FACILITY NO.  582A
FACILITY TITLE:  Low-Turbulence Pressure Tunnel

FACILITY DESCRIPTION:

The tunnel is a single return, closed throat, fan driven wind tunnel. The pressure in the tunnel can be varied from 0.1 to 10 atmospheres giving a wide range of Reynolds numbers. Two-dimensional airfoil models usually span the 3-foot wide test section and have a chord of about 2 feet. Three-dimensional models can be tested with spans of about 2 feet.

TESTING CAPABILITIES:

<table>
<thead>
<tr>
<th>Test section size</th>
<th>= 3.0 ft. by 7.5 ft.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed, Mach No.</td>
<td>= 0.05 to .50</td>
</tr>
<tr>
<td>Reynolds number</td>
<td>= 0.1 to 15 x 10^6/ft.</td>
</tr>
<tr>
<td>Total pressure</td>
<td>= 0.1 to 10 atmos.</td>
</tr>
<tr>
<td>Dynamic pressure</td>
<td>= .01 to 5.0 psi</td>
</tr>
</tbody>
</table>

June 1990
FACILITY NO: 640
FACILITY TITLE: 8-Foot Transonic Pressure Tunnel (8-Ft. TPT)

FACILITY DESCRIPTION:

The 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-ft. diameter circle. The floor and the 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 side walls are solid and fitted with windows for schlieren flow visualization. The 8-Ft. TPT is a very versatile wind tunnel capable of supporting basic fluid dynamics research as well as a wide range of applied aerodynamic research. With the installation of screens and honeycomb in conjunction with the recently completed Laminar Flow Control experiment, the quality of the flow in the test section is suitable for performing reliable code validation experiments.

TESTING CAPABILITIES:

Tunnel stagnation pressure can be varied from a minimum of about 0.25 atmosphere at all test Mach numbers to about 1.0 atmosphere at a Mach number of 1.2, about 1.5 atmospheres at high subsonic Mach numbers, and about 2.0 atmospheres at Mach numbers of 0.4 or less. The tunnel is capable of achieving Mach numbers to about 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 a model be located further aft in the test section.
FACILITY NO:  643  
FACILITY TITLE:  30- by 60-Foot Tunnel

FACILITY DESCRIPTION:

The 30- by 60-Foot Tunnel is a continuous flow, double return, open throat type tunnel. The test section is 30-feet by 60-feet by 56-feet. This facility is powered by two 4-blade, 35.5-foot diameter fans, each driven by a 4000 hp electric motor.

TESTING CAPABILITIES:

The tunnel is equipped for free-flight dynamic model tests, and is equipped with shielded struts for the 6-component scale balance. There is available a variety of smaller model mounts for use with small models having internal balances. Auxiliary equipment consists of 1000 and 500 horsepower d.c. motors for power supply to models as well as 2 lb/sec at 500 psi and 15 lb/sec at 300 psi compressed-air supplies. Eighty channels of information or data can be recorded on the data acquisition system. The facility will accommodate models of up to 40 foot wing span and weighing 20,000 lbs.

June 1990
FACILITY NO: 645
FACILITY TITLE: 20-Ft. Vertical Spin Tunnel

FACILITY DESCRIPTION:

This is a free-spin tunnel with a closed throat and an annular return passage. The vertical test section has 12 sides and is 20 feet across the flats by 25 feet high. The test medium is air. The turbulence factor is 2. Tunnel speed is variable from 0 to 90 fps with accelerations to 15 ft/sec². This facility is powered by a 400 hp maindrive with short-term 1300 hp capability.

TESTING CAPABILITIES:

The spin tunnel is used to investigate spin and tumbling characteristics of dynamically scaled models. Spin recovery characteristics are studied by remotely actuating the aerodynamic controls of models to predetermined positions. Force and moment testing is performed using a gooseneck rotary arm model support which permits angles of attack and sideslip from 0° to 360°. Video and motion picture records are used to record the tumbling, spinning, and recovery characteristics in the spin tunnel tests. Force and moment data from the rotary balance tests are recorded in coefficient form and stored on magnetic tapes.

June 1990
Facility Data Sheet

Facility No: 648
Facility Title: Transonic Dynamics Tunnel (TDT)

Facility Description:

Closed circuit variable pressure tunnel with 16 ft. x 16 ft. test section capable of using air or heavy gas (R-12) as a test medium. Specifically designed for studies and tests in the field of aeroelasticity. Has a computer controlled data acquisition system for dynamic data collection and analysis. 30,000 H.P. electric motor powers tunnel. Very rapid slowdown capability. Direct view of models through test section window.

Testing Capabilities:

Can test cable mounted, sidewall mounted, sting mounted, or floor mounted models. Has gust simulation capability. Maximum Mach number is 1.2. Max dynamic pressure is 550 psf for R-12 and R-150 psf for air (continuous operation). Max RN for Freon operation is approximately $10.0 \times 10^6$ per foot at Mach 0.7 decreasing to $3 \times 10^6$ at Mach 1.2. Mach number and dynamic pressure are independently variable.

June 1990
FACILITY NO: 720
FACILITY TITLE: Hydrodynamics Research Facility

FACILITY DESCRIPTION:

The Tow Tank is a high-speed towing basin used to test high-performance underwater vehicles. The tank is 2800 ft. long, 24 ft. wide, and 12 ft. deep. The volume is approximately 5.5 million gallons. An 18-ton, 3200-HP, electrically propelled carriage tows models at speeds up to 75 ft./sec. (45 knots). Two smaller electrically propelled carriages are also available for test purposes. This is the only facility in the Country capable of providing high-speed, full-scale testing of torpedoes in both freshwater and seawater.

The Naval Underwater Systems Center (NUSC) in its research capacity of developing laminar flow technology for drag reduction of underwater vehicles, reactivated this Facility in 1981. The Facility is utilized by NUSC approximately 70 percent of the time and by NASA approximately 30 percent of the time.

TESTING CAPABILITIES:

See above descriptions.
FACILITY NO: 1146
FACILITY TITLE: 16-Foot Transonic Wind Tunnel

FACILITY DESCRIPTION:

This is a closed circuit, single return, continuous flow, atmospheric tunnel. Speeds up to Mach 1.05 are obtained with the tunnel main drive fans. Speeds above Mach 1.05 are obtained with a combination of main drive and test-section plenum suction. The slotted octagonal test section nominally measures 15.5 feet across the flats. The test section length is 22 feet for speeds up to Mach 1.0 and 8 feet for speeds above Mach number 1.0. The tunnel is equipped with an air exchanger with adjustable intake and exit vanes to provide some temperature control. This facility has a main drive of 60,000 hp. A 36,000 hp compressor provides test section plenum suction.

TESTING CAPABILITIES:

This tunnel is used for force, moment, pressure, flow visualization and propulsion-airframe integration studies. Model mounting consists of sting, sting-strut, and fixed-strut arrangements. Propulsion simulation studies are made utilizing dry, high pressure air. Dual high pressure (each capable of 15 lb/sec at 1000 psi) air systems provide the test medium for propulsion simulation.

June 1990
Facilities Data Sheet

FACILITY NO: 1192C, D, E, & T
FACILITY TITLE: Computational Fluid Dynamics Laboratory (CFDL)

FACILITY DESCRIPTION:

The CFDL houses the Computational Aerodynamics Branch and the Theoretical Flow Physics Branch of the Fluid Mechanics Division, the Unsteady Aerodynamics Branch of the Structural Dynamics Division, and the Institute for Computer Applications in Science and Engineering (ICASE). These organizations all conduct research in CFD. The facility consists of office space, specialized rooms for computer equipment, and an extensive computer networking system.

TESTING CAPABILITIES:

The CFD laboratory currently has a superminicomputer, an advanced architecture parallel computer, several advanced computer graphics workstations, many personal workstations, and an extensive computer networking system.

June 1990
FACILITY NO: 1200
FACILITY TITLE: Advanced Technology Research Laboratory

FACILITY DESCRIPTION:

The facility consists of a set of laboratories on the first or ground floor and offices for laboratory personnel on the second floor. Two large solar simulators in the laboratories are capable of radiating powers of 100 kilowatts and 150 kilowatts, respectively. With optical concentrators, these systems provide solar concentrations to 2,000 solar constants. The facility contains two chemistry labs, including fume hoods, capacitive energy storage equivalent to 1 megajoule in a radio-frequency-shielded room. Other labs include facilities for high-vacuum research, laser-to-electric-photovoltaic testing, microscopic evaluation of surfaces, and several of the rooms are darkenable for light-sensitive experiments.

TESTING CAPABILITIES:

High intensity, simulated solar energy, up to 2,000 solar constants, can be produced on a line 20 centimeters long. The facility is also capable of high-intensity bursts of light for 1 millisecond focused into a line up to 2 meters long. High-vacuum equipment reaches $10^{-10}$ torr, provides atomically clean surfaces, and performs surface compositional analysis. Chemistry labs provide analysis of solid, gaseous, and liquid lasants.

June 1990
FACILITY NO: 1205
FACILITY TITLE: Mechanics of Materials Research Laboratory

FACILITY DESCRIPTION:

A comprehensive collection of servohydraulic mechanical testing machines with capability for elevated temperature and environmental exposure and with auxiliary apparatus such as microscopes and shop equipment.

TESTING CAPABILITIES:

Fatigue load capacities from 4.5 kN to 4.5 MN at selected frequencies from 1 Hz to 50 Hz. Loading may be at constant amplitude, variable amplitude or random. Loading conditions include uniaxial tension and compression, combined uniaxial and torsion, and in-plane biaxial tension and compression.
Facilities Data Sheet

FACILITY NO: 1205
FACILITY TITLE: Light Alloy Research Lab

FACILITY DESCRIPTION:

An integrated facility for light alloy research to include alloy synthesizing and development, innovative processing and joining, coating technology, and complex characterization using electron optics and surface analysis techniques.

TESTING CAPABILITIES:

Surface analysis, innovative processing and joining techniques, and the capability for light alloy and metal matrix composite synthesis and development by deposition processes.

June 1990
FACILITY NO: 1208
FACILITY TITLE: Acoustics Research Laboratory

FACILITY DESCRIPTION:

The laboratory consists of an anechoic chamber (30 ft x 30 ft x 20 ft), a
reverberant chamber (14 ft x 30 ft x 20 ft), an acoustic flow duct test area, a
quiet air supply system, a research audiometric chamber, an external flyover
noise simulation chamber (14 ft x 28 ft x 30 ft), and an internal noise
simulation chamber (10 ft x 16 ft x 16 ft). Provision is made for studying jet
noise and flow-induced noise generation on airfoils and rotors, for evaluating
acoustic duct treatments, and for measuring the effects of noise on people.
The experimental research data obtained in these chambers are (operated on)
through a microprocessor and fed into a central computer for real time
analysis. Simultaneously, during the analysis the computer/microprocessor
controls the experiment.

TESTING CAPABILITIES:

- Noise radiation patterns from simulated engine inlets and bypass
ducts to 0.7 Mach no.
- Far field noise from model jet nozzles, at transonic Mach numbers,
within a flow field up to 0.4 Mach no.
- Jet nozzle refraction studies with cryogenic fluids (helium and
nitrogen).
- Airfoil and airframe component noise.
- General aviation propellers and aircraft structural acoustic properties.

June 1990
FACILITY NO:  1212B  
FACILITY TITLE:  High-Speed 7- by 10-Ft. Tunnel  

FACILITY DESCRIPTION:

The Langley High-Speed 7- by 10-Foot Tunnel (7x10 HST) is a closed-circuit single-return continuous-flow atmospheric tunnel with a solid wall test section 6.6 ft. high, 9.6 ft. wide, and 10 ft. long. The tunnel is fan driven and is powered by a 14,000-hp electric motor. It operates over a Mach number range from 0.0 to 0.9 to produce a maximum Reynolds number of \(4 \times 10^6/\text{ft.}\).

TESTING CAPABILITIES:

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's flow visualization capability has been upgraded through the installation of a permanent laser vapor screen system.
Facilities Data Sheet

FACILITY NO:  1212C
FACILITY TITLE:  14- by 22-foot Subsonic Tunnel

FACILITY 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 8000-hp electrical drive system, which can provide precise tunnel speed control from 0 ft/s to 318 ft/s with the Reynolds number per foot ranging from 0 to $2.1 \times 10^6$. 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 when the side walls and ceiling are removed to allow extra testing capability, such as flow visualization and acoustic tests. The tunnel is equipped with a two-component laser velocimeter system. Furthermore, boundary-layer suction on the floor at the entrance to the test section and a moving-belt ground board for operation at test section flow velocities to 111 ft/s can be installed for ground effect tests.

TESTING CAPABILITIES:

Langley Research Center has completed significant modifications to the 14- by 22-foot Subsonic Tunnel to improve and expand its aerodynamic and acoustic test capability. One of the more significant aerodynamic improvements was achieved through the use of flow deflectors installed downstream of the first corner of the tunnel circuit to improve the performance of the tunnel fan. The deflectors resulted in a more uniform velocity distribution into the tunnel drive system and eliminated regions of large-scale flow separation in the return leg of the tunnel circuit.

June 1990
A turbulence reduction system consisting of a grid, a honeycomb, and four fine-mesh screens dramatically reduced the level of longitudinal turbulence intensity in the tunnel test section. This system provided a reduction in turbulence of 50 percent or more for the closed test section configuration. Periodic flow pulsations that occurred at several speeds in the unmodified configuration of the open test section were eliminated by installation of a new flow collector.

Acoustic reverberations in the open test section were reduced through the use of sound-absorbing panels on the test chamber walls. A major operational improvement was achieved through the construction of a specially designed laser velocimeter laboratory for setup and maintenance of the two component laser velocimetry system. Finally, an addition to the model preparation area, which includes a support system and rotor test cell, provides the capability to assemble and test rotor models in hovering conditions prior to actual entry into the tunnel.
FACILITY NO: 1218A
FACILITY TITLE: Anechoic Noise Facility

FACILITY DESCRIPTION:

The test chamber (8 m x 8 m x 8 m) is composed of acoustic fiberglass wedges that are 99% absorbent on the ceiling, floor, and walls so as to provide a free-field or anechoic environment. This capability permits measurements of the true noise radiation patterns of noise sources associated with aircraft and aerospace vehicles. A 300-psi air supply system is used to conduct studies of jet exhaust noise. The air system is designed with quiet valves and mufflers to provide a very low system noise. Jet nozzles of from one cm to 6 cm can be investigated at velocities of M 0.1 to M 2.5.

TESTING CAPABILITIES:

See above description.

June 1990
The Avionics Integration Research Laboratory (AIRLAB) is NASA's facility for developing methods of systematically evaluating highly reliable, fully integrated aircraft guidance and control systems. The research conducted in AIRLAB focuses on the development of assessment techniques using simulations, emulations, analytical models, and experimental hardware and software to characterize performance, predict reliability and judge the benefits of proposed guidance and control system architectures and technology.

AIRLAB provides the capability for simulating an entire aircraft guidance and control system. This comprehensive simulation capability allows the realistic validation of new assessment methods technology in a laboratory situation with a simulated aircraft flight environment. The AIRLAB design is highly adaptable for studying a variety of advanced integrated system architectures. It also contains the Digital Avionics Design and Reliability Analyzer which is a diagnostic emulator designed to aid reliability analysis and software verification of advanced avionic computers and digital systems.

June 1990
FACILITY NO: 1220
FACILITY TITLE: DC-9 Full-Work-Load Simulator (FWLS)
(formerly DC-8 Transport Simulator)

FACILITY DESCRIPTION:

The DC-9 FWLS consists of a fixed-base McDonnell Douglas DC-9-30 cockpit, a test console, and electronics cabinets. This cockpit was formerly a DC-8 cockpit, but was recently upgraded to provide the capability for dedicated DC-9 full-work-load simulations. Stations are available in the cockpit for a captain and a first officer. Flight control responses for elevator, aileron, and rudder are simulated by forces from hydraulic servo systems. Manual throttle control for two engines is provided on the center console. The forward electronics panel of the center console is outfitted with a 9-in. color cathode ray tube (CRT) which can be used to display computer-generated graphic presentations, such as Cockpit Display of Traffic Information (CDTI) or Area Navigation (RNAV). A transparent touch panel superimposed over the face of the CRT provides a discrete input to the computer when any point on the surface is touched. Work is progressing toward improvement of this simulator through retrofit of a modified aircraft center console with autothrottle capability and through the installation of a collimated visual display system to provide an out-the-window color display for both the captain and the first officer.

TESTING CAPABILITIES:

Full-work-load studies can be performed in this simulator because the capacity exists to simulate all aircraft instruments, annunciators, switches, and alarms. Three very-high-frequency (VHF) communication receivers are simulated for VHF Omni-directional Range/Instrument Landing System (VOR/ILS). One Airborne Direction Finder (ADF) radio receiver and three marker beacon receivers are simulated in this cockpit. In 1986, a visual display system was installed to display out-the-window scenes to the pilot and copilot. The visual display system was upgraded in 1989 for compatibility with the Computer-Generated Image system. In 1988, a Control Display Unit (CDU) was installed in place of the CDTI CRT.

June 1990
FACILITY NO: 1220
FACILITY TITLE: Automated Structures Assembly Laboratory (ASAL)

FACILITY DESCRIPTION:

The ASAL consists of an industrial robot manipulator arm mounted on an x-y moving base carriage. The structure to be assembled is mounted on a turntable arrangement so the manipulator arm can reach all points on the structure. The manipulator arm uses a specialized end effector to retrieve the struts from trays mounted behind the arm and install them into the structure. The facility includes a video camera surveillance system to observe, record, and analyze the assembly operations. The automated assembly system is driven by several computers which contain data bases and algorithms to enable the manipulator arm to perform the assembly. When problems are encountered, the system has a manual command mode in which the operator uses closed-circuit television and menu displays to intervene in the assembly process. Other end effectors are also available for the installation of panels and modules on the structure.

RESEARCH APPLICATIONS:

The Automated Assembly Facility (AAF) is used to identify real problems and evaluate hardware and software systems for the telerobotic assembly of large space structures. The facility has been used to assemble a two-ring, 102-member tetrahedral truss structure. Plans call for studies of the installation of panels on this truss structure, the assembly of curved trusses for aerobrake or antenna applications, and assembly of panels for the Space Station Freedom Solar Dynamics collector. Advanced systems studies include sensor systems for assembly operations, distributed computer architecture for automated systems, including end effector-mounted microprocessors, and automated path and task sequence planners for complex assembly operations. The AAF and the technology it develops will provide guidelines for more sophisticated ground testbeds, flight experiments, and in-space assembly facilities associated with future manned Lunar/Mars missions.

June 1990
Facilities Data Sheet

FACILITY NO:  1220  
FACILITY TITLE:  Intelligent Systems Research Laboratory (ISRL)

FACILITY DESCRIPTION:

The ISRL is used to develop and demonstrate telerobotics technology using a pair of PUMA 560 robots. High-level control, including active compliance based on force and torque sensing, vision-guided trajectory control, and task macros is done on a network of distributed minicomputers. An operator is able to supervise automatic operations and also can control the arms using a six-degree-of-freedom joystick. A set of eight-degree-of-freedom arms will replace the PUMA arms in 1991. A large capacity, high bandwidth Stewart platform, capable of supporting any of the LaRC dual-arm manipulator systems will also be installed in 1991. Using admittance control, it will be used to simulate the interaction of two coupled dynamic systems, such as the Shuttle RMS and the Flight Telerobotic Servicer, in telerobotic tasks.

RESEARCH APPLICATIONS:

Basic and applied research in multiarm coordination and control, force accommodation, vision-based control, and redundant arm kinematics are conducted in ISRL. Examples of telerobotic tasks performed in ISRL are:

Biostack Removal - Using vision and force sensors, a model of the Biostack experiment container carried on LDEF was removed. Simple markings on the mockup enables the vision system to autonomously guide the arm.

Structural Assembly - Using wrist-mounted force/torque sensors, two arms assembled a 12-foot strut/node assembly. Force sensor information was used to automatically distribute the load between the two arms and to cancel any disturbing forces.

Refueling Valve - Two coordinated arms plus vision and force/torque sensors are required to insert a refueling fixture mockup, and then to actuate six simulated valves. ISRL results will be compared with manned results from zero g simulations.

June 1990
FACILITY NO: 1220
FACILITY TITLE: Telerobotic Systems Research Laboratory (TSRL)

FACILITY DESCRIPTION:

The TSRL is a facility for performing Earth-based systems-level research and evaluation of space telerobotic functions and systems. The TSRL contains a versatile software/hardware-reconfigurable telerobotic system called the Laboratory Telerobotic Manipulator (LTM). LTM is a dual-arm, force-reflecting, master/slave manipulator in its basic form. But it can also accept inputs from a variety of other devices to control the slave arms, or the master arms can be driven as another set of dual slave arms. Full robotic control of the arms is also possible. Each of the LTM arms has seven degrees of freedom with additional motion being provided by a track and turntable on which the slave unit is mounted.

