Atlas V Launch Incorporated NASA Glenn Thermal Barrier

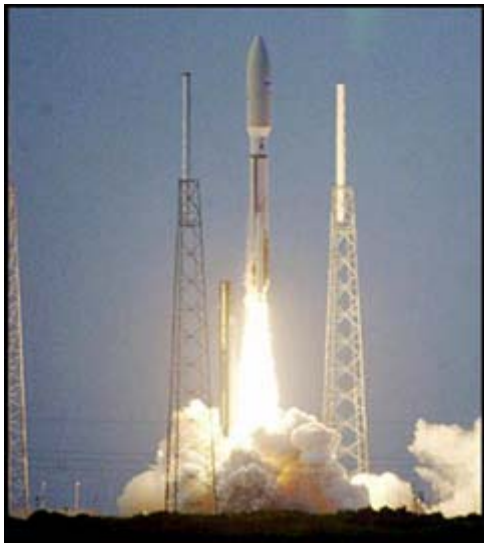
5500 °F oxyacetylene torch flame on braided carbon-fiber thermal barrier during testing at Glenn.

In the Spring of 2002, Aerojet experienced a major failure during a qualification test of the solid rocket motor that they were developing for the Atlas V Enhanced Expendable Launch Vehicle. In that test, hot combustion gas reached the O-rings in the nozzle-to-case joint and caused a structural failure that resulted in loss of the nozzle and aft dome sections of the motor. To improve the design of this joint, Aerojet decided to incorporate three braided carbon-fiber thermal barriers developed at the NASA Glenn Research Center (see the preceding photograph). The thermal barriers were used to block the searing-hot 5500 °F pressurized gases from reaching the temperature-sensitive O-rings that seal the joint. Glenn originally developed the thermal barriers for the nozzle joints of the space shuttle solid rocket motors, and Aerojet decided to use them on the basis of the results of several successful ground tests of the thermal barriers in the shuttle rockets.

Aerojet undertook an aggressive schedule to redesign the rocket nozzle-to-case joint with the thermal barriers and to qualify it in time for a launch planned for the middle of 2003. They performed two successful qualification tests (Oct. and Dec. 2002) in which the Glenn thermal barriers effectively protected the O-rings (see the next photograph). These qualification tests saved hundreds of thousands of dollars in development costs and put the Lockheed-Martin/Aerojet team back on schedule.

Final qualification test of the Aerojet solid rocket motor with Glenn thermal barriers installed (Dec. 11, 2002).

On July 17, 2003, the first flight of an Atlas V boosted with solid rocket motors successfully launched a commercial satellite into orbit from Cape Canaveral Air Force Station (see the final photograph). Aero-jet's two 67-ft solid rocket boosters performed flawlessly, with each providing thrust in excess of 250,000 lbf. Both motors incorporated three Glenn-developed thermal barriers in their nozzle-to-case joints. The Cablevision satellite launched on this mission will be used to provide direct-to-home satellite television programming for the U.S. market starting in late 2003.



Atlas V boosted by two Aerojet solid rocket motors incorporating Glenn thermal barriers (July 17, 2003).

The Atlas V is a product of the military's Enhanced Expendable Launch Vehicle program designed to provide assured military access to space. It can lift payloads up to 19,100 lb to geosynchronous transfer orbit and was designed to meet Department of Defense, commercial, and NASA needs. The Atlas V and Delta IV are two launch systems being considered by NASA to launch the Orbital Space Plane/Crew Exploration Vehicle. The launch and rocket costs of this mission are valued at $250 million. Successful application of the Glenn thermal barrier to the Atlas V program was an enormous breakthrough for the program's technical and schedule success.

Find out more about this research:
Structural seals and thermal barriers at
http://www.grc.nasa.gov/WWW/structuralseal/
High-temperature, flexible, fiber perform seal at
http://www.grc.nasa.gov/WWW/structuralseal/InventYr/1996Inv_Yr.htm
Glenn's Mechanical Components Branch at
http://www.grc.nasa.gov/WWW/5900/5950/

Reference

1. Steinetz, B.M.; and Dunlap, P.H.: Development of Thermal Barriers for Solid Rocket Motor Nozzle Joints. J. Propul. P. (NASA/TM--1999-209278), vol. 17, no. 5, 2001, pp. 1023-1034. http://gltrs.grc.nasa.gov/cgi-bin/GLTRS/browse.pl?1999/TM-1999-209278.html

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