The Flying Laboratory: A Very Valuable Aircraft

Some of the advanced technology testing that used the 737 from 1974-1994 included:

- **Electronic Flight Displays:** Boeing 757/767 aircraft have cathode ray tube electronic attitude indicators and horizontal situation displays. The technology was developed and first demonstrated on the Langley B-737 research aircraft.

- **Microwave Landing Systems (MLS):** Flights were conducted with the Federal Aviation Administration (FAA) evaluating MLS performance as a precision landing guidance system. As a result of joint flight demonstrations, the U.S. MLS system was adopted as the international standard approach and landing guidance system.

- **Precision Flare Control:** Aircraft landing-flare control computations, developed and flight tested to tighten touchdown area, demonstrated that improved touchdown accuracy could reduce time aircraft remains on runway.

- **Profile Descent Program:** Flights were conducted to evaluate the aircraft descent procedures from high altitude using automation to achieve efficient descent paths for fuel and time savings.
When the 737 arrived at Langley in May 1974, it had been painted to fit NASA's specifications complete with its number N515. Dozens of research projects were accomplished using the unique capabilities of the Langley 737.

- **Wing Surface Coating:** Joint program with Boeing evaluated advanced paints for improved laminar flow over wing surfaces.
- **Digital Autonomous Terminal Access Communications (DATAAC):** Joint program with Boeing developed, flight tested and demonstrated practical use of an onboard computer network to communicate between aircraft electronic flight systems. NASA/Boeing DATAAC system adopted as industry standard.
- **Runway Friction Program:** Tests were conducted to improve and predict aircraft ground handling performance on slippery runways during bad weather.
- **Precision Guidance: “Airport ’85”:** Joint program with U.S. Air Force required unique guidance capability to verify that proposed approach path to new Denver airport would not affect critical satellite link of Air Force communications system.
- **Total Energy Control System (TECS):** Joint program with Boeing validated new computations to improve fuel efficiency during climb and descent maneuvers.
- **Takeoff Performance Monitoring System (TOPMS):** Display formats, computations and alerts were developed and demonstrated to improve information available to the crew for assessing aircraft takeoff performance.
- **Helmet Mounted Display:** Joint program with McDonnell Douglas Aircraft Co. conducted flight tests of new display concepts applicable to advanced high-speed vehicles without conventional windshields.
- **Airborne Information Transfer System:** Flight tests were conducted to evaluate the benefits of using electronic data link, vs. voice, as primary communications system between aircraft and air traffic control.
- **GPS (Global Positioning Satellite) Performance Evaluation:** Joint program with Honeywell assessed GPS performance for self-sufficient landing guidance system for proposed orbital manned return vehicle and for commercial aircraft applications.
- **Engine Monitoring & Control System:** Engine display format developed and tested by NASA improved aircrew awareness of engine status when conditions are abnormal.
- **Airborne Wind Shear Sensors:** With industry participation, joint program with FAA developed and flight tested airborne wind shear detection sensors. Langley B-737 flight tested five wind shear measurement technologies. The wind shear hazard index, developed as part of the flight program, is the industry measurement standard and basis for FAA certification.
- **Advanced High-Lift Technologies:** Flight test data will validate new NASA computer fluid flow and wind tunnel techniques for developing advanced wing designs.
- **Optical Propulsion Management Interface System:** Joint program with McDonnell Douglas flight tested and evaluated use of fiber optic lines as communication link between pilot and engine.
Langley’s Space-Related Projects Make News This Year

BY CATHARINE G. SCHAUER

Langley space-related projects are making the headlines this calendar year, as researchers see the results of their efforts flying on a shuttle or gaining recognition in a variety of ways as ongoing projects.

MAPS, the Latest

MAPS (Measurement of Air Pollution from Satellites), which calculates the global distribution of carbon monoxide in the free troposphere, flew on Shuttle Endeavour April 9. Because of MAPS’ previous flights on-board shuttle, Earth system scientists now know that carbon monoxide concentrations in the troposphere are highly variable around the planet, and that widespread agricultural burning in the South American Amazon region and the African savannas are major global sources of carbon monoxide in the troposphere.

During two dedicated Earth Observing space shuttle missions, in April and mid-August, MAPS will measure the distribution of carbon monoxide in the middle troposphere to evaluate CO the first time lidar will be operated in space to study the atmosphere.