RESEARCH APPLICATIONS:

TSRL became operational in 1990. It will be used to evaluate system and subsystem performance in full-size tasks, including control methods and performance metrics. Initial studies will be:

Control Input Devices - The LTM master would be too large to be used in space, but will be used as a baseline for comparing other controllers, including miniature master controllers (with and without force reflection) and six degree-of-freedom force- and displacement-type joysticks.

Redundant Manipulator Control - LTM’s seven joints provide an extra (redundant) degree of freedom, which can be used to optimize the trajectory (e.g., obstacle avoidance). Alternative methods for efficient redundant manipulator control will be implemented and tested.
Facilities Data Sheet

FACILITY NO: 1221, 1221D
FACILITY TITLE: Hypersonic Propulsion Facility

FACILITY DESCRIPTION:

The Combustion Heated Scramjet Test Facility (CHSTF) is a direct combustion heated propulsion wind tunnel. The fuel is hydrogen with oxygen replenishment to simulate air at conditions up to Mach 6 flight speed (ie. 3000°F and 600 psi). Facility nozzles approximately one foot square are available with exit Mach numbers of 3.5 and 4.7. Altitude simulation is provided with an air ejector or exhaust to a 70 ft. diameter vacuum sphere.

The Supersonic Combustion Test Stand (SCTS) is a direct-connect supersonic combustion test facility which employs hydrogen combustion heating with oxygen replenishment. Maximum simulated flight speeds up to Mach 8 can be achieved (ie. 4500°F and 600 psi). A variety of rectangular nozzles with Mach 2 to 3.3 exit Mach number are available, and the test stream is exhausted either by an air driven ejector or to the vacuum sphere.

A common control room and data acquisition system serves both test facilities. Pressure force and thermocouple data as well as special purpose optical and gas sample data can be recorded and processed to engineering units.

TESTING CAPABILITIES:

See above descriptions.

June 1990
FACILITY NO: 1236
FACILITY TITLE: National Transonic Facility (NTF)

FACILITY DESCRIPTION:

The NTF is a cryogenic fan-driven, closed circuit, continuous-flow, pressurized, transonic wind tunnel. The test gas is air or gaseous nitrogen. The fixed-pitch, single-stage fan is used in combination with variable inlet guide vanes to provide the required compressor performance envelope. The test section is 2.5m x 2.5m and 7.62m long with a slotted-wall configuration.

TESTING CAPABILITIES:

The NTF has a Mach number range from 0.2 to 1.2, with Reynolds number up to $120 \times 10^6$ at Mach 1 (based on reference length of 0.25m). The pressure range for the facility is from 1 to about 9 bars and the temperature can be varied from 340K to 78K. The model angle-of-attack range is 30' with a roll capability of ±180'.
National Aeronautics & Space Administration
Langley Research Center

Facilities Data Sheet

FACILITY NO: 1242
FACILITY TITLE: 0.3-Meter Transonic Cryogenic Tunnel

FACILITY DESCRIPTION:

The 0.3-Meter Transonic Cryogenic Tunnel (0.3-M TCT) is a closed circuit, fan driven cryogenic pressure tunnel. The 0.3-M TCT operates over the Mach number range of 0.20 to 0.95 at stagnation temperatures and pressures from 150°F to approximately -300°F and from 1 to 6 atm. respectively. The wide ranges of pressure and temperature allow the study of Reynolds number effects on flow phenomena up to Reynolds numbers of 100 million/ft.

TESTING CAPABILITIES:

The tunnel was placed in operation in 1973 as a three-dimensional pilot tunnel to demonstrate the cryogenic wind tunnel concept at transonic speeds. During more than 15 years of operation, the 0.3-M TCT has run with three different test sections. Currently the facility is operating with an adaptive wall test section which is nominally 13 in square and has an effective length of 55.8 in. This test section has four solid walls with the horizontal walls (floor and ceiling) being flexible. A system of 21 computer controlled jacks support each of the flexible walls. The facility has motorized model support turntables and a traversing wake survey probe, both of which are computer controlled. For two-dimensional testing, the 0.3-M TCT has provisions for both active and passive sidewall boundary-layer control. Porous plates can be fitted into the rigid sidewalls just upstream of the model location.

June 1990
Facilities Data Sheet

FACILITY NO: 1244
FACILITY TITLE: Flight Research Facility

FACILITY DESCRIPTION:

The truss-supported roof of the huge hangar of the Flight Research Facility provides a clear floor space with nearly 300 ft. in each direction (over 87,000 ft²).

Door dimensions will allow entry of a Boeing 747. Features such as floor air and electrical power services, radiant floor heating to eliminate corrosion-causing moisture, a modern deluge fire suppression system, energy-saving lighting, modern maintenance spaces, and entry doors and taxiways on either side of the building make this structure equal or superior to any hangar in the country. Extensive and modern maintenance equipment makes it possible to maintain, repair, and modify aircraft ranging in sophistication from modern metal and composite airliners, fighters, and helicopters to fabric-covered light airplanes. Surrounding the hangar are ramp areas with load-bearing capacity sufficient to handle the largest current wide-body jet. The high-power turn-up area can also handle a wide variety of aircraft.

TESTING CAPABILITIES:

The present array of research and research support aircraft includes an airliner, military fighters, trainers, experimental one-of-a-kind designs, helicopters, and single and multi-engine light airplanes. This variety enables research to be carried out over a wide range of flight conditions, from hover to Mach 2 and from the surface to 50,000 ft. Research pilot currency in this wide spectrum of aircraft is important in conducting credible in-flight experiments as well as in-flight simulator assessments. A variety of research can be conducted in such areas as terminal traffic flow, microwave landing system (MLS) approach optimization, airfoil properties, handling qualities, performance, engine noise, natural laminar flow, winglet studies, stall/spin, and severe storm hazards.

June 1990
Facilities Data Sheet

FACILITY NO: 1247B
FACILITY TITLE: Hypersonic Helium Tunnel Facility
(22-Inch Helium Tunnel)

FACILITY DESCRIPTION:

