



# NEWS RELEASE

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## T NASA TO LAUNCH AIR DENSITY EXPLORER

The National Aeronautics and Space Administration will launch a polka-dotted 12-foot diameter spherical satellite from the Pacific Missile Range, Pt. Arguello, Calif., no earlier than December 19.

The inflatable sphere, which is called Air Density Explorer, will be launched by a Scout vehicle. The mission is similar to that of Explorer IX which was flown by NASA from Wallops Island, Va., in 1961.

The near-polar orbit sought is an ellipse inclined 78.5 degrees to the equator with a perigee of about 375 miles, an apogee of about 1,875 miles. At these altitudes, the satellite would circle the Earth every 122 minutes.

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Covered with aluminum, the fragile sphere will be visible to the naked eye under twilight conditions. Scientists estimate it will have the brightness of a third magnitude star at perigee.

✓ The major objectives of this mission are:

1. To extend upper atmosphere air density studies to the polar regions and to determine density and temperature of the atmosphere at various latitudes.

Although the density of the Earth's atmosphere diminishes rapidly at high altitudes, there are enough gas molecules to cause resistance or drag to spacecraft moving through them.

Information about high altitude air density is gathered by measuring the slight variations in satellite orbits. Lightweight satellites of large size such as the Air Density Explorer are ideal instruments for making such measurements since they are extremely sensitive to any resistance they encounter in space.

2. To measure flight performance of the new X-258 fourth stage of the Scout launch vehicle.

A package of instrumentation will be carried in a rack on top of the fourth stage to monitor flight environment and performance of the stage -- such things as shock, vibration,

chamber pressure, temperature and acceleration.

The X-258 is a solid stage and normally Scout project officials must rely on the orbit achieved by a launch to determine its performance. In early Scout developmental flights, the predecessor X-248 fourth stage was instrumented to determine its flight characteristics.

With detailed environmental data on the new X-258, Scout project officials will be able to more accurately predict for future launches the performance of this stage in injecting spacecraft into orbit.

Additional information on performance characteristics also may make possible some relaxation in spacecraft environmental standards and testing. In addition to increased performance, the X-258 is a smoother burning stage than the X-248 and spacecraft will not be required to withstand such high vibration levels.

In addition to these two major objectives, this mission will test out recent modifications to Scout's third stage hydrogen peroxide control system. Some additional instrumentation is being carried by the third stage to monitor the control system environment and performance.

This is the first in a series of three planned launches of Air Density Explorers. In the following two launches, scheduled for next year, an Injun Explorer will be flown along with the inflatable sphere.

Both the spacecraft and launch vehicle are programs of NASA Headquarters Office of Space Science and Applications directed by Dr. Homer E. Newell. Project management for both the Explorer and Scout is by the NASA Langley Research Center, Hampton, Va. The fourth stage instrumentation was designed and built by the NASA Goddard Space Flight Center, Greenbelt, Md. The Scout will be launched by the U.S. Air Force 6595th Aerospace Test Wing.

#### Air Density Experiment

Existing knowledge of the Earth's atmosphere and its density at extreme altitudes has been in the main gathered from observations of satellite orbit variations. Although the density of the atmosphere diminishes rapidly as one moves away from the Earth's surface, enough gas molecules are sparsely distributed at heights of 300 to 500 miles above the surface to provide very small amounts of resistance to spacecraft moving through them. The proper term for such resistance is drag, and, like any other

physical property, it can be measured accurately only by instruments especially suited to the job.

The 12-foot light-weight, inflatable sphere is considered ideal for drag measurement at the fringe of the atmosphere. It is very large and its mass is quite small, making it very sensitive to the small quantities of drag it is intended to measure. Furthermore, its spherical shape means the same area always is exposed to atmosphere.

With the exception of Vanguard I, Echo I, Explorer IX, and Explorer XVII, all of which were round, satellite drag measurements gathered so far have been obtained from non-spherical spacecraft whose orientation at the time they passed through perigee was unknown. Assumptions therefore had to be made in calculating the density of the atmosphere with some loss of precision.