The LITE system, developed by Langley, is a testbed for the development of technology required for future operational spaceborne lidars. It employs a three wave-length Nd:YAG laser and a one-meter-diameter collecting telescope. LITE data will also be useful in improving current spaceborne sensor measurement retrieval algorithms and in developing parameters of these atmospheric phenomena for use in global climate models.

New information which LITE will provide on the distribution and characteristics of clouds will increase America’s understanding of its role in the global climate system. LITE will also provide information on aerosols in the atmosphere derived from both human and natural activity. Millions of tons of particulates are suspended in the atmosphere as a result of activities such as biomass burning, volcanic eruptions, wind erosion and the use of internal combustion engines. These aerosols are currently believed to have the potential to reduce the Earth’s albedo, and Gas Experiment II (SAGE II). ERBE non-scanner radiometers measuring total and shortwave solar energy continue to be operational on the Earth Radiation Budget Satellite, which was launched in 1984, and on two NOAA operational satellites launched in 1984 and 1986. These data are important in advancing our understanding of the Earth’s radiation balance and in studying large-scale climate anomalies such as El Ninos and volcanic eruptions.

The SAGE II instrument, also launched on ERBE in 1984, measures aerosols, clouds, and trace gases (O3, H2O, and NO2) in the troposphere and lower stratosphere using solar occultation techniques. The SAGE II data continue to be used to provide inputs for global climate models and in studies of important atmospheric phenomena such as ozone depletion and disturbance of motion from volcanic eruptions.

OARE Prepares for Reflights

Langley’s OARE (Orbital Acceleration Research Experiment) is working on designs for access to space. The study, conducted under the auspices of NASA Headquarters, examined three launch system options that would provide the nation’s required payload delivery capability until 2030. The first option looked at upgrading the shuttle, the second examined a conventional technology expendable launch vehicle and the third studied the potential of applying advanced technology to reusable launch vehicle design. Langley was active in the development of the second and third options. The Access-to-Space study concluded that current launch operations costs could be reduced by designing a new, operationally efficient launch system with advanced technologies. Studies in this area are underway to refine the cost and sensitivities models to allow more refined technology trade studies.

Video Section Honored

The Video Section recently received an Award of Merit in the 1994 Society for Technical Communication (STC) competition in the Information for External Audiences category. Mike O’Harra was the producer for the award-winning production, chosen from more than 100 entries. The video is entitled “Leading Edge Vortex-System Details Obtained on F-106B Aircraft Using Rotating Vapor Screen and Surface Techniques.”

According to Frank Ziegler, manager of the video competition for STC, entrants in the 1994 international contest represented all members of the society, the International Television Association and filmmakers from 22 states and Canada.

The video is a supplement to NASA TP-3374.

Retirement Dinner for George Palko

A retirement dinner for George F. Palko will be held June 22, from 6 to 9:30 p.m., at the H.E. Reid Conference Center. The social will begin at 6 p.m., and dinner will be served at 6:45 p.m. A cash bar will be available. The cost is...
troposphere to evaluate CO sources and chemistry as well as evaluate the seasonal variation of this key atmospheric trace gas. Interpretation of the data will help scientists understand the consequences of human activities in global climate change.

The MAPS instrument was originally built by TRW Space Technology Group of California. It later underwent extensive changes and modifications by Langley engineers.

LITE Slated for September

Langley is preparing to launch its Lidar In-Space Technology Experiment (LITE) in September 1994 aboard STS-64, Discovery. The project will detect stratospheric and tropospheric aerosols, probe the planetary boundary layer and measure cloud top heights. Lidar (light detection and ranging) is a remote sensing technique which can be used to study clouds and aerosols in the atmosphere with very high vertical resolution. Lidar is similar to radar except that very short pulses of light produced by a laser are used instead of radio frequency pulses. The LITE mission is to have the potential to reduce the extent of greenhouse warming experienced by Earth. LITE will help study the distribution and sources of these particulates.

