

Determining atmospheric composition

Commemorating Kitty Hawk

A good precedent for debris mitigation

# AEROSPACE

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2023

# YEAR-IN-REVIEW



## Solid rocket boosters enable solid progress in space exploration

BY CLYDE E. CARR JR.

The **Solid Rockets Technical Committee** studies techniques applied to the design, testing and modeling of rocket motors based on solid propellant grains.



**T**he year's top achievements in space would not have been possible without **solid rocket boosters**. These boosters were crucial to missions including cargo resupply, lunar exploration, satellite deployment, flight and static tests.

In terms of industry dynamics, propulsion maker **Aerojet Rocketdyne** in July was acquired by **L3 Harris**.

In the area of launch vehicles, **Japan** in January launched an **H-IIA** rocket, equipped with SRBs, placing the **IGS-Radar 7 satellite** into orbit. In September, another **H-IIA** was launched, carrying the **SLIM, Smart Lander for Investigating the Moon**. **China** was equally active, launching several SRB-based rockets throughout the year, including two three-stage **Kuaizhon-1A** rockets in January and July; and in April, a four-stage **Hyperbola-1**, a four-stage **Kinecta-1** and a three-stage **Gushenxing-1**. In July, the **Indian Space and Research Organization** launched a **Launch Vehicle Mark-4 M4** rocket equipped with two SRBs for its **Chandrayaan-3** moon mission. Those SRBs boosted the **Vikram lander** and **Pragyan rover** to orbit, setting up their August landing on the lunar south pole. ISRO also conducted various satellite launches, further solidifying its role in space exploration. August also marked the final launch of an **Antares 230+**, featuring a **Northrop Grumman Castor 30 SRB** second stage, which sent a **Cygnus** spacecraft to orbit to dock with the **International Space Station**. And in July, the final **Ariane 5** was launched, carrying the **Syracuse 4B** and **Heinrich Hertz communications satellites** into orbit. Since its debut in 1996, the Ariane 5 design has been launched 117 times.

SRBs also played a large role in flight testing. In March, the **U.S. Missile Defense Agency** and the **U.S. Navy** conducted the **Flight Test Aegis Weapon System 31 Event 1a**, intercepting a medium-range ballistic missile target during its terminal phase with an Aerojet Rocketdyne solid-fueled **Standard Missile-6 Dual II** rocket. Later in October, two ballistic missile targets were intercepted by two multistaged solid-fueled **SM-3** missiles launched from the USS Levin at the Pacific Missile

Range Facility in Hawaii. In April, the **U.S. Air Force and Navy** jointly launched an unarmed **Minuteman III** intercontinental ballistic missile from Vandenberg Space Force Base in California, showcasing a reliable and effective nuclear deterrent as the vehicle impacted near the Marshall Islands. May marked the fifth successful flight of the U.S. Navy's **AGM-88 G Advanced Anti-Radiation Guided Missile-Extended Range**, which detected and engaged a land-based emitter target. Also in May, a Lockheed Martin **PAC-3 Missile Segment Enhancement** interceptor was fired from a German-modified **M903** launcher at White Sands Missile Range in New Mexico, demonstrating missile and launcher compatibility. In June, the **U.S. Navy** launched an unarmed **Trident II D5** life-extension missile off the coast of southern California — the 190th successful flight of a Trident since 1989. In July, the **Air Force and Raytheon** live fired an **AIM-120D-3 Advanced Medium Range Air-to-Air Missile** from an F-16, completing developmental and operational testing of the design.

In May, **Northrop Grumman** completed the first static test of the **Sentinel stage-one SRB** in Promontory, Utah. In June, **Aerojet Rocketdyne** conducted the first static testing of an **eSR-19** advanced large solid rocket motor, a crucial component for the next generation of **Medium Range Ballistic Missile** targets. In July, **NASA** announced progress in testing the solid rocket motors for its **Mars Ascent Vehicle**, a rocket in development for the **Mars Sample Return** mission. **Northrop Grumman** static fired the motors for the MAV first stage at the Air Force Research Laboratory's California facility and the second stage motor at the company's Elkton, Maryland, facility.

These missions made possible by SRBs underscore the progress made in launch technology, and the missions still in development may expand our knowledge of the cosmos. The future of space exploration shines brighter than ever, with endless possibilities lurking along the horizon. ★

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▲ A development motor based on one that will power the second stage of NASA's Mars Ascent Vehicle was tested in March at Northrop Grumman's facility in Elkton, Maryland. Part of the NASA-European Space Agency Mars Sample Return mission, the MAV would be the first rocket fired off another planet.

NASA