

Commercial Space Transportation

QUARTERLY LAUNCH REPORT

Special Report:

U.S. Small Launch Vehicles



1st Quarter 1996

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U.S. SMALL LAUNCH VEHICLES

1995 was an ambitious and difficult year for the United States small launch vehicle market. A total of five small launch vehicles were launched from the United States, two of which were successful (Atlas E and Pegasus 1) and three of which resulted in failure (Pegasus XL, LMLV, and Conestoga). A total of four payloads were successfully deployed.

Note that a small launch vehicle is defined as one capable of lifting no more than 5,000 pounds to low earth orbit. See the table below for a summary of currently operational U.S. small launch vehicles.

Three of last year's five launches were commercial launches (Pegasus 1, LMLV, and Conestoga). Last year, two new U.S. small launch vehicles were introduced: Lockheed's LMLV and EER's Conestoga. The initial flights of both these vehicles resulted in failure.

Industry analysts predict that the drive for wireless mobile communication systems, like Iridium and Globalstar, will significantly increase demand for small launch vehicles over the next ten years.

Atlas E

An Atlas E was launched on March 24, successfully orbiting a military meteorological satellite for the Defense Meteorological Satellite Program (DMSP). The DMSP 5D-3-F15 was manufactured by Lockheed Martin Astro Space.

The March 24 launch was the last and the 26th consecutive successful launch of the Atlas E booster. There are no remaining Atlas E launch vehicles in the U.S. Air Force inventory.

Pegasus 1

Orbital Sciences Corporation's Pegasus 1 flight on April 3 successfully orbited two small Orbcomm communications satellites as well as a NASA scientific payload. The Orbcomm commercial communications satellites, Orbcomm FM1 and FM2, were the first two satellites to be deployed as part of the Orbcomm 26 satellite constellation. The Orbcomm system will provide customers with mobile data communication services. NASA's Microlab 1, a scientific satellite, will study the distribution of lightning on Earth. All three payloads were manufactured by Orbital Sciences Corporation.

Another Pegasus 1 launch is scheduled for April 1996. It will orbit the Miniature Sensor Technology Integration satellite, MSTI-3, for the Department of Defense. The satellite is being manufactured by Spectrum Astro.

Pegasus XL

Orbital Sciences Corporation experienced its second launch and its second failure of the Pegasus XL on June 22. The payload was the Space Test Experiments Platform (STEP) 3 for the Department of Defense. The military payload was lost when the military range safety officer destroyed the vehicle after detecting an in-flight anomaly 148 seconds into the mission. Preliminary analysis indicated that the interstage clamping ring failed to release properly after the jettison of the first stage and obstructed the second stage motor. The payload was manufactured by TRW.

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The XL increases the Pegasus's LEO capacity from 635 lbs. To 840 lbs.

Two additional Pegasus XL launches are scheduled to take place during the next two quarters. In February, the Pegasus XL is scheduled to orbit the REX 2, a military satellite which will measure electron density irregularities in the ionosphere. REX 2 is being manufactured by CTA Space Systems for the Rome Laboratory. In June, another Pegasus XL will orbit NASA's Total Ozone Mapping Spectrometer satellite, TOMS-1. The TOMS spacecraft is being manufactured by TRW.

Lockheed Martin Launch Vehicle (LMLV)

The maiden flight of the Lockheed Martin Vehicle (LLV), recently renamed the Lockheed Martin Launch Vehicle (LMLV), on August 15 was terminated in mid-flight after uncontrolled oscillations of the rocket were detected. This resulted in the loss of the vehicle and the payload. There is speculation that the cause of mishap was guidance system failure coupled with overheating of the booster's first stage steering mechanism. The payload on board was GEMstar 1, a small communications satellite manufactured by CTA, Inc. for the Volunteers in Technical Assistance (VITA), a non-profit organization.

The LMLV is currently slated to launch the Lewis and Clark satellites, two NASA science payloads, scheduled for June (Clark) and July (Lewis) of this year.

NASA Administrator, Dan Goldin, announced in September that all new rockets must first complete a successful test flight before they can carry any NASA payloads. However, it was announced in December that NASA will not require a demonstration

flight of the LMLV prior to Lewis and Clark flights.

Conestoga

The Conestoga 1620 launch on October 23, 1995 resulted in failure, disintegrating in midair 46 seconds after launch. This was the maiden flight of the Conestoga 1620 and was the first orbital rocket launched out of NASA's Wallops Flight Facility in 10 years. EER Space Systems, Conestoga's manufacturer, concluded that low frequency noise from an unknown source upset the guidance system on the rocket, causing it to order course corrections when none were needed. The rocket went off course when its first stage steering mechanism ran out of hydraulic fluid and became inoperable. EER Space Systems, NASA, and the Department of Transportation are currently conducting an investigation of the October Conestoga failure.

The destruction of this flight resulted in the loss of the Multiple Experiment Transporter to Earth Orbit and Return payload (METEOR 1, formerly the Commercial Experiments Transporter, COMET 1) and the 14 microgravity experiments on board. METEOR 1 was to be a recoverable payload, designed for on-orbit microgravity experiments advancing commercial applications of materials processing and medical research. The launcher and the spacecraft were designed and developed commercially over a five-year period with NASA and private funding.

New U.S. Small Launch Vehicles

In the area of new small launch vehicles, McDonnell Douglas plans to develop a smaller derivative of its Delta 2 rocket called Delta-Lite. The three stage Delta-Lite would be able to launch 1,985 to 2,540

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kilograms to equatorial low Earth orbit. McDonnell Douglas is developing Delta-Lite as one part of NASA's Med-Lite procurement, awarded to the McDonnell Douglas-Orbital Sciences Corporation team in March 1995. The Med-Lite contract covers five launches of NASA payloads starting in 1998. Other launch vehicles to be used under the Med-Lite program include a three strap-on booster version of the Delta 2 and OSC's Taurus launch vehicle. Delta-Lite's first payload will be NASA's Far Ultraviolet Spectroscopic Explorer (FUSE), scheduled for launch in fall 1998.

Lockheed Martin last year began design work on a three-stage version of the Lockheed Martin Launch Vehicle called the LMLV-2. The new rocket builds on the

design of the two-stage LMLV-1 but will be capable of lofting payloads in the 1,800 kilogram-range rather than the LMLV-1's 900-kilogram range.

Other small launch vehicles currently proposed or in development in the United States include Pac Astro's PA-2 launch vehicle, Kistler's K-1 launch vehicle, Microcosm's Scorpius launch vehicle, and E'Prime Aerospace Corporation's Eagle S launch vehicle. A number of U.S. launch vehicle families are also currently being expanded, including EER Space Systems' Conestoga, Orbital Sciences Corporation's Taurus and Pegasus, and Lockheed Martin Corporation's MSLS launch vehicle families.

U.S. Operational Small Vehicles	Manufacturer	Pounds to LEO Orbit
Atlas E	Lockheed Martin Corporation (General Dynamics)	1750 lbs.
LMLV 1	Lockheed Martin Corporation	1800 lbs.
MSLS A*	Lockheed Martin Corporation	300 lbs.
Conestoga 1620	EER Space Systems	2600 lbs.
Pegasus 1	Orbital Sciences Corporation	635 lbs.
Pegasus XL	Orbital Sciences Corporation	840 lbs.
Taurus 1	Orbital Sciences Corporation	3000 lbs.

*Scheduled for 1st Quarter 1996 sub-orbital launch