HALOE Still Flying

Langley continues to manage the Halogen Occultation Experiment (HALOE) aboard the Upper Atmosphere Research Satellite (UARS). HALOE is obtaining high resolution (2-3 km) measurements of the vertical distributions of ozone, key trace gases (HCl, HF, NO, NO2, CH4, and H2O), aerosols and temperature that will provide a better understanding of the chemistry and dynamics of the middle atmosphere. The experiment is unique in that measurements of HF (whose only source is chlorofluorocarbons, CFCs), taken simultaneously with HCl (a measure of the stratospheric chlorine), permit differences of the anthropogenic contribution of chlorine from that due to natural sources (chlorine is a major catalyst in the destruction of ozone).

ERBE and SAGE

Ongoing Langley activities include the Earth Radiation Budget Experiment (ERBE) and the Stratospheric Aerosol Acceleration Research Experiment (SAGE). ERBE measures drag forces in orbit and during early stages of re-entry into the atmosphere. It flew on its fourth mission in March 1994. OARE can measure absolute acceleration levels to an accuracy never before achievable on the orbiter. The measurements will be used to predict aerodynamic and other forces on future missions.

Another OARE mission is planned in 1994 on Columbia, where the experiment will be adapted to support shuttle international microgravity laboratory (ILM-2) research.

The Orbiter Experiments Program (OEP), which began in the 1970s, had its first shuttle flight in 1981, and concluded with the OARE experiment on STS-58 in 1993. It used the shuttle as a testbed to measure orbiter aerodynamic performance during flight. OEP flight data have enabled NASA to validate its aeroelastic design methods for shuttle-class hypersonic vehicles. These methods include new, hypersonic wind tunnel testing techniques and state-of-the-art computational fluid dynamics (CFD).

In an effort to develop a less costly launch system for use to and from Space Station, LDEF will be available. The cost is $14.50 per person, including the gift. For reservations or gift contributions, please contact Gloria S. Evans, ext. 44570, or Linda F. McKnight, ext. 44572, Mail Stop 481, by June 15. Please make checks payable to Gloria S. Evans.

Retirement Party for Joyce Tracy

A retirement social for Joyce F. Tracy will be held at the Langley Officers' Club, Wednesday, June 8, 1994, from 5-8 p.m. The cost is $13 per person, which includes heavy hors d'oeuvres and a gift contribution. A cash bar will be available. Contributions for gift only are welcome. Please send checks payable to Effie Nicosia (M/S 185, ext. 42394) for reservations and gift donations by June 1, 1994.

Mark Your Calendars – An Open House will be held Saturday, July 16, in recognition of the Apollo 25th Anniversary
Volunteers Recognized as Vital Resource
Community Service Central to Being Good Neighbor

BY MARNY SKORA

"Covering the news gives me the opportunity to see firsthand what's going on in the local area," said Terry Zahn, WVEC-TV news anchor and featured speaker at the recent volunteer recognition program. "Covering the news also makes me very aware of the needs in our community," Zahn told the audience of more than 125 employees.

Zahn also passed along some startling statistics:

- for first time in eight years, income of a typical U.S. household dropped
- the number of people in poverty in the U.S. rose for first time in seven years
- one in every sixteen U.S. families is on welfare
- there are 36 percent more female-headed families in the 1990s than in the 1980s

And, locally, Zahn reported, the need is just as vital. Our population has grown 15 percent in the past decade. Median household income continues to fall. Our local economy, traditionally fed by government jobs and government contractors, is threatened by cutbacks. And,

"Langley's Community Service program is the strongest in NASA," Holloway reported. "That's because of your immediate response to our community's needs, because of your generosity and your propensity to 'get involved' and because of your ability to get to the root of a problem and offer a solution."

Holloway recognized members of Langley's Speakers Bureau and Operation Communication, those who participated in the United Way's Day of Caring and in Langley's National Engineers Week school visitation program and those who volunteer on their own—whether in their child's school, their church or a community organization.

"Look around and see the power we possess to counteract what's wrong in the world—or at least in our own community," Holloway said. "Thank you for stepping up to serve our neighbors."

Shulman presented Holloway with a memento of the 1993-94 Combined Federal Campaign, congratulating him on his efforts.

Center Director Paul F. Holloway, right, presents WVEC-TV-13 news anchor Terry Zahn with a Langley photo. Zahn was the featured speaker at the first of what will be an annual Community Service Recognition Program.

U. S. Savings Bonds — A Good Investment

No one said it would be easy to be a parent, but one part of parenthood can be made easier. Saving for college with U.S. Savings Bonds is an easy way to make sure the money is there by the time your child goes to college.