The test medium, purified helium, is supplied at either ambient temperature (Tw/Tt = 1) or at 1000°F (Tw/Tt = .6) ambient temperature. The facility is composed of two test legs (22-inch aerodynamics leg, open jet fluid mechanics leg), a helium reclamation system, and a 1100 cu. ft, 4500 psia storage bottle field. The reclamation system, a critical, major part of the operation consists of two 60 ft diameter vacuum spheres; a system of parallel and series connected forepumps and blowers for evacuating the spheres; two compressors (100 hp airdox, 150 hp Rix) for compressing the helium to 4500 psia for storage; and a purification system to reduce impurities to 0.005 percent for normal operation. The facility is a blowdown type requiring about 1.5 hrs between runs to recycle the test medium. Run times are normally 20-30 sec. with a limit near 60 sec. Additional vacuum capability provided by two adjoining 60 ft spheres (High Reynolds Number Helium Tunnel spheres) can extend run time to 2 minutes, if necessary. Models are sting mounted to a strut support with angle of attack and sideslip ranges of -5 to 50° and ±5° respectively; bent stings extend this range. The strut is injectable and provides for angle of attack sweeps at constant yaw or yaw sweeps at constant angle of attack through a true angle of attack, yaw drive mechanism. Force and moment data are obtained at discrete angles (using a photo optical system), in a continuous mode at fixed angles, or in a continuous mode continually sweeping. An electron beam illuminates the flow for 3-dimensional flow-visualization studies. Test cores are 8- to 10 in. in diameter. Model size is limited to approximately 6 in. for angles up to 60° and 12 in. up to 30°. Three contoured nozzles (design Mach number = 18, 22, and 26) are available for the 22-inch leg and two nozzles (design Mach number = 22, 40) are available for the open jet leg. A 67 kw resistance heater is in line to provide temperatures to 600°F for heat transfer testing (both legs) and M=40 testing (open jet leg). Only the M=22 nozzle (22-inch leg) is fully calibrated and has been in use for 20 years at a 90 percent occupancy level. A new M=20 nozzle was acquired in 1990 for improved flow quality and a M=15 nozzle will be acquired in 1991 to provide capability between M=10 and 20 (non-existent at the present time). For the foreseeable future the open jet leg is committed to M=18 quiet tunnel research.

June 1990
TESTING CAPABILITIES:

22-Inch Leg - Mach 22 Nozzle

Stagnation Pressure, psia: 300 to 3000
Stagnation Temperature: ambient to 1000°F
Mach Number: 18.3 to 22.2
Reynolds Number, per ft. $1.1 \times 10^6$ to $15 \times 10^6$
Maximum Running Time, sec: 60 to 40
FACILITY NO: 1247B
FACILITY TITLE: Hypersonic Nitrogen Tunnel (Room 109 and the Basement)

FACILITY DESCRIPTION:

High purity liquid nitrogen (LN2) flows from a 4000-gallon storage vessel to a liquid nitrogen conversion unit which pumps the LN2 to pressures up to 8000 psia. The nitrogen exits the conversion unit as a gas, passes into four surge tanks and next passes through a high pressure regulator valve to produce desired stagnation pressures from 2000 to 6000 psia. The test gas flows around the outside of the nozzle to cool the throat region, and is then supplied to the stagnation chamber where the nitrogen is heated to about 3000°F by a 2 MW dc-powered tungsten grid resistance heater. The heated nitrogen is expanded through the nitrogen-cooled nozzle throat section (fabricated of a molybdenum alloy) with a throat diameter of 0.111 in and a 10.5 ft long, water-cooled, axisymmetric, contoured nozzle with a 16 in. exit diameter, into the open-jet test section where a free stream Mach number of 17 is produced. The gas is decelerated by a water-cooled diffuser and passes into a 100 ft vacuum sphere. A quick (0.5 sec injection time) model injection/support system allows the angle of attack to be varied from -15° to +30°, and angle of sideslip between ±15°. The test section is equipped with schlieren windows on both sides. Typical run times are 60 to 90 minutes.

TESTING CAPABILITIES:

Current testing capabilities include the measurements of aerodynamic forces and moments, pressure distributions, heating distributions, performance, stability, and control of advanced aerospace vehicles, flow visualization using an electron beam, nonintrusive density and temperature measurements using an electron beam, and free shear layer surveys.

June 1990
FACILITY NO: 1247D
FACILITY TITLE: 20-Inch Mach 6 Tunnel

FACILITY DESCRIPTION:

This tunnel uses pressurized air as the test medium and an electrical resistance heater to provide air temperature control. The nozzle blocks are two-dimensional and contoured terminating in a test section 20 x 20.5-inches; the usable test core is approximately 16 x 16-inches. The flow exhausts through a movable second minimum either to atmosphere with the aid of an annular ejector or to 60-foot, 41-foot and 100-foot diameter vacuum spheres. A model injection system beneath the facility allows models up to 5-feet long to be rapidly injected into the moving airstream with angle-of-attack and yaw angle variation. A flow probing mechanism with 3-degrees of freedom is available.

TESTING CAPABILITIES:

Range of operating conditions: Total pressure from 25 to 550 psia; total temperature from 800°F to 1000°F; Reynolds number from 0.5 x 10^6 to 10.5 x 10^6 per foot. Run time is approximately 15-minutes to vacuum spheres to atmosphere. Can measure heat transfer, pressures, forces and moments, skin friction, equilibrium temperatures, temperatures, boundary layer and flow profiles and has separate system to provide gases for model engine exhaust simulation.
FACILITY NO: 1247B
FACILITY TITLE: Arc-Heated Scramjet Test Facility (AHSTF)

FACILITY DESCRIPTION:

The facility is an electric-arc-heated blowdown to vacuum facility that provides a true-temperature, true-velocity flow environment for testing hydrogen-burning scramjet engine models. Facility systems include 2-10 MW dc electric power supplies, a 5000 lbf/in² air supply system, a 1400 lb/in² deionized cooling water system, a gaseous hydrogen fuel system, a silane-hydrogen ignitor gas system, a hydraulic model injection system, a 100-ft. diameter vacuum sphere, and a three-stage steam ejector for evacuating the sphere. The test air exhausts from the 11 in. x 11 in. nozzle exit as a free jet into a 4-ft. diameter test cabin.

TESTING CAPABILITIES:

The AHSTF operates up to a stagnation pressure of 45 atmospheres and stagnation temperatures from 1000°F to 5000°F. Two contoured nozzles provide either a test Mach number of 4.7 or 6.1. Typical model sizes are 9.5 in. x 7.5 in. in cross section by 72 in. long. Typical test time is 30 seconds.
FACILITY NO:  1247D
FACILITY TITLE:  M6 High Reynolds Number Tunnel

FACILITY DESCRIPTION:

The test medium is air heated by electric resistance heaters and the tunnel incorporates an axisymmetric-contoured nozzle with a low-flow turning angle to minimize pressure gradient effects on the nozzle wall boundary layer. There are two interchangeable test sections. One test section has schlieren windows and a model injection system capable of injecting 3.5 ft. long models for configuration and heat transfer studies at Reynolds numbers up to 122 million. The other test section is for tunnel-wall boundary-layer studies using heat-transfer skin friction and pitot and total temperature survey measurements over a length of 12 ft. and Reynolds numbers up to 1200 million. The test section diameter is approximately 12 in.

TESTING CAPABILITIES:

This facility is capable of fundamental aerodynamic and fluid dynamic studies over a large Reynolds number range at Mach 6. Major support components are the high pressure air compressor system and the 41- and 60-ft. vacuum sphere systems.

June 1990
FACILITY NO: 1247D
FACILITY TITLE: Mach 8 Variable-Density Tunnel

FACILITY DESCRIPTION:

This tunnel uses pressurized air as the test medium and an electrical resistance heater to provide air temperature control. The nozzle is axisymmetric and contoured and terminates in a test section approximately 18-inches in diameter; the usable test core size is 4-inches to 14-inches depending on pressure. The flow exhausts through a fixed second minimum either to atmosphere or to a 41-foot diameter vacuum sphere. A model injection system beneath the facility allows models up to 27-inches in length to be rapidly injected into the moving airstream with angle-of-attack and yaw angle variation.