One previous inflatable satellite experiment -- Explorer IX -- orbited by NASA on Feb. 16, 1961, from Wallops Island, provided sensitive measurements needed for a better understanding of the upper atmosphere. Like the forthcoming experiment, Explorer IX is a 12-foot spherical satellite whose orbit has been carefully tracked for nearly three years. Among the important scientific findings from it is that the density of the

Earth's upper atmosphere undergoes a decrease by a factor of ten or more as the solar minimum is approached in apparent rhythm with the 11-year solar cycle and there is a very high sensitivity of atmospheric density and temperature to small solar events.

In mid-November, Explorer IX had a perigee of 250 miles, an apogee of 1,450 miles, and was circling the Earth every 113 minutes. The orbit is inclined about 40 degrees to the equator. Explorer IX is expected to reenter the lower atmosphere and burn up early next year.

The orbit planned for this Air Density Explorer will cover almost twice the Earth's surface and extend existing knowledge of the atmosphere into regions not previously surveyed. Air densities in the regions near the poles are particularly interesting to scientists because charged particles -- electrons and protons -- may only enter the atmosphere in polar regions because of the Earth's magnetic field. Although solar radiation -- ultraviolet radiation from the Sun -- is the main atmospheric heating source, these energetic particles can contribute importantly to atmospheric heating in high latitudes.

Comparison of data from this satellite and Explorer IX obtained at the same time will permit scientists to evaluate the contribution of energetic particles to heating effects in high

latitudes and in low latitudes where the effects are caused mainly by solar radiation.

### Tracking

The world-wide NASA STADAN network (Satellite Tracking and Data Acquisition Network) will track the Air Density Explorer using a beacon mounted inside the 12-foot sphere. The tracking beacon will be turned on when the folded satellite is ejected from its container and will operate at a frequency of 136.62 megacycles. The world-wide Baker-Nunn camera network operated by the Smithsonian Astrophysical Observatory will obtain all possible optical sightings of the spacecraft and it is expected that highly accurate measurements of orbital changes can be obtained by combining the results of both methods.

Scientists of the Langley Research Center will determine the mean atmospheric density and its systematic variations from the orbital elements and the sightings of the Air Density Explorer obtained by the tracking of the spacecraft by both the NASA Goddard Space Flight Center and the Smithsonian Astrophysical Observatory. The systematic variations to be studied include density changes related to latitude, variations between day and night, seasonal changes, altitude variations and variations due

to solar rotation and to the 11 year solar cycle. The Smithsonian Astrophysical Observatory will investigate non-systematic density changes with particular emphasis on solar disturbances that also manifest their influence on the Earth by magnetic field fluctuations.

### Air Density Spacecraft

The Air Density Explorer spacecraft, like Explorer IX, is an inflatable structure built up of four alternating layers of 1/2 mil thick aluminum foil and 1/2 mil polyester film known as Mylar. (A mil is one thousandth of an inch). The inner layer is plastic; the outermost is aluminum foil which reflects both sunlight and radio waves. It was built by technicians of the Langley Center who bonded together 40 flat gores of the aluminum-Mylar sandwich to form a sphere. In order to make the sphere serve as its own radio antenna, it is separated into halves by a strip of plastic. Temperature control is provided by painting a series of white dots on the outer surface, giving the spacecraft a polka-dot appearance.

A tracking beacon is placed inside the skin of the satellite, diametrically opposite a group of nickel-cadmium batteries which form a part of the power supply. Four groups of solar cells protected from radiation damage by quartz windows are located on the outer surface of the satellite. The energy they gather when

the satellite is in sunlight will recharge the storage batteries and provide electrical power to operate the tracking beacon. All the elements of the beacon electrical system are interconnected by ribbon wire.