U.S. Savings Bonds are affordable, secure, guaranteed to grow, and they offer tax advantages. The interest they earn is free from state and local taxes, and federal income tax payments can be deferred until the bonds are redeemed.

For more information, contact Langley's 1994 Campaign Coordinator for the U.S. Savings Bond drive Jim Ogiba, ext. 42075, or write: U.S. Savings Bonds for Education, Department of the Treasury, Washington, D.C. 20226. For a recorded message of current rate information, call 1-800-4US BOND.

Langley Offers Buyouts: 47 Accept
Langley Offers Buyouts: 47 Accept

In March, Congress passed the long-awaited Federal Workforce Restructuring Act of 1994, which authorized agencies to offer incentive payments or “buyouts” to encourage employees to resign or retire voluntarily. In response to passage of the Government-wide buyout legislation, Langley received a total of 222 applications for the separation incentive. Of the 64 Center employees (those who were eligible for an early out or managers and supervisors) were offered the buyouts, 47 accepted and 17 declined these offers. Employees could separate as soon as they received official notification from the Office of Human Resources that their application was accepted but no later than May 3, 1994. This will be the only time that buyout will be offered at NASA under the current legislation which expires March 31, 1995.

The 47 who left as of May 3 are: Robert M. Baucum, Richard G. Booth Jr., Richard M. Boykin Jr., Walter E. Bruce Jr., David F. Caplan, Michael F. Cavelli, Scarlett E. Coffey, Joseph B. Davenport Jr., Dariene D. DeRyder, Jarrell R. Elliott, Emily J. Evans, Joyce E. Fly, Ilona G. Gambill, Jack E. Harris,


Retired in Style: Forty-seven Langley employees retired Tuesday, May 3. Probably no one received the tremendous send-off that Gerald F. Hill, a physicist in the Aerospace Electronic Systems Division, received. A 40-car entourage, flags flying, and the sounds of cheers and horns created quite an audience as Hill was escorted out the gate in a white limousine, thus ending his 32-year NASA career.

To receive a copy of the Agency Community Service brochure or a volunteer survey form, call the Office of Public Services, ext. 43309.
The 737 Celebrates 20 Years as NASA's Flying Laboratory

Since it first entered the NASA inventory in 1974, NASA 515 has been a testbed for research for many issues affecting aircraft safety, efficiency and capacity. Called an "airborne trailblazer," it goes beyond the typical research facility in that it demonstrates new concepts in real-world situations.

Government and industry decision makers could observe first-hand as research pilots used innovations in computer-generated display formats and content while interacting with air traffic controllers in a busy terminal area. Others experienced flying through potentially hazardous wind shears to prove that advance-warning devices really can give pilots precious extra seconds to avoid hazardous weather. As a result, this flying laboratory and its supporting facilities have been responsible for rapid adoption of new aviation technology by U.S. industry.

NASA 515 is the first B-737 built. Originally used by Boeing to qualify the 737 for airline service, the prototype 737 has since been heavily modified by NASA. It has two cockpits, a conventional B-737 forward cockpit providing operational support and safety backup, and an operational research flight deck positioned behind what was the first-class cabin section. Behind the research cockpit, in place of seating, are rows of computer consoles and data collection stations where researchers monitor real-time flight results.

This national facility has been maintained and flown by Langley as part of the Center's Terminal Area Productivity (TAP) program.

The Wind Shear Flight Tests, an oil painting by John Clark, depicts Langley's 737 flying home after penetrating a wind shear over Orlando, Fla. Because of the research conducted by Langley's team, all airline passengers will travel in the future without the threat of aviation's largest weather hazard.

NASA B-737
Facts and Figures

• THE PROTOTYPE BOEING 737

• DATE OF MANUFACTURE: 1967

• FIRST FLIGHT: April 3, 1967
ARRIVED AT LANGLEY:
May 17, 1974

COST TO NASA:
$2.2 million

DESCRIPTION:
Twin-engine, short-range transport

TOTAL FLIGHT HOURS:
- Upon arrival at Langley: 978
- As of May 8, 1994: 2,966

GROSS TAKEOFF WEIGHT: 97,800 lbs.

CRUISING SPEED:
575 mph

RANGE: 2,140 statute miles

CEILING: 35,000 ft.