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Complexities of the Indian Hypersonic Missile Test

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Introduction

On January 27, 2023, India tested the Hypersonic Technology Demonstrator Vehicle (HSTDV) for the third time.[1] The HSTDV is a missile powered by a scramjet engine. It has a speed of Mach 6. The program is in charge of the DRDO. As per the Ministry of Defence (MoD) statement in 2020, the HSTDV is basically a hypersonic cruise missile.[2] Hypersonic cruise missiles are missiles that are very difficult to detect because they have the capability to maintain high speeds (Mach 6-10) at low altitudes, while being manoeuvrable.

Understanding the Origin of Hypersonic Flight

The first time a missile flew faster than Mach 5 was on February 24, 1949. This missile was an old V-2 rocket, which had been mounted with a WAC Corporal second-stage rocket. Its launch was conducted from White Sands, a proving ground in New Mexico.[3] It achieved a high speed of 5150 miles per hour while it entered back into the atmosphere. With the 1950s setting in, intercontinental ballistic missiles were flying at speeds of Mach 25. The speed was noted when the nose cones were tested for entry. In the 1950s, special focus was given by the US to hypersonic glide vehicle development, but at that point in time, the technology had not matured enough. By the beginning of the 21st century, countries like Russia and China started working on hypersonic weapons with higher determination than ever before.

On April 12, 1961, Russian cosmonaut Yuri Gagarin[4] became the first human being to go around the Earth in the form of an orbit. Hence, he experienced a hypersonic flight at Mach 25 while the entry phase was on. By the end of 1961, the X-15 hypersonic research aircraft had, for the first time, exceeded Mach 5 during its flight.[5] X-15 was only for research purposes; it was not intended to have warfighting abilities. So, it basically collected data to support the design of future combat vehicles.[6] During 1969 and the 1970s, the Apollo lunar-return vehicles reached a speed of Mach 36 while entering the Earth's atmosphere. In India, scientists developed the re-entry vehicles of AGNI-I, which entered back into Earth at hypersonic speeds of Mach 12.[7] The AGNI-I was successfully tested in May 1989.[8]

Technological Attributes of HSTDV

In 2019, the DRDO tested the HSTDV for the first time.[9] VK Saraswat, the former DRDO chief, had said in 2008 that demonstrating the performance of scramjet engines at an altitude of 15-20 km was

the aim.[10] Saraswat had also predicted in 2008 that under this project, we would develop a hypersonic missile powered by a scramjet engine.[11]

A scramjet engine is defined as an engine conducting combustion inside a ramjet engine at supersonic speeds. Similar to a ramjet engine, a scramjet engine carries the fuel in the missile, it uses air for oxidization, and then compresses the air forcefully, which comes into the intake at supersonic speