:



LANGLEY RESEARCH CENTER FACILITIES



General Aviation Simulator (GAS)

DESCRIPTION: The General Aviation Simulator (GAS) consists of a general-aviation aircraft cockpit mounted on a 3 degree-of-freedom motion platform. The cockpit is a reproduction of a twin-engine propeller-driven general aviation aircraft with a full complement of instruments, controls, and switches, including radio navigation equipment. Programmable control force feel is provided by a "through-the-panel" two-axis controller that can be removed and replaced with a two-axis programmable sidestick controller that can be mounted in the pilot's left hand, center, or right hand position. A variable-force-feel system is also provided for the rudder pedals. The pilot's instrument panel can be configured with various combinations of CRT displays and conventional instruments to represent aircraft such as the Cessna 172, Cherokee 180, and Cessna 402B. A collimated-image visual system provides a nominal 40-degree horizontal by 23-degree vertical field-of-view out-the-window color display. The visual system primarily accepts inputs from a CGI system, but has the capability of mixing with a graphics display from the Calligraphic Raster Display System (CRDS). The simulator is flown in real time with a Convex C3850 computer to simulate aircraft dynamics.

POINT OF CONTACT: Mr. Billy Ashworth
 Analysis & Simulation Branch, Mail Stop 125B
 NASA Langley Research Center
 Hampton, VA 23681-0001
 Phone: (804) 864-6449 Fax: (804) 864-8837

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POTENTIAL NON-GOVERNMENT USES: Research has been conducted to improve the ride quality of GA aircraft by developing gust alleviation control laws to reduce the aircraft response to turbulence while still maintaining generally good flying characteristics. A research study recently completed is the GA Easy Fly, a program to investigate ways of making general aviation airplanes easier to fly, especially for low-time pilots or non-pilots. Another piloted simulation study addressed the handling qualities issues of advanced commuter-type turboprop configurations. Other research has included study and development of two advanced systems for general aviation novice pilots.

REQUIREMENTS FOR NON-GOVERNMENT USE:

REFERENCES:

Real-Time Simulation Users Guide edited by Randall D. Grove, NASA Langley Research Center, January 1993.



LANGLEY RESEARCH CENTER

FACILITIES



High-Intensity Radiated Fields Facility

DESCRIPTION: The High-Intensity Radiated Fields (HIRF) test facility is designed to test avionics systems for effects of electromagnetic radiation. The test chambers are a Gigahertz Transverse Electromagnetic (GTEM) cell and three reverberation chambers. Portions of the facility are now in operation. Other portions are under construction with completion scheduled for November 1993. Automated operation is expected in the Spring of 1994.

The HIRF test facility will be capable of producing fields from 10 KHz to 40 Ghz at levels that meet or exceed the present SAE recommendation for HIRF testing. Average field levels of 1,000 volts per meter (V/m) will be available over a 1-cubic meter test volume in the GTEM cell and 2,000 V/m in the reverberation chambers in a 49- x 25- x 10-foot chamber. These figures are dependent on the frequency range and other detailed considerations.

POINT OF CONTACT: Mr. Peter Padilla
 System Validation Methods Branch, Mail Stop 130
 NASA Langley Research Center
 Hampton, VA 23681-0001
 Phone: (804) 864-6187 Fax: (804) 864-4234

For More Information, Complete Form Below and Return to:
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POTENTIAL NON-GOVERNMENT USES: The HIRF facility can be used to test electronic devices used in a wide variety of applications from transportation to medical. Anywhere that there is risk of damage or operation upset to electronic devices from high intensity radiated fields such as might emanate from TV, radio, or radar.

REQUIREMENTS FOR NON-GOVERNMENT USE: Non-interference with needs of Langley programs, and access to the Langley Research Center.

REFERENCES:



LANGLEY RESEARCH CENTER

FACILITIES

Human Engineering Methods Research Laboratory



DESCRIPTION: The Human Engineering Methods (HEM) Research Laboratory develops human response measurement technologies to assess the effects of advanced crew station concepts on the crew's ability to perform flight management tasks effectively. Behavioral response and psychophysiological response measurement systems have been developed to assess mental loading, stress, task engagement, and situation awareness.

Measurement capabilities include topographic brainmapping (EEG and evoked responses), monitoring of pulse, heart and muscle electrical activity (EKG and EMG), skin temperature and conductance, respiration, and tracking of eye lookpoint (oculometry) and overt behavior (video analysis). A real-time multi-attribute task (MAT) battery has been developed to recreate flight management task conditions in the laboratory setting for initial testing of advanced human response measurement concepts. Mobile physiological monitoring and behavioral response capture stations are located at simulator sites to refine these measurement concepts for flight management research.

POINT OF CONTACT: Dr. Alan Pope
Human/Automation Integration Branch, Mail Stop 152
NASA Langley Research Center
Hampton, VA 23681-0001
Phone: (804) 864-6642 Fax: (804) 864-7793

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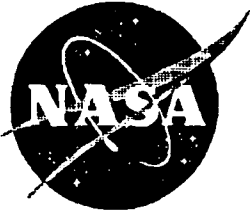
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POTENTIAL NON-GOVERNMENT USES: Development of human factors assessment technologies through aerospace industry collaborations; development of hardware and software technologies for neuropsychological diagnosis and treatment through medical school and medical industry collaborations; cognitive neuroscience research through university collaborations.

REQUIREMENTS FOR NON-GOVERNMENT USE: Collaborations with the HEM Research Laboratory are conducted through Cooperative Agreements with universities and medical schools, Memoranda of Agreement, and research contracts.

REFERENCES:

- Pope, A.T.; and Bogart, E.H.: Identification of Hazardous Awareness States in Monitoring Environments. SAE Technical Paper No. 921136.
- Pope, A.T.; and Bogart, E.H.: Extended Attention Span Training System. Proceedings of Technology 2001 Conference.
- Arnegard, R.J.; and Comstock, J.R., Jr.: Multi-Attribute Task Battery: Applications in Pilot Workload and Strategic Behavior Research. Proceedings of the Sixth International Symposium on Aviation Psychology, Columbus, Ohio, 1991, pp. 1118-1123.
- Nataupsky, M.; Pope, A.T.; McManus, M.L.; and Burdette, D.W.: Workload Evaluations of a Stereo 3-D Computer-Generated Pictorial Primary Flight Display. Proceedings of the Human Factors Society 32nd Annual Meeting, October 1988, pp. 162-163.



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FACILITIES

Hypersonic Facilities Complex



DESCRIPTION: This complex of facilities provides an unparalleled capability at a single installation to study the effects of compressibility, viscosity, and real gases via simulation of Mach number, Reynolds number, and density ratio or ratio of specific heats on the hypersonic characteristics of aerospace vehicles. Research activities include study of aerodynamic and aerothermodynamic phenomena associated with advanced space transportation systems, including future space transfer and Personnel Launch System vehicles; support for development of national aerospace plane technology, planetary entry vehicles, and hypersonic missiles and transports; basic studies of fluid mechanics to establish databases for calibrating computational fluid dynamics (CFD) codes and development of testing and measurement techniques.