TESTING CAPABILITIES:

Range of operating conditions: Total pressure from 15 to 3000 psia; total temperature from 1160°F to 1510°F; Reynolds number from 0.1 x 10^6 to 12 x 10^6 per foot. Run time is approximately 600 sec. to atmosphere and 90 sec. to vacuum. Can measure heat transfer, pressure, force, and flow visualization data.

June 1990
Facilities Data Sheet

FACILITY NO: 1247D
FACILITY TITLE: 20-Inch Supersonic Wind Tunnel

FACILITY DESCRIPTION:

This tunnel operates in a blowdown mode and uses electrically heated air as the test medium. Two Rigimesh plates, nine flow straightening screens and a honeycomb section are located in the settling chamber in order to obtain high quality flow in the test section. The flexible nozzle is 18 in. wide, approximately 16 ft. in length, is shaped with 22 pairs of electrically operated jacks and leads to the 18- by 20-in. test section. The test section has schlieren windows, survey probes and a model support arc sector with range of -10° to 30°. The flow exhausts to vacuum spheres (41-ft, 60-ft, or 100-ft diameter) or to atmosphere.

TESTING CAPABILITIES:

Range of operating conditions: Total pressure from 7 to 130 psia; total temperature from 560 to 660°R; Reynolds number from $1 \times 10^6$ to $20 \times 10^6$ per foot. Mach number varies from 1.4 to 5.0. Run time varies from approximately 5 to 20 minutes. Measurement capability includes forces and moments, pressures, temperatures, boundary layer and flow profiles.

June 1990
FACILITY NO:  1247H
FACILITY TITLE:  Mach 20 High Reynolds Number Helium Tunnel

FACILITY DESCRIPTION:

Blowdown Tunnel with run time of 4.8 sec. using helium as the test medium. Freestream unit Reynolds number variation obtained by changing the stagnation pressure from 2000 to 14,000 kPa. Stagnation temperature is local ambient. Originally the tunnel was comprised of Mach 10 and Mach 20 legs; however, the Mach 10 leg has been removed.

TESTING CAPABILITIES:

For the tunnel stagnation pressure range of 2000 to 14,000 kPa, the freestream Mach number varies from 17 to 18, with a unit Reynolds number range from $7.6 \times 10^6$ to $48.6 \times 10^6$/m. Test core diameter is .51 m and the test section length is 3.05 m. Model can be sting or strut mounted. A sequence of 3 spark schlierens can be taken with adjustable time delay between photographs. Electron beam flow visualization is also available.

June 1990
FACILITY NO:  1251
FACILITY TITLE:  Unitary Wind Tunnel

FACILITY DESCRIPTION:

This is a closed circuit, continuous flow variable density type tunnel with two 4-ft. by 4-ft. by 7-ft. test sections. The tunnel has sliding block type nozzles which allow continuous variation in Mach number while on-line. The facility is equipped with a local dry air supply system (including storage tanks of 47,000 cu. ft. capacity at 150 psia) to assure low dewpoint during tests and a cooling system sufficient to maintain stagnation temperatures down to 100°F. The facility has six centrifugal compressors powered by two drive motors totaling 100,000 hp. The UWT has been in continuous operation since 1955.

TESTING CAPABILITIES:

The facility has a Mach number range from 1.47 to 4.63; maximum Reynolds number per foot varies from $6 \times 10^6$ to $11 \times 10^6$ depending on Mach number (minimum Reynolds number per foot is $\approx 0.5 \times 10^6$). The tunnel is used for force and moment, pressure distribution, jet effects (hot or cold), dynamic stability, and heat-transfer studies. The normal operating temperature is approximately 125°F with heat bursts of 300°F available for heat-transfer studies. Model mounting provisions consist of various sting arrangements, including axial, lateral, and rotary movement and sidewall support. A schlieren system, oil flow visualization and vapor screen are available in both test sections. On-line data are recorded at the facility.
FACILITY NO:  1251A
FACILITY TITLE:  31-Inch Mach 10 Tunnel (Formerly Continuous Flow Hypersonic Tunnel)

FACILITY DESCRIPTION:

This facility was constructed in 1959-1962 and was designed as a blowdown start, continuous running tunnel but since about 1974 has operated only in the blowdown mode. It consists of a 5000 psi 875 ft$^3$ air pressure storage bottleneck; a 12-5-MW electrical resistance two-pass heater; a stagnation chamber; a water-cooled three-dimensional contoured converging, diverging nozzle with a 1.07-inch square throat which expands into a 31-inch square test section; a hydraulically-operated sidewall-mounted model injection/support system with a $\pm 45^\circ$ angle of attack range and a $\pm 5^\circ$ angle of sideslip range; an adjustable water-cooled second minimum and diffuser; an after-cooler; and a vacuum system into which the flow exhausts consisting of two 41-foot diameter spheres (72,000 ft$^3$) and four 750 cfm Beach Russ pumps.

TESTING CAPABILITIES:

This facility provides a very uniform Mach 10 test core of approximately 14 inches square with exceptionally uniform flow in the center six inches. A maximum stagnation pressure of approximately 1800 psi and stagnation temperature of approximately 1400°F yields a free stream Reynolds number of 0.4 -2.4 x 10$^6$/ft. It is used to measure aerodynamic characteristics and performance and aerothermodynamic characteristics of aerospace vehicles including the acquisition of forces and moments, pressure distributions, temperature distributions, and flow field characterization. Maximum run times are approximately 60 seconds.

June 1990
Facilities Data Sheet

FACILITY NO: 1257 - 1262
FACILITY TITLE: Aircraft Landing Dynamics Facility

FACILITY DESCRIPTION:

In 1985, the Landing Loads Track was updated to the Aircraft Landing Dynamics Facility (ALDF) to improve the capability for low-cost testing of wheels, tires, and advanced landing systems. The main features of the updated facility are the propulsion system, arresting gear system, high-speed carriage, and track extension. In 1988, the capability of ALDF was enhanced by the addition of a Rain Simulation System (RSS). The ALDDF-RSS is a 500 ft. long, 44-ft.-wide overhead distribution system comprised of three parallel 10-in. diameter irrigation pipes aligned lengthwise along the track and supported every 100 ft. at a height of 42 ft. above the track. The RSS can be configured with as many as 1590 nozzles and can simulate rainfall intensities as high as 40 in./hr.

TESTING CAPABILITIES:

The ALDF uses a high-pressure water jet system to propel the test carriage along the 2800 ft. track. The propulsion system consists of an L-shaped vessel that holds 28,000 gal. of water pressurized to 3150 lb./in.² by an air supply system. A timed quick-opening shutter valve is mounted on the end of the "L" vessel and releases a high-energy water jet, which catapults the carriage to the desired speed. The propulsion system produces a thrust of $2 \times 10^6$ lb. force, which is capable of accelerating the 108,550-lb. test carriage to 220 knots within 400 ft. This thrust creates a peak acceleration of approximately 20 g. The carriages coast through the 1800-ft. test section and decelerates to a velocity of 175 knots or less when it intercepts the five arresting cables that span the track at the end of the test section. The arresting system brings the test carriage to a stop in 600 ft. or less. Essentially any landing gear can be mounted on the test carriage, including those exhibiting new concepts, and any runway surface and weather condition can be duplicated on the track.