### Operational Sequence

The deflated Mylar-aluminum foil satellite is folded accordion-fashion and carefully fitted inside a metal tube eight and one half inches in diameter and about 19 inches long, mounted on an adapter section attached to the forward face of the fourth stage of the launch vehicle. Behind the folded satellite is an ejection bellows and a steel inflation bottle containing nitrogen gas compressed to 1,800 pounds per square inch. The adapter section also contains the instruments and telemetry to report on the flight performance of the X-258 fourth stage rocket motor.

After burnout of the fourth stage motor and while the spacecraft container and the fourth stage are spinning at approximately 180 rpm, a timer will activate squibs to open the valve on the nitrogen bottle. Compressed nitrogen flows immediately into the ejection bellows, which expand to push the folded 12-foot sphere out of its cylindrical container. A wire cable limits the distance the folded satellite can move beyond the payload container, and when the cable becomes taut, the inflation gas

passes through a disconnect mechanism, thereby inflating the satellite. Inflation has the effect of slowing the spin rate of the satellite. When pressure in the bellows decreases to a selected value, the disconnect mechanism releases the satellite from the payload container and a separation spring imparts energy to move the satellite away from the payload container. After separation, the nitrogen inflation gas is immediately allowed to escape through the open valve stem, reducing the internal pressure to that of the space environment. The aluminum-Mylar sandwich structure is sufficiently rigid to maintain the spherical shape even after the inflation gas leaves the 12-foot sphere.

#### Launch Vehicle

The basic Scout launch vehicle is a multi-stage, guided booster using four solid propellant rocket motors capable of carrying payloads of varying sizes on orbital, space probe or reentry missions. Developed by the Langley Research Center, the Scout is currently the only operational solid propellant launch vehicle with orbital experience.

The four Scout motors, Algol, Castor, Antares, and Altair, are interlocked with transition sections that contain the guidance, control ignition, instrumentation system, separation mechanisms, and the spin motors needed to orient the fourth stage. Guidance is provided by an autopilot and control achieved by a combination

of aerodynamic surfaces, jet vanes, and hydrogen peroxide jets. Scout is approximately 72 feet long and weighs approximately 40,000 pounds at lift off.

The Scout is capable of placing a 240 pound payload into a 300 mile orbit or carrying a 100 pound scientific package approximately 7,000 miles away from Earth. Launching sites are now operational on both coasts of the United States for polar or east-west orbital launches. Scout is employed extensively for small space research payloads by the NASA, Department of Defense, and for international programs. The Langley Center provides Scout project management services.

The instruments and associated telemetry to monitor fourth stage performance were provided by the Goddard Space Flight Center.

#### Project Participants

The following scientists and engineers have had active roles in the development of the Air Density Explorer:

#### NASA HEADQUARTERS

Dr. Homer E. Newell, Associate Administrator for Space Science and Applications; Dr. John E. Naugle, Director, Geophysics and Astronomy Programs, OSSA; Dr. Robert F. Fellows, Program Scientist; Raymond Miller, Program Engineer; R. D. Ginter, Small Vehicles Program Manager, OSSA; and Warren E. Guild, Scout Program Manager.

LANGLEY RESEARCH CENTER

William J. O'Sullivan, Jr., principal scientist; Gerald M. Keating, associate scientist; Claude W. Coffee, Jr., project manager-mission director; William A. Carmines, Technical project engineer; Charles V. Woerner, Air Density Explorer engineer; Eugene D. Schult, head, Scout Project Office; James R. Hall, director of Scout project operations; and James D. Church, Langley launch vehicle field director.

GODDARD SPACE FLIGHT CENTER

James A. Nagy, X-258 performance vibration engineer; and Robert W. Conrad, X-258 performance telemeter engineer.

SMITHSONIAN ASTROPHYSICAL OBSERVATORY

Dr. Luigi Jacchia, scientific investigator.

PACIFIC MISSILE RANGE

William H. Evans, Director, NASA Pacific Launch Operations Office; Dean Crowder, Langley vehicle test director at PMR; Lt. Col. H. M. Sloan, USAF 6595th Aerospace Test Wing launch control officer.