Test Gas	p_o , psia	T_o , deg R	M	R /ft $\times 10^{-6}$	Density Ratio	Normal Run Time, Sec
CF ₄	100- 2500	1100- 1480	6	0.03-0.7	12.0	30
Air	30- 500	760- 960	6	0.5-9	5.3	120
Air	45- 500	940- 1260	6	0.5-8.5	5.3	180
Air	50- 2700	700- 1060	6	1-40	5.3	180

POINT OF CONTACT: Mr. Charles Miller
 Experimental Hypersonics Branch, Mail Stop 364
 NASA Langley Research Center
 Hampton, VA 23681-0001
 Phone: (804) 864-5221 Fax: (804) 864-5374

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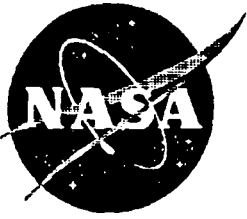
DESCRIPTION (Cont'd):

Test Gas	p _o , psia	T _o , deg R	M	R /ft x 10 ⁻⁶	Density Ratio	Normal Run Time, Sec
Air	30-3000	1160-1500	7.5-8.0	0.1-12	5.6	90
Air	125-1450	1830	10	0.25-2	6.0	120
N ₂	500-10000	2800-3500	17	0.05-1.20	6.6	3600
He	300-2000	520	16.5-18.5	2-15	4.0	5
He	300-3500	500-1060	16-20	1-28	4.0	45

POTENTIAL NON-GOVERNMENT USES:

REQUIREMENTS FOR NON-GOVERNMENT USE:

REFERENCES:



LANGLEY RESEARCH CENTER FACILITIES



Impact Dynamics Research Facility

DESCRIPTION: The Impact Dynamics Research Facility, originally used by the Apollo program for simulation of lunar landings, has been modified to simulate crashes of full-scale aircraft, up to 30,000 pounds, under controlled conditions. The aircraft are swung by cables, pendulum-style, into the concrete impact runway from an A-frame structure approximately 400 feet long and 40 feet high. The impact runway can be modified to simulate other ground crash environments, such as packed dirt, to meet a specific requirement. The length of the swing cables regulate the aircraft impact angle from 0 (level) to approximately 60 degrees. Impact velocity can be varied up to approximately 60 miles per hour (governed by the pullback height). Variations of aircraft pitch, roll and yaw can be obtained by changes in the aircraft suspension harness. Onboard instrumentation allows data to be obtained through an umbilical cable attached to the top of the A-frame. Photographic data are obtained by onboard cameras, ground-mounted cameras, and cameras mounted on top of the A-frame.

POINT OF CONTACT: Mr. Huey Carden
 Landing & Impact Dynamics Branch, Mail Stop 495
 NASA Langley Research Center
 Hampton, VA 23681-0001
 Phone: (804) 864-4151 Fax: (804) 864-8547

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POTENTIAL NON-GOVERNMENT USES: Full-scale testing to evaluate new systems or concepts for improved safety and survivability during crash situations.

REQUIREMENTS FOR NON-GOVERNMENT USE:

- Formal requests through Director for Structures.
- Formal Memorandum of Agreement between Government and industry company.

REFERENCES:

Vaughan, V.L.; and Alford-Bov, Emilio: Impact Dynamics Research Facility for Full-Scale Aircraft Crash Testing. NASA TN D-8179, April 1976.



LANGLEY RESEARCH CENTER FACILITIES



Jet Noise Lab & Anechoic Jet Facility

DESCRIPTION: Jet Noise Laboratory Low Speed Aeroacoustic Wind Tunnel (LSAWT) and Small Anechoic Jet Facility (SAJF). The LSAWT is an aeroacoustic jet facility with maximum forward flight speed of Mach 0.3. It incorporated a dual stream propulsion model with a six component balance and a 17 in² throat nozzle. Each stream has a maximum temperature of 3,000 degrees F. Each stream provides measurements of performance, aerodynamics and acoustics. The maximum NPR = 11. The SAJF has static model jets with 1.3 in² throats and with a single stream with temperatures of 1,000 degrees F and maximum NPR = 11. Measurements include turbulence aerodynamics and acoustics.

POINT OF CONTACT: Dr. John Seiner
 Aeroacoustics Branch, Mail Stop 165
 NASA Langley Research Center
 Hampton, VA 23681-0001
 Phone: (804) 864-6276 Fax: (804) 864-8316

For More Information, Complete Form Below and Return to:
 TOPS Project Office, NASA Langley Research Center
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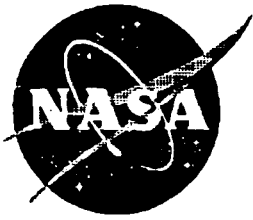
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POTENTIAL NON-GOVERNMENT USES: Commercial subsonic and supersonic jet studies of propulsion efficient noise suppression nozzles by Boeing, GE, Pratt & Whitney, and Douglas. Launch loads by commercial vendors. Computational fluid dynamic flow field solver validation studies. Optical emissions and heat transfer studies.

REQUIREMENTS FOR NON-GOVERNMENT USE:

REFERENCES:

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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LANGLEY RESEARCH CENTER

FACILITIES

Light Alloy Laboratory



DESCRIPTION: The Light Alloy Laboratory complex provides approximately 19,000 sq ft for research on new and advanced light alloy materials systems. Two floating concrete slabs provide for first floor laboratory space which is isolated from building and ground vibrations. The complex is divided into separate and enclosed discipline-oriented laboratories for materials research. Each laboratory has an independent environmental control and a distribution system for laboratory gases and liquid nitrogen. A separate controlled environment laboratory is available for the development of thin-gage metal-matrix materials.

This laboratory complex provides integrated research facilities to conduct alloy synthesis and development, innovative processing and joining, coatings technology, and complex characterization using electron optics and surface analysis techniques. Specifically, equipment and instrumentation are available to conduct surface analysis, thermal analysis, metallurgy, microscopy, X-ray, and dimensional stability studies, in addition to room and elevated temperature mechanical testing.

Some of the materials systems either currently or planned for investigation in the Light Alloy Laboratory include aluminum-lithium, titanium-aluminide, high-temperature alloys and metal-matrix composites as well as more conventional aluminum and titanium-based systems. These materials have potential application on subsonic and supersonic transports, hypersonic vehicles, and advanced space transportation systems.