June 1990
FACILITY NO: 1265
FACILITY TITLE: 8-Ft. High-Temperature Tunnel

FACILITY DESCRIPTION:

This is a blowdown-type facility which achieves the required energy level for flight simulation by burning methane in air under pressure and using the resulting combustion products as the test medium. The nozzle is a conical-contoured, axisymmetrical design with an exit diameter of 8 ft. Model mounting is semi-span or sting with insertion after the tunnel is started. A single-stage air ejector is used as a downstream pump to permit low-pressure or high-altitude simulation.

TESTING CAPABILITIES:

Stagnation Temperature 2400°-3800°R
Combustor Stag. Press. 500-3500 psia
Mach 4, 5, 5.8 to 7.5
Static Temperature 300°-500°R
Dynamic Press. 160 to 2000 psf

RN/ft 0.3 x 10⁶-3.0 x 10⁶
Testing time 15-140*sec.
*at stag press of 2200 psia
Max. model diameter:
    hemispherical - 24 in.
    streamlined - 40 in.

June 1990
FACILITY NO: 1267
FACILITY TITLE: Thermal Structures Laboratory

FACILITY DESCRIPTION:

The facility consists of 3 Electric arc heater units and 2 test sections that are connected to a vacuum system. The 2 dc arc units (a 20 Megawatt Modified Thermal Dynamics Arc Heater) can be utilized on the "A" test section and the ac arc unit can utilized only on the "B" test section. These Arc Heater Facilities produce high temperature and high velocity flows that can be used to simulate the environments for evaluation of the performance of the thermal-protection.

TESTING CAPABILITIES:

<table>
<thead>
<tr>
<th>Parameter Range</th>
<th>20 Mw Arc Heater</th>
<th>5 Mw Arc Heater</th>
<th>1 Mw Arc Heater</th>
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<tr>
<td></td>
<td>Body of Rev</td>
<td>Panel</td>
<td>Body of Rev</td>
</tr>
<tr>
<td>Arc Chamber Pressure, Atm</td>
<td>3-18.5</td>
<td>1-18.5</td>
<td>2.5-5.0</td>
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<tr>
<td>Enthalpy, Btu/lbm/1000</td>
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<td>1.0-5.5</td>
<td>6.3-2.0</td>
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<td>Mass Flow Rate, lb/sec</td>
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<td>4.2-25</td>
<td>0.5-2.0</td>
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<td>Nozzle Exit Dia, in</td>
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<td>6</td>
<td>6</td>
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<tr>
<td>Model Pressure, Btu/sq. ft. sec</td>
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<td>.03-1.9</td>
<td>.04-1.0</td>
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<tr>
<td>Heat Transfer Rate, Btu/sq. ft. sec</td>
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<td>6-48</td>
<td>10-250</td>
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<tr>
<td>Specimen Dia/size, in</td>
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<td>5x5</td>
<td>3</td>
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<tr>
<td>Nozzle Exit Dia, in</td>
<td>12</td>
<td>12</td>
<td>9</td>
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<tr>
<td>Model Pressure, Atm</td>
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<td>.009-06</td>
<td>.02-5</td>
</tr>
<tr>
<td>Heat Transfer Rate, Btu/sq. ft. sec</td>
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<td>6-150</td>
<td>1-10</td>
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<tr>
<td>Specimen Dia/size, in</td>
<td>6</td>
<td>14x25</td>
<td>4.5</td>
</tr>
</tbody>
</table>

June 1990
FACILITY NO: 1268
FACILITY TITLE: Data Reduction Center

FACILITY DESCRIPTION:

This facility provides a major portion of centralized capability for the processing and computation of data for research programs conducted by LaRC. It includes large-scale digital computers capable of handling a variety of problems in the areas of experimental data reduction, analytical and engineering studies, and real-time simulation. It also contains the capability for central digital recording of data from 20 remotely-located ground test facilities, for the transcription of data collected and recorded on magnetic tape at remote stations, for data plotting and display, and for "open shop" commuting from remote terminals connected to the digital computers.

Central recording for model testing is provided by underground lines connecting analog transducer signals to 21 test sites. Remote terminals for "open shop" computing are located at 20 different sites at the Center, and are connected to the central computers by standard telephone lines.

TESTING CAPABILITIES:
Facilities Data Sheet

FACILITY NO:  1268A
FACILITY TITLE:  Flight Simulation Laboratory
(General-Aviation Simulator)

FACILITY DESCRIPTION:

The General-Aviation Simulator (GAS) consists of a general-aviation aircraft cockpit mounted on a three-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 side-stick 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 cathode-ray tube (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 60° field-of-view out-the-window color display. The visual system can accept inputs from a terrain model board system and a computer-generated graphics system. The simulator is flown in real time with a CDC CYBER 175 computer to simulate aircraft dynamics.

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.

TESTING CAPABILITIES:

See above description.

June 1990
FACILITY NO: 1268A
FACILITY TITLE: Visual Motion Simulator

FACILITY DESCRIPTION:

The Visual Motion Simulator (VMS) is a general-purpose simulator consisting of a two person cockpit mounted on a six-degree-of-freedom synergistic motion base. A collimated visual display provides 60° out-the-window color display for both left and right seats. The visual display can accept inputs from several sources of image generation. A programmable hydraulic-control loading system is provided for column, wheel, and rudder in the left seat. A second 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 the right seats. An observer's seat was installed in 1986 to allow a third person to be in the cockpit during motion operation.

A realistic center control stand was installed in 1983 which, 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 VMS 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 is provided which can be interchanged between the left and right seats to augment the motion cues from the base.

TESTING CAPABILITIES:

See above description.
Facilities Data Sheet

FACILITY NO: 1268A
FACILITY TITLE: Differential Maneuvering Simulator

FACILITY DESCRIPTION:

The Langley Differential Maneuvering Simulator (DMS) provides a means of simulating two piloted aircraft operating in a differential mode with a realistic concept 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 projectors to provide a realistic terrain scene and a system for target image generation and projection. 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 one or two other (target) vehicles in six degrees of freedom.

The target image presented to each pilot represents aircraft being flown by the other pilot in this two-aircraft simulator. This dual simulator can be tied to a third dome and can provide three aircraft interactions when required. Each cockpit provides three color displays with a 6.5-in. square viewing area and a wide-angle head-up display. 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. Other controls include a side arm controller, dual throttles, and a rotorcraft collective.

TESTING CAPABILITIES:

See above description.

