NASA tests 3D-printed, rotating detonation rocket engine

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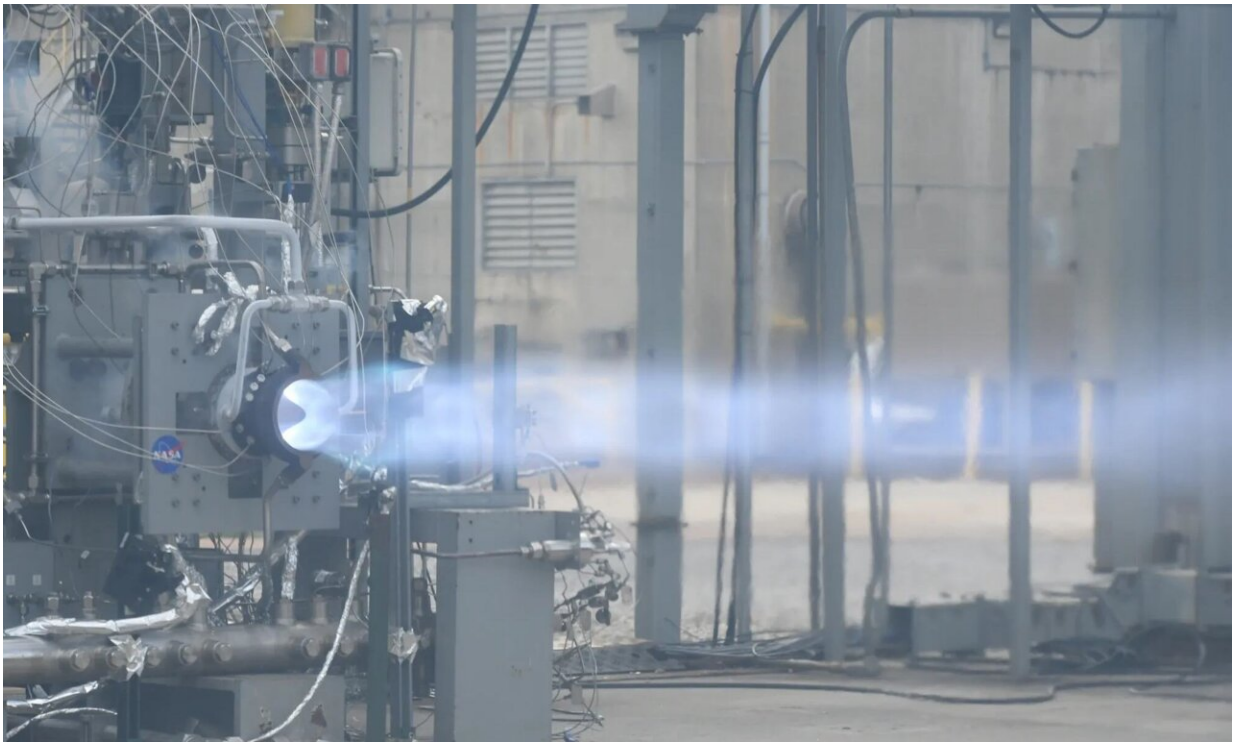

Engineers at NASA's Marshall Space Flight Center in Huntsville, Alabama, conduct a successful, 251-second hot fire test of a full-scale Rotating Detonation Rocket Engine combustor in fall 2023, achieving more than 5,800 pounds of thrust. Credit: NASA

Looking to the future, NASA is investigating several technologies that will allow it to accomplish some bold objectives. This includes returning

to the moon, creating the infrastructure that will let us stay there, sending the first crewed mission to Mars, exploring the outer solar system, and more. This is particularly true of propulsion technologies beyond conventional chemical rockets and engines. One promising technology is the rotating detonation engine (RDE), which relies on one or more detonations that continuously travel around an annular channel.

In a recent hot fire test at NASA's Marshall Space Flight Center in Huntsville, Alabama, the agency achieved a new benchmark in developing RDE technology. On September 27, engineers successfully tested a 3D-printed rotating detonation rocket engine (RDRE) for 251 seconds, producing more than 2,630 kg (5,800 lbs) of thrust.

This sustained burn meets several mission requirements, such as deep-space burns and landing operations. NASA recently shared the footage of the RDRE hot fire test as it burned continuously on a test stand at NASA Marshall for more than four minutes.

While RDEs have been developed and tested for many years, the technology has garnered much attention since NASA began researching it for its "moon to Mars" mission architecture. Theoretically, the engine technology is more efficient than conventional propulsion and similar methods that rely on controlled detonations. The first hot fire test with the RDRE was performed at Marshall in the summer of 2022 in partnership with advanced propulsion developer In Space LLC and Purdue University in Lafayette, Indiana.

During that test, the RDRE fired for nearly a minute and produced more than 1,815 kg (4,000 lbs) of thrust. According to Thomas Teasley, who leads the RDRE test effort at NASA Marshall, the primary goal of the latest test is to understand better how they can scale the combustor to support different engine systems and maximize the variety of missions they could be used for. This ranges from landers and upper-stage engines

to supersonic retropropulsion—a deceleration technique that could land heavy payloads and crewed missions on Mars. As Teasley said in a recent NASA press release:

"The RDRE enables a huge leap in design efficiency. It demonstrates we are closer to making lightweight propulsion systems that will allow us to send more mass and payload further into deep space, a critical component to NASA's moon to Mars vision."

Meanwhile, engineers at NASA's Glenn Research Center and Houston-based Venus Aerospace are working with NASA Marshall to identify ways to scale the technology for larger mission profiles.

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