POINT OF CONTACT: Mr. Barry Lisagor
 Metallic Materials Branch, Mail Stop188A
 NASA Langley Research Center
 Hampton, VA 23681-0001
 Phone: (804) 864-3140 Fax: (804) 864-7893

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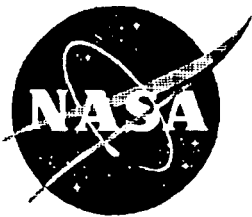
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POTENTIAL NON-GOVERNMENT USES:

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LANGLEY RESEARCH CENTER

FACILITIES

Low-Frequency Antenna Test Facility



DESCRIPTION: The Low-Frequency Antenna Test Facility is an indoor far-field measurement facility that provides a simulated free-space environment for performing antenna measurements to support the analysis and design of advanced antenna systems for NASA's current and future research programs.

Antenna measurements can be conducted over the 0.10- to 40-Ghz frequency range. Test models or antennas up to 12 ft (max) in length and weighing 2,000 lbs or less can be measured as long as the far-field criteria is satisfied. Instrumentation includes a Hewlett Packard (HP) Model 85301B antenna measurement system, a Flam and Russell Model FR959 workstation, an HP Model 8720C network analyzer, and a Scientific Atlanta precision antenna/model positioning system. Test chamber size is 30-ft high by 32-ft wide by 105-ft long.

POINT OF CONTACT: Mr. Melvin Gilreath
 Antenna and Microwaver Research Branch, Mail Stop 490
 NASA Langley Research Center
 Hampton, VA 23681-0001
 Phone: (804) 864-1817 Fax: (804) 864-7975

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POTENTIAL NON-GOVERNMENT USES:

- Antenna performance measurements.

REQUIREMENTS FOR NON-GOVERNMENT USE: Measurements must be scheduled on a noninterference basis with on-going NASA research programs.

REFERENCES:



LANGLEY RESEARCH CENTER FACILITIES



Low-Turbulence Pressure Tunnel (LTPT)

DESCRIPTION: The Langley Low-Turbulence Pressure Tunnel (LTPT) is a single-return closed-circuit tunnel that can be operated at pressures from near vacuum to 10 atm. The test section is rectangular in shape (3-ft wide and 7.5-ft in height and length), and the contraction ratio is 17.6:1. The LTPT is capable of testing at Mach numbers from 0.05 to 0.50 and unit Reynolds numbers from $0.1 \times 10^6/\text{ft}$ to $15 \times 10^6/\text{ft}$.

Two sidewall boundary-layer control (BLC) systems for two-dimensional (2-D) high-lift airfoil testing are available. They consist of an active blowing system fed by 300 psia supply air and a passive suction system vented to atmosphere. A high-lift model support and force balance system is provided to handle both single-element and multiple-element airfoils. Computerized traversers for wake and boundary-layer surveys as well as a three-component Laser Doppler Velocimeter (LDV) are available. Three-dimensional (3-D) models can be tested with spans up to 2 feet in LTPT.

The measured turbulence level of the LTPT is very low due to the large contraction ratio and the many fine-mesh antiturbulence screens. The excellent flow quality of this facility makes it particularly suitable for boundary-layer transition research. Flow quality measurements in the LTPT indicate that the velocity fluctuations in the test section range from 0.025 percent at Mach 0.05 to 0.30 percent at Mach 0.20 at the highest unit Reynolds number.

POINT OF CONTACT: Mr. Bob McGhee
 Low-Turbulence Pressure Tunnel Section, Mail Stop 339
 NASA Langley Research Center
 Hampton, VA 23681-0001
 Phone: (804) 864-1005 Fax: (804) 864-8091

For More Information, Complete Form Below and Return to:
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POTENTIAL NON-GOVERNMENT USES: NASA/Industry cooperative high-lift airfoil research with the following customers:

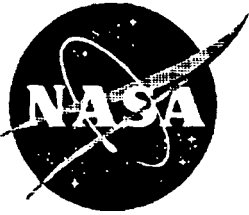
1. Boeing Commercial Aircraft Group, Seattle, Washington
2. McDonnell Douglas Aerospace, Long Beach, California
3. McDonnell Douglas Aerospace, St. Louis, Missouri
4. Gulfstream Aerospace, Savannah, Georgia

REQUIREMENTS FOR NON-GOVERNMENT USE: Contact LTPT Section Head for tunnel scheduling and contact LTPT Facility Safety Head for discussion of model stress analysis. Must follow guidelines in LHB 1710.15 (Wind-Tunnel Model Systems Criteria).

REFERENCES:

Stainback, P. Calvin; McGhee, Robert J.; Beasley, William D.; and Morgan, Harry L., Jr.: "The Langley Research Center's Low Turbulence Pressure Tunnel," AIAA Paper No. 86-0762. West Palm Beach, Florida, March 5-7, 1986.

McGhee, Robert J.; Beasley, William D.; and Foster, Jean M.: "Recent Modifications and Calibration of the Langley Low-Turbulence Pressure Tunnel," NASA Technical Paper No. 2328. Langley Research Center, Hampton, Virginia, 1984.



LANGLEY RESEARCH CENTER FACILITIES



Mechanics of Materials Laboratory

DESCRIPTION: The Mechanics of Materials Laboratory houses experimental facilities for a wide range of research to characterize behavior of structural materials under the application of mechanical and thermal loads. Research encompasses study of deformation characteristics of new materials to develop nonlinear constitutive relationships; and study of damage mechanics to develop strength criteria and damage tolerance criteria based on fracture mechanics. A vacuum chamber allows for the control of moisture, temperature, and gaseous environment. Fatigue tests can also be conducted in salt water environments. A total of 50 servohydraulic testing systems are used for monotonic and cyclic loading of material level coupons under tension, compression, combined tension torsion, and mechanical loading at cryogenic and elevated temperatures, with load capacities from 1 kip to 100 kips. A special cryostat and 100-kip load frame allow testing to approximately -450 degrees F in liquid helium. Current projects include mixed-mode bending fixture, aimed at building databases for development of new tougher composites and design of critical aerospace structures; and research supporting materials selection for the next generation supersonic civil transport aircraft.

POINT OF CONTACT: Dr. Charles Harris
 Mechanics of Materials Branch, Mail Stop 188E
 NASA Langley Research Center
 Hampton, VA 23681-0001
 Phone: (804) 864-3449 Fax: (804) 864-7729

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HAMPTON VA 23681-0001**



LANGLEY RESEARCH CENTER FACILITIES



National Transonic Facility (NTF)

DESCRIPTION: The National Transonic Facility (NTF) is a fan-driven, closed-circuit, continuous-flow pressurized wind tunnel. The 8.2- x 8.2- x 25-ft long test section has a slotted-wall configuration. The wind tunnel can operate in an elevated temperature mode up to $T = 140$ deg F, normally using air, and in a cryogenic mode, using liquid nitrogen as a coolant, to obtain a test temperature range down to about -250 deg F. Thermal insulation inside the pressure shell minimizes energy consumption. The design total pressure range for the NTF is from 15 psia to 130 psia. The combination of pressure and cold test gas can provide a maximum Reynolds number of 120,000,000 at Mach 1.0, based on a chord length of 9.75 inches. These characteristics afford full-scale Reynolds number testing for a wide range of aircraft. Three types of investigations are possible: Reynolds number effects at constant Mach number and dynamic pressure; model aeroelastic effects at constant Reynolds number and Mach number; and Mach number effects at constant dynamic pressure and Reynolds number.