June 1990
FACILITY NO: 1275  
FACILITY TITLE: Hypersonic CF₄ Tunnel

FACILITY DESCRIPTION:

Tetrafluoromethane (CF₄) gas stored in a high pressure bottlefield passes through a pressure regulator and then through two molten lead bath heaters in parallel where the CF₄ is heated to 1000°F. The heated gas then flows through an in-line particle filter (10 microns) and into the settling chamber where a maximum pressure of 2500 psia may be attained. Flow is expanded through a contoured, axisymmetric nozzle having a throat diameter of 0.446 in. and an exit diameter of 20 in., and designed to produce a Mach number of 6 at the exit. The flow exhausts from the nozzle into the open-jet test section, is then collected and decelerated by the diffuser, and passed through a water cooled heat exchanger and collected in two vacuum spheres having a combined volume of 72,000 ft³. Run time is limited to about 30 seconds. The CF₄ is reclaimed using a liquid nitrogen recovery system. The hydraulic model injection/support system allows the angle of attack to be varied from -10° to +50° and angle of sideslip between ±5°. The CF₄ test gas yields a normal shock density ratio of about 12 which simulates real-gas effects encountered during entry of blunt vehicles into Earth and other planetary atmospheres.

TESTING CAPABILITIES:

Current testing capabilities include the measurement of aerodynamic forces and moments, pressure distributions, heating distributions, performance, stability, and control of advanced aerospace vehicles, and flow visualization using holographic interferometry or schlieren.
Facility Data Sheet

FACILITY NO: 1293B
FACILITY TITLE: Spacecraft Dynamics Laboratory

FACILITY DESCRIPTION:

This laboratory is designed to carry out research on spacecraft and aircraft structures, equipment and materials. It offers controlled environmental conditions, including acceleration, thermal radiation and vacuum. Available actuation and excitation equipment includes several types of small shakers. All areas are monitored by closed circuit television and are hard-wired to data acquisition and processing equipment. A 128 channel digital signal processing system is available along with on-line test controllers. A variety of auxiliary data logging and signal processing equipment is also available.

TESTING CAPABILITIES:

16 Meter Thermal Vacuum Chamber: Has a 55-ft. diameter cylinder with a removable 5-ton crane, a 64-ft. high hemispherical dome peak, and a flat floor. Access is by an air-lock door and an 18-ft. high by 20-ft. wide test door. There are ten 10-in. diameter view ports, randomly spaced for visually monitoring. A vacuum level of 10 torr can be achieved within 160 minutes. A centrifuge can be attached to the floor of the chamber that is rated at 20,000-lbs. Temperature gradients of 100°F are obtained from 250 sq. ft. of portable radiant heaters and liquid nitrogen cooled-plates.

Main Laboratory: The dominant feature is a 38-ft. high back-stop of I-beam construction. Test areas available around this facility are 15- x 35- x 38-ft. high and 12- x 123- x 95-ft. high.

Space Structures Research Laboratory: It is an open room with nominal dimensions of 72- x 84- x 84-ft. high. There is a work platform 73-ft. above the floor made with removable planks. In one corner there is a 12- x 12-ft. back-stop. There is a full environmental control system and many platforms accessible for viewing and instrumentation.

June 1990
FACILITY NO: 1293C
FACILITY TITLE: Composite Materials Laboratory

FACILITY DESCRIPTION:

The Composite Materials Laboratory of the Langley Research Center is a 25,000 square foot, two story facility in which research is performed on high performance, fiber reinforced composites made from novel polymers. The broad scope of the research includes polymer synthesis, analytical chemistry, and preparation and evaluation of films, adhesives, moldings and composites. The facility houses chemical laboratories with fume removal hoods, a wide variety of analytical instruments, testing machines for adhesives, molding and composites, and areas for prepreg and composite preparation.

TESTING CAPABILITIES:

The Composite Materials Laboratory provides the capability for synthesis and characterization of novel polymeric materials, the conversion of these polymers into films, adhesives, moldings and ultimately fiber reinforced composites and the mechanical testing of these materials. The facility provides the ability to test a material from the test tube through its development into a final composite structure. All the necessary equipment for chemical, physical and mechanical testing of these novel materials is available.

June 1990
Facilities Data Sheet

FACILITY NO: 1297
FACILITY TITLE: Impact Dynamics Research Facility

FACILITY DESCRIPTION:

This facility, which was originally used by the astronauts during the Apollo Program for simulation of lunar landings, has been modified to simulate crashes of full-scale aircraft under controlled conditions. The aircraft was swung by cables, pendulum-style, into the concrete impact runway from an A-frame structure approximately 400 ft. long and 230 ft. high. The impact runway can be modified to simulate other ground crash environments, such as packed dirt, to meet a specific test requirement.

TESTING CAPABILITIES:

Each aircraft is suspended by swing cables from two pivot points 217 ft. off the ground. It is then pulled back along an arc to a predetermined height by a pullback cable from a movable bridge on top of the A-frame, released from the pullback cable, and allowed to swing, pendulum-style, into the ground. An instant before impact, the swing cables are separated from the aircraft by pyrotechnics. The length of the swing cables regulates the aircraft impact angle from 0° (level) to approximately 60°. Impact velocity can be varied to approximately 65 mph (governed by the pullback height) and to 90 mph with rocket assist. Variations of aircraft pitch roll, and yaw can be obtained by changes in the aircraft suspension harness attached to the swing cables. Onboard instrumentation data are obtained though an umbilical cable attached to the top of the A-frame. Data are transmitted by hard wire to the control room at the base of the A-frame. Photographic data are obtained by onboard cameras, ground-mounted cameras, and cameras mounted on top of the A-frame. The maximum allowable weight of the aircraft is 30,000 lb.

June 1990
FACILITY NO: 1299
FACILITY TITLE: Electromagnetic Scattering Laboratory (ESL)

FACILITY DESCRIPTION:

The ESL will be constructed adjacent to the Experimental Test Range (ETR), Building 1299F, and will be a combination three story building and large high-bay laboratory area, shielded enclosure, approximately 150 ft. wide x 200 ft. long x 70 ft. high. In addition to the RF shielded chamber, the facility will include laboratory space for model handling and storage; computer equipment space for model positioning, control, and data collection/reduction; and limited office space for researchers. ESL will be a controlled-access laboratory with independent environment control and security systems. The facility will also provide a model handling area for ETR with access between the respective model handling areas of ESL and ETR.

TESTING CAPABILITIES:

The proposed ESL will provide a research laboratory for advancing the technology of indoor electromagnetic (EM) measurement systems and for conducting electromagnetic research for aerospace applications. The enhanced indoor measurements capability is essential for research programs in high performance aircraft, aircraft antenna design, large spacecraft antenna experiments, volumetric communication coverage for space station, electromagnetic code development and re-entry microwave sensors. This facility will be a shielded enclosure that will contain a dual compact reflector system.

June 1990
FACILITY NO:  
FACILITY TITLE:  Research Support Building

FACILITY DESCRIPTION:

This facility will provide for two 2-story research support buildings of approximately 60,000 gross square feet each. Research Support Building No. 1 will be located on the wooded site which faces Ames Road in the proximity of existing Building 1250 (Environmental and Space Sciences Lab.). Research Support Building No. 2 will be located on the partially cleared site between Buildings 1208 and 1298. Interior space utilization is characterized by only office and office-like automation/work stations, which is approximately three-quarters desked-type space and one-fourth office support space. The support space will house computer system operations and conference rooms. The computer systems areas are normal computer-room-type construction with no special considerations other than isolated power, grounding and air conditioning requirements, as required.

TESTING CAPABILITIES:

None

June 1990