POINT OF CONTACT: Mr. Elwood Putnam
 High-Reynolds Number Aerodynamics Branch, Mail Stop 267
 NASA Langley Research Center
 Hampton, VA 23681-0001
 Phone: (804) 864-5116 Fax: (804) 864-7892

For More Information, Complete Form Below and Return to:
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HAMPTON VA 23681-0001**



LANGLEY RESEARCH CENTER FACILITIES



NDE Research Laboratory

DESCRIPTION: The Nondestructive Evaluation (NDE) Research Laboratory is a cluster of 18 separate operations focusing on development of new measurement technologies to ensure material integrity and development of physical properties to enhance structural performance. As the NASA focal point for NDE, the laboratory combines basic research with technology development and transfer. Research concentrates on NDE of materials measurement science for composites and metals, with emphasis on materials characterization, impact damage, fatigue, applied and residual stress, and structural NDE with smart sensors/materials. A new focus highlights NDE requirements for Space Station Freedom, on-orbit NDE, and National problems of aging aircraft.

POINT OF CONTACT: Dr. Eric Madaras
Nondestructive Evaluation Sciences Branch, Mail Stop 231
NASA Langley Research Center
Hampton, VA 23681-0001
Phone: (804) 864-4970 Fax: (804) 864-4914

For More Information, Complete Form Below and Return to:
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LANGLEY RESEARCH CENTER FACILITIES



Polymers & Composites Lab

DESCRIPTION: The Polymer and Composites Laboratory complex provides 25,000 sq ft of floor space for synthesis and characterization of high performance polymers and development of processing technology and composite fabrication. Emphasis is on the synthesis of processable, tough, durable, high-performance matrices and development of relationships between molecular structure, neat resin properties, and composite properties. Classes of polymers being investigated as matrix resins include: amorphous and semicrystalline thermoplastics; lightly cross-linked thermoplastics; semi-interpenetrating networks; and toughened thermosets. Extensive characterization equipment is housed in the instrument laboratories and used for chromatography and molecular weight determinations; thermal analyses; x-ray characterizations; rheological evaluation; infrared and mass spectroscopy; and mechanical strength determinations of adhesive bonds, polymer moldings, films, fibers, and composites. The Composites Processing Laboratory is Langley's focal point for research and development of advanced polymer composite systems. It is engaged in determining the potential of newly synthesized and commercially promising polymers for use as matrix systems for advanced fiber reinforced composites. Novel tooling concepts are employed for fabricating complex structural shapes. Research quantities of graphite-reinforced polymer composite material are fabricated in drum-wound prepreg machines by solvent solution impregnation. Hot rolls are used to manufacture melt-impregnated composite material. Unique dry powder coating/melt fusion equipment is employed to fabricate prepreg from advanced, difficult-to-process polymer matrix materials. Test panels fabricated from these composite systems are scanned ultrasonically to establish structural integrity before mechanical testing to

POINT OF CONTACT: Dr. Terry St. Clair
 Polymeric Materials Branch, Mail Stop 226
 NASA Langley Research Center
 Hampton, VA 23681-0001
 Phone: (804) 864-4273 Fax: (804) 864-

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DESCRIPTION (Cont'd): determine tensile, shear, and compression properties. Current projects include: characterization of polymer molecular weight, using analytical techniques developed by the Solution Property Laboratory; and the Langley TPI Dry Powder Towpreg Process. The process overcomes many difficulties associated with melt, solution, and slurry prepregging of advanced composite materials, and is especially effective in impregnating high-temperature polymers.

POTENTIAL NON-GOVERNMENT USES:

REQUIREMENTS FOR NON-GOVERNMENT USE:

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LANGLEY RESEARCH CENTER FACILITIES



Pyrotechnic Test Facility

DESCRIPTION: The Pyrotechnic Test Facility contains the Langley Research Center aerospace environmental and functional simulation equipment used for the handling and testing of small-scale potentially hazardous materials, including explosive and pyrotechnic materials, devices, and systems. The facility contains three 12- by 18-foot test cells, which are used for assembly and checkout, environmental testing and test firing, respectively. A 30- by 60-foot general purpose, high bay, open work area is used for system testing and contains control systems for test capabilities for small items, including remotely operated vibration (2,000 lbf), mechanical shock 30,000 g for 0.2 ms), constant acceleration (200 g), thermal (-320 degrees to +600 degrees F), thermal/vacuum (-320 degrees to +200 degrees F at vacuums to 1×10^{-7} mm Hg), electrostatic discharge (25,000 volts with 500 pf capacitor), electrical and mechanical firing systems, and high-speed measurements (40 KHz response analog) of acceleration, force, pressure, temperature, and explosive performance monitoring systems. Adjacent facilities include a control room providing automatic programming and monitoring of remote tests and three larger test cells. Two cells measure 15 by 19 feet and the third is 20 by 19 feet; all three have vertical clearances to 18 feet with overhead canes to 15 feet. The cells have full access, roll-up doors, as well as roll-back ceilings. A fragment-containing net covers the entire width of the building. Capabilities include 250,000 pounds of thrust and testing of up to 5 pounds of high explosives. Emergency containment of up to 6,000 pounds of double-base rocket motor propellant is provided by thick reinforced concrete, covered by earth, as well as earth berms on two sides.

POINT OF CONTACT: Mr. David Shuster
Systems Development Support Section, Mail Stop 459
NASA Langley Research Center
Hampton, VA 23681-0001
Phone: (804) 864-3336 Fax: (804) 864-8344

For More Information, Complete Form Below and Return to:
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POTENTIAL NON-GOVERNMENT USES:

REQUIREMENTS FOR NON-GOVERNMENT USE:

REFERENCES:

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
LANGLEY RESEARCH CENTER M/S 480
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LANGLEY RESEARCH CENTER FACILITIES



Quiet Flow Facility

DESCRIPTION: The Quiet Flow Facility has a test chamber treated with sound-absorbing wedges and is equipped with a low-turbulence, low-noise test flow to allow aeroacoustic studies of aircraft components and models such as rotors, propellers, inlets, wings, and flaps. The dimensions of the chamber are about 20 ft x 24 ft x 30 ft.

Tests may be performed in the Quiet Flow Facility with or without airflow. Testing with flow is possible with either a horizontal high-pressure air system or a vertical low-pressure air system. Test flow with the high-pressure system varies in Mach number up to 0.9 if a 12-inch diameter nozzle is used.

POINT OF CONTACT: Mr. Lorenzo R. Clark
Acoustics Division, Mail Stop 462
NASA Langley Research Center
Hampton, VA 23681-0001
Phone: (804) 864-3637 Fax: (804) 864-7687

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POTENTIAL NON-GOVERNMENT USES: Small model testing; duct propagation studies; noise radiation studies; instrument calibration.

REQUIREMENTS FOR NON-GOVERNMENT USE: Scheduling of non-Government use is required in order to minimize interruption of normal NASA research activities.

REFERENCES:

Hubbard, Harvey H.; and Manning, James C.: Aeroacoustics Research Facilities at NASA Langley Reserach Center. NASA TM 84585, 1983.



LANGLEY RESEARCH CENTER

FACILITIES

Robotics Facilities



DESCRIPTION: 7,800 square feet of laboratory space and over \$10M of facilities are available for telerobotic technology development and controls research. The Hydraulic Manipulator Testbed (HMTB) includes a full-size, seven degree-of-freedom, hydraulically driven version of the Flight Telerobotic Servicer manipulator. The Intravehicular Automation & Robotics (IVAR) laboratory has a full-size mockup of a space station laboratory for simulating microgravity science payloads and ground-based control. The Automated Structures Assembly Laboratory (ASAL) uses an industrial manipulator with special purpose tools to robotically assemble large truss structures.

Flight software, control modes, and operator interface for dexterous orbital robotic systems can be evaluated using HMTB. Besides simulating individual space science experiments, a telerobotic logistics system in IVAR is used for onboard logistics and experiment support. A pair of eight degree-of-freedom robots are available for redundant and cooperative manipulator control studies; and a high capacity, fast response Stewart platform is available for studies of manipulator-coupled spacecraft. Real-time computer graphics are available to support operator interface and predictive displays.

POINT OF CONTACT: Mr. Jack Pennington
 Automation Technology Branch, Mail Stop 152D
 NASA Langley Research Center
 Hampton, VA 23681-0001
 Phone: (804) 864-6677 Fax: (804) 864-8672

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POTENTIAL NON-GOVERNMENT USES: Facilities and technology, such as automated path planning, vision-based guidance, sensor-based control, dual arm coordination, expert-system based monitoring, and high precision noncontact sensing, are available to support flexible manufacturing, industrial automation, undersea maintenance and inspection, dynamic vehicle simulation, and structural mobility tasks.

REQUIREMENTS FOR NON-GOVERNMENT USE: All facilities available, subject to scheduling with ongoing activities.

REFERENCES:

Pennington, Jack E.: Space Telerobotics Research at NASA's Langley Research Center. 2nd International Symposium on Artificial Intelligence, Robotics and Automation in Space (i-SAIRAS), Toulouse Labège, France, October 1992.



LANGLEY RESEARCH CENTER FACILITIES



Scientific Visualization System

DESCRIPTION: The Scientific Visualization System (SVS) is a state-of-the-art digital video editing suite for creating video reports of time dependent theoretical and experimental data. The system consists of a DF/X Compositum video editor which controls digital video machines as well as analog video machines. The digital video machines include two Sony D1 tape recorders and two Abekas real-time disk drives. Because these machines are digital video, they preserve the integrity of the original images irregardless of the number of editing generations, so they are used as the primary editing sources and destinations. Also, the Abekases are connected to the network so that digital images can easily be transferred from a workstation to the SVS. The analog machines include WORM laser disk recorders and numerous tape recorders (Betacam SP, S-VHS, and Umatic). These machines are used for input (e.g., a wind tunnel or in-flight experiment recorded onto video tape) and a final output. One laser disk recorder is mounted into a transportable rack with a multiple frequency scan convertor so that it can be shipped to the researcher's site and connected to a workstation/PC for local recording. Finally, an audio system and a recording booth have been incorporated into the system to support narrations and background music.

POINT OF CONTACT: Mr. Bill von Ofenheim
Flight Software & Graphics Branch, Mail Stop 125A
NASA Langley Research Center
Hampton, VA 23681-0001
Phone: (804) 864-6712 Fax: (804) 864-7635

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FACILITIES

Scramjet Test Complex



DESCRIPTION: The NASA Scramjet Test Complex consists of five test facilities and a diagnostics laboratory which offers a complete spectrum of supersonic combustion ramjet (scramjet) test capabilities. The complex includes the Direct-Connect Supersonic Combustion Test Facility (DCSCTF), the HYPULSE expansion tube, the Combustion-Heated Scramjet Test Facility (CHSTF), the Arc-Heated Scramjet Test Facility (AHSTF), the 8-Foot High-Temperature Tunnel (8-Foot HTT), and the Nonintrusive Diagnostics Laboratory (NDL). Scramjet inlets are tested in air or nitrogen from Mach 1.6 to 17 in various Langley aerodynamic wind tunnels to study inlet flow phenomena and to validate computational fluid dynamics codes. Scramjet combustors are tested in the DCSCTF and the HYPULSE expansion tube to provide basic research data on fuel/air mixing and combustion processes. The hydrogen-air-oxygen combustion heater of the DCSCTF supplies simulated air to the combustor entrance at total enthalpy levels ranging up to Mach 8 flight speeds (total temperatures to 5000 R). The NASA Langley HYPULSE expansion tube, a pulse facility with a 500 microsecond test time, is located at the General Applied Sciences Laboratory in Ronkonkoma, New York. HYPULSE provides clean, undissociated air to the combustor entrance at total enthalpy levels duplicating Mach 13.5, 15, and 17 flight (total temperatures to 15000 R). Designs from the individual scramjet component tests are assembled to form component integration engines which are tested in two subscale engine test facilities, the CHSTF and the AHSTF. A hydrogen-air-oxygen combustion heater in the CHSTF produces simulated air which duplicates Mach 3.4 to 6 flight total enthalpies and an electric arc in the AHSTF heats air to total enthalpy levels corresponding to flight speeds up to Mach 8. Scramjet model size in both of the facilities is approximately 6 inches by 8 inches in frontal area by 6 feet in length. The 8-Foot HTT is capable of testing injectable scramjet models up to 12 feet in length. These models can be

POINT OF CONTACT: Mr. Wayne Guy
 Hypersonic Propulsion Branch, Mail Stop 168
 NASA Langley Research Center
 Hampton, VA 23681-0001
 Phone: (804) 864-6272 Fax: (804) 864-6243

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DESCRIPTION (Cont'd): single or multiple engines of the size tested in the subscale facilities mounted on aircraft-type forebody/afterbody structures or larger scale single scramjets with frontal areas of approximately 20 by 28 inches. Test gases with total enthalpy levels duplicating Mach 4, 5, and 7 flight are produced in the 8-Foot HTT by methane-air-oxygen combustion. The NDL is used to develop various optical diagnostic techniques for supersonic reacting flows. Laboratory scale combustion devices provide air total temperatures of 4000 R and a speed range to Mach 2. This laboratory has been used to develop the hardened Coherent Antistokes Raman Spectroscopy (CARS) system to demonstrate the application of ultraviolet Raman scattering to measure temperature and O₂, N₂, H₂, H₂O, and OH mole fractions simultaneously, and to develop laser-induced fluorescence of OH in supersonic reacting flow. These facilities comprise a Scramjet Test Complex unequaled in its capability to investigate engine flowfields, scale effects, speed effects, and engine/airframe integration.

POTENTIAL NON-GOVERNMENT USES: The U.S. aircraft engine industry and airframe industry.

REQUIREMENTS FOR NON-GOVERNMENT USE: Memorandum of Agreement

REFERENCES:

- Rock, Kenneth E.; Andrews, Earl H.; and Eggers, James M.: Enhanced Capability of the Combustion-Heated Scramjet Test Facility. AIAA-91-2502, June 1991.
- Thomas, Scott R.; and Guy, Robert W.: Expanded Operational Capabilities of the Langley Mach 7 Scramjet Test Facility. NASA TP-2186, October 1983.
- Reubush, D.E.; Puster, R.L.; and Kelly, H.N.: Modification to the Langley 8-Foot High Temperature Tunnel for Hypersonic Propulsion Testing. NASA TM-100486, June 1987.
- Calleja, John; and Tamagno, Jose: Calibration of HYPULSE for Hypervelocity Air Flows Corresponding to Flight Mach Numbers of 13.5, 15, and 17. General Applied Science Laboratories, Inc., GASL TR 335, February 1992.



LANGLEY RESEARCH CENTER

FACILITIES

Space Materials Research Laboratories



DESCRIPTION: The Space Materials Research Laboratories house experimental facilities for conducting research to characterize the effects of simulated Earth orbital space environments on the performance of a wide variety of spacecraft materials. Research areas include the study of degradation mechanisms in advanced polymers and composites, materials life prediction modeling, and accelerated test methodology. These studies support in-house research aimed at developing new, more durable spacecraft materials. The space exposure facilities allow simulation of various environmental parameters in low Earth orbit (LEO) and geostationary orbit (GEO). These facilities include: a combined electron/proton/thermal cycling facility that operates at a 10^{-7} torr vacuum and has a 10-inch diameter exposure area, an ultraviolet (UV) exposure system operating in vacuum with in-situ spectral reflectance measurement capability, a combined UV/vacuum UV (VUV)/thermal cycling exposure system, a combined atomic oxygen (AO) plasma/VUV system with AO flux rates ranging from 3×10^{14} AO-atoms/cm²sec to 2×10^{18} AO-Atoms/cm²sec, and several thermal cycling chambers with temperature capabilities ranging from -250 degrees F to +300 degrees F. The laboratories also contain a wide variety of materials characterization equipment for determining pre- and post-exposure material properties. This equipment includes: dynamic mechanical and thermomechanical analyzers, mass spectrometers, spectrophotometers (UV, visible and infrared), and an outgassing/contamination facility. In addition to these standard characterization techniques, several unique interferometric facilities for measuring the dimensional stability of materials, over temperatures ranging from -250 degrees F to +300 degrees F, have also been developed. These include a system for measuring thermal strains in small specimens with a strain

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 Applied Materials Branch, Mail Stop 191
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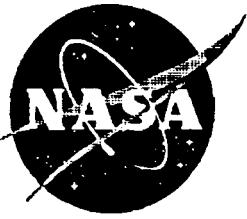
DESCRIPTION (Cont'd): resolution of 1×10^{-6} , and a system for measuring the surface distortion of mirrors in vacuum with a resolution of 4×10^{-6} inches, in terms of surface figure.

POTENTIAL NON-GOVERNMENT USES:

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FACILITIES

Space Simulation and Environmental Test Complex



DESCRIPTION: The Space Simulation and Environmental Test Complex consists of facilities and equipment used to evaluate and qualify space flight experiments and components. These facilities include a 60-foot vacuum sphere, an 8- by 15-foot thermal vacuum chamber, two 5- by 5-foot thermal vacuum chambers, two vibration testing systems, several thermal vacuum bell jars, and mass properties measurement equipment.

The vacuum spheres and chambers are used to simulate space environments by providing vacuum pressures to 1×10^{-7} mm HG and temperatures ranging from -300 degrees F to +300 degrees F. The large 60-foot vacuum sphere can attain a vacuum pressure of 1×10^{-2} mm HG and operates at ambient temperatures. The thermal vacuum chambers are equipped with cryogenic pumps and cryogenic cold traps to avoid contamination to payloads which can result from oil migrating from diffusion or turbomolecular pumps. The thermal vacuum chambers are equipped with residual gas analyzers (RGA's) to continuously monitor and identify molecular species within the chambers.

The engineering vibration test facility includes two dynamic shakers rated at 17,000 and 34,000 force pounds respectively. They are used to perform environmental vibration tests on aerospace flight systems and components to demonstrate that the flight equipment will maintain structural and operational integrity at expected mission load levels. A GENRAD data acquisition and control system allows precise control of dynamic loads through a broad frequency and acceleration range.

POINT OF CONTACT: Mr. Thomas Lash
Systems Development Support Section, Mail Stop 424
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FACILITIES

Structural Dynamics Research Laboratories



DESCRIPTION: The Spacecraft Dynamics Research Laboratory Complex is a group of facilities designed for structural dynamics, vibration isolation, and pointing controls research on aerospace structures and equipment. Primary emphasis is on testing at low frequencies; i.e., 0-300 Hz, allowing the characterizing of structural systems and high-gain pointing control systems. The individual laboratories are described below.

The 16-Meter Thermal Vacuum Chamber has a 55-ft diameter cylinder, a 64-ft high hemispherical dome peak, a flat floor, and a rotation option of a centrifuge arm or table. The centrifuge is rated at 20,000 lb up to 100 g with a 50,000 force-lb capacity and a maximum allowable specimen weight of 2,000 lb. Access is by two doors; one 18 by 20 ft. A vacuum of 100 microns Hg can be achieved in 160 minutes. Temperature gradients of 100 deg F can be obtained from portable radiant heaters and liquid nitrogen cooled plates. The laboratory is serviced by a control room featuring video monitoring and 138 channels of data acquisition.

The Space Structures Research Laboratory is an open room of 5,200 ft². There is a work platform 73 ft above the floor with removable decking, a 20 by 30 by 40 ft free standing gantry for isolated suspension, and a vertical 12 by 12 ft backstop. There is a full environmental control system and several platforms accessible for viewing and instrumentation. The laboratory is serviced by a control room that can support several simultaneous test setups. The control room features video monitoring, 784 channels of data acquisition, a 384 channel structural test and analysis system, a distributed control system, and an environmental monitoring system.

POINT OF CONTACT: Mr. Brantley Hanks
 Spacecraft Dynamics Branch, Mail Stop 297
 NASA Langley Research Center
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 Phone: (804) 864-4325 Fax: (804) 864-8540

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DESCRIPTION (Cont'd):

The Structural Dynamics Research Laboratory is dominated by a 38 ft high back-stop. Test areas available around this back-stop are 15 x 35 x 38 ft and 12 x 12 x 95 ft. Access to the tall levels is provided by spiral stairs, ladders and platforms. The laboratory is supported by a control room that features video monitoring and 416 channels of data acquisition. A variety of dynamic sensing, auxiliary data logging, and signal processing equipment is available to support each of these laboratories. Unique instrumentation include 10-inch stroke shakers, near-zero spring-rate suspension systems, and an arc-second attitude and jitter measurement system. The facility complex is supported directly by NASA technicians and test engineers. Outside contracted test engineer and technician support can be made available for high demand activities. Recent tests include control-structures integration tests on a suspended flexible truss platform, structural identification of a model of an early space station design, and vacuum verification tests of the SAMPEX spacecraft. A simulator of the EOS AM-1 spacecraft is currently (10/93) being installed in the Space Structures Research Laboratory.

POTENTIAL NON-GOVERNMENT USES:

REQUIREMENTS FOR NON-GOVERNMENT USE:

REFERENCES:



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Structural Dynamics Research Testbed

DESCRIPTION: The Structural Dynamics Research Laboratories currently house three testbeds: the Controls-Structures Integration (CSI) Evolutionary Model (CEM), the Flexible Manipulator, and a Hybrid-Scale Space Station model.

The CEM testbed is available to experimentally evaluate methods for controlling the dynamic behavior of spacecraft. The model can be reconfigured and adapted to meet future research needs dictated by actual spacecraft requirements. In the past the testbed has been used by NASA and industry to evaluate vibration of integrated controls/structures design methodologies, and system identification technologies. Currently (10/93), the testbed is being reconfigured to represent the EOS AM-1 spacecraft. The testbed will be used to demonstrate CSI technology enhancements for the EOS AM-1 program.

The Flexible Manipulator testbed is available to experimentally evaluate the modeling issues and non-linear control laws that are required to move an object rapidly and with precision. The testbed includes a standard seven degree-of-freedom multi-linked arm. Two of the links can be replaced with flexible links which lower the links first resonance to around 1 Hz. The testbed includes a gravity off-load suspension system, dynamic instrumentation, and programmable control system.

The Hybrid-Scale Space Station testbed is available to experimentally evaluated structural testing and modeling methods. The original purpose of the testbed was to demonstrate the validity of hybrid scaling laws for the early truss design of the Space Station. The structure is approximated 1/10 the size of the Space Station. The structure has been used to verify substructuring methods, advanced model suspension systems, and requirements and methods for on-orbit structural test of space structures.

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Structures and Materials Research Laboratory

DESCRIPTION: The Structures and Materials Research Laboratory supports a broad range of structural and materials development activities for advanced aircraft, aerospace vehicles, and space platform and antenna structures. Research includes the development, fabrication, and characterization of advanced materials and the development of novel structural concepts. Static testing, environmental testing, material fabrication and structural analysis are performed. Research results are directly applicable to the development of structures and materials technologies required for future advanced subsonic aircraft, high-speed transports, high-performance military aircraft, advanced hypersonic and aerospace vehicles, and large space structures and antennas. Emphasis is on the development of structural mechanics technology and advanced structural concepts enabling the verified design of structurally efficient, cost-effective, damage-tolerant advanced composite and metallic airframe structural components subjected to complex loading and demanding environmental conditions. This research also emphasizes advanced space-durable materials and structural designs for future large space systems. Equipment includes a 1,200,000 lb capacity testing machine that is used for tensile and compressive tests of specimens up to 6-ft wide by 18-ft long. Capability also exists for assembly and testing large structural specimens and components such as the trusses used for Space Station Freedom. This complex also house the Langley Research Center state-of-the-art analytical and metallurgical laboratory for all aspects of material specimen preparation and examination with equipment for automated metallographic preparation equipment; optical microscopy; electron microscopy; scanning transmission electron microscopy, and electron microprobe X-ray analysis. Environmental testing for

POINT OF CONTACT: Dr. Jim Starnes
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DESCRIPTION (Cont'd): materials can also be performed using two thermal cycling chambers, three electron irradiation chambers, and four laser interferometers. A hypersonic materials environmental system is capable of continuous test operation at Mach 5 to a 150,000-ft altitude to simulate operating conditions for future high-speed and hypersonic aircraft. Efforts are underway to develop aluminum-lithium alloys for use in cryogenic tanks and dry bay structure of future space launch and transportation systems. Also, the precision segmented reflector (PSR) program is aimed at developing large-diameter segmented space-based reflectors for a scientific mission, using an infrared laser interferometer system capable of measuring the surface accuracies of flat and parabolic reflector panels.

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Supersonic Low-Disturbance Pilot Tunnel (SLDPT)



DESCRIPTION: The Supersonic Low-Disturbance Pilot Tunnel (SLDPT) is one of five Langley high-speed wind tunnels designed to provide a quiet flow environment in which to conduct boundary layer instability and transition experiments. Conventional (i.e., non-quiet) high-speed wind tunnels typically have intense noise fields that radiate from turbulent nozzle walls and directly influence the transition process. Such data is facility-dependent and is generally not suitable for scientific application. The major system elements used in the SLDPT to quiet the flow are: acoustic baffles and screens in the settling chamber, removal of the settling chamber boundary layer through a bleed slot upstream of the nozzle entrance, computed nozzle contours designed to minimize growth of unstable instability modes and a highly polished nozzle throat region to minimize roughness-induced transition. The SLDPT is an air, blow-down facility with maximum operating pressure and temperature of 200 psia and 200 degrees F, respectively. The current Mach number is 3.5 although new Mach 2.4 nozzle designs are being developed for future installation. The current nozzle size is 15.5 inches long with a 6x10 inch rectangular exit. Run times vary but are on the order of 30 minutes. Typical research programs carried out in the SLDPT are: evaluation of supersonic laminar flow control by suction on wings, basic instability and transition studies of planar and axisymmetric bodies with various amounts of bluntness and angle of incidence, and attachment-line transition studies including passive relaminarization techniques.

POINT OF CONTACT: Mr. Steve Wilkinson
 Experimental Methods Branch, Mail Stop 170
 NASA Langley Research Center
 Hampton, VA 23681-0001
 Phone: (804) 864-5733 Fax: (804) 864-8348

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Thermal Acoustic Fatigue Apparatus (TAFA)

DESCRIPTION: The Thermal Acoustic Fatigue Apparatus (TAFA) is a grazing incidence, high intensity noise apparatus with heating capability. Noise is generated by two 30,000 watt acoustic modulators using filtered pressurized air coupled to an exponential horn. Heat is provided by a bank of 60 quartz lamps rated at 6,000 watts each. Sound pressure levels are available from 125 to 168 dB, both sinusoidal and random, in the frequency range of 40 to 500 Hz. Heating capability is up 44 BTU/ft²-sec on test panels up to 26 inches by 26 inches (2000 degrees F).

POINT OF CONTACT: Dr. Kevin Shepherd
Structural Acoustics Branch, Mail Stop 463
NASA Langley Research Center
Hampton, VA 23681-0001
Phone: (804) 864-3583 Fax: (804) 864-8823

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POTENTIAL NON-GOVERNMENT USES: Flat, built-up, or composite panels up to 26 inches x 26 inches may be subjected to noise levels of 125dB up to 168 concurrent with heating the panel to 2,000 degrees F.

REQUIREMENTS FOR NON-GOVERNMENT USE: Must be jointly sponsored research with Langley Research Center.

REFERENCES:

Clevenson, S.A.; and Daniels, E.F.: Capabilities of the Thermal Acoustic Fatigue Apparatus. NASA TM 104106, February 1992.

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Transonic Dynamics Tunnel (TDT)

DESCRIPTION: The large Transonic Dynamics Tunnel (TDT) is dedicated specifically to work on the dynamics and aeroelastic problems associated with the development of high-speed aircraft. The tunnel has been used almost exclusively to clear new designs for safety from flutter and buffet, to evaluate solutions to aeroelastic problems, and to research aeroelastic phenomena at transonic speeds. The tunnel is a slotted-throat, single-return, closed-circuit wind tunnel with a 16- x 16-ft test section. The stagnation pressure can be varied from near vacuum to atmospheric conditions, and the Mach number can be varied from 0 to 1.2. The facility can use either air or a heavy gas as the test medium, and is equipped with many features uniquely suited to dynamic and aeroelasticity testing, including a computerized data acquisition system; a system for rapidly reducing test section Mach number and dynamic pressure to protect models from damage when aeroelastic instabilities occur; a system of oscillating vanes to generate sinusoidal variations in tunnel flow angle for use in gust response studies; and special mount systems that enable simulation of airplane rigid-body modes and of launch vehicle ground wind loads.

POINT OF CONTACT: Dr. Tom Noll
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POTENTIAL NON-GOVERNMENT USES: Commercial aircraft companies, general aviation companies, and universities.

REQUIREMENTS FOR NON-GOVERNMENT USE: Establish Memorandum of Agreement to perform cooperative aeroelastic research.

REFERENCES:



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Transport Systems Research Vehicle (TSRV)
and TSRV Simulator



DESCRIPTION: The flight test vehicle, the Transport Systems Research Vehicle (TSRV), and associated simulator are used for research by the Advanced Transport Operating Systems (ATOPS) Program, which strives to increase the operational capability of modern aircraft. The basic flight test vehicle is a B737-100 aircraft with added research capability. The TSRV has two flight decks: a conventional Boeing 737 flight deck provided operational support and safety backup, while the fully operational research flight deck in the aircraft cabin is used to explore innovations in display formats, and in-aircraft operations. In addition to video displays of flight and navigation information, center panel displays show engine and system status. The center panel displays will permit research on how additional information can be displayed and used to improve situational awareness, air traffic control communications, flight management options, and traffic awareness. The simulator nearly replicates the research deck of the TSRV and is supported by a non-linear 6 DOF version of the basic B737-100 aircraft.

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ATOPS Program Office, Mail Stop 265
NASA Langley Research Center
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Phone: (804) 864-3844 Fax: (804) 864-8093

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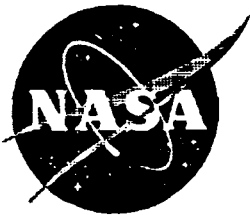
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Unitary Plan Wind Tunnel

DESCRIPTION: The Unitary Plan Wind Tunnel is a closed-circuit continuous-flow variable-pressure tunnel with two 4- by 4- by 7-ft test sections with continuous Mach number ranges of 1.5 to 2.9 and 2.3 to 4.6. The tunnel is used for force and moment, pressure distribution, jet effects, dynamic stability, and flow visualization studies. Supersonic experimental programs include intrusive flow-field surveys of High-Speed Civil Transport concepts, sonic boom tests, aerodynamic characteristics of Sidewinder missile variant configurations, incipient leading-edge separation study, experimental analysis of optimized waveriders, aerodynamics characteristics of HL-20A lifting-body configuration, dynamic stability characteristics of National Aero-Space Plane (NASP) test technique demonstrator configuration, and propulsion/airframe integration of NASP configurations.

POINT OF CONTACT: Mr. Jim Dillon
Supersonic/Hypersonic Aerodynamics Branch, Mail Stop 413
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Visual Motion Simulator (VMS)

DESCRIPTION: The Visual Motion Simulator (VMS) is a general-purpose simulator consisting of a two-crew member cockpit mounted on a six degree-of-freedom synergistic motion base. Four collimated visual display units (two per crew member) provide a horizontal by vertical field-of-view of 106 degrees by 36 degrees of out-the-window scene for each crew member. The out-the-window scenes are generated by a Computer-Generated Image (CGI) system. Heads-up display presentations are generated by mixing CGI video signals with signals generated by the Calligraphic Raster Display System (CRDS) raster mix (RMIX) graphics unit. An additional feature is the Control Display Unit (CDU) mounted in the center of the cockpit. Left- and right-side instrumentation consists of six CRTs with CRDS graphics displays and some electro-mechanical instrumentation.

A programmable sidestick hydraulic control loading system provides pitch and roll controls for the left seat with a separate programmable control loading system providing rudder control. Another programmable hydraulic control loading system for the right seat provides roll and pitch controls for either a fighter-type control stick or a helicopter cyclic controller. Right-side rudder control is an extension of the left-side rudder control system. A friction-type collective control is provided for both the left and right seats. An observer's seat allows a third person to be in the cockpit during motion operation. A realistic center control stand, in addition to providing transport-type control features, provides auto-throttle capability for both the forward and reverse thrust modes.

Motion cues are provided in the simulator by the relative extension or retraction of the six hydraulic actuators of the motion base. Washout techniques are used to return the motion base to the neutral point once the onset motion cues have been commanded. In addition, a g-seat can be

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DESCRIPTION (Cont'd): provided which can be interchanged between the left and right seats to augment the motion cues from the base.

POTENTIAL NON-GOVERNMENT USES: Research applications have included studies for transport, fighter, and helicopter aircraft as well as for space vehicles. Recent applications have included a generic hypersonic transport, Personnel Launch System (PLS), High-Speed Civil Transport (HSCT), and F16-XL aircraft.

REQUIREMENTS FOR NON-GOVERNMENT USE:

REFERENCES:

Real-Time Simulation Users Guide edited by Randall D. Graves, NASA Langley Research Center, January 1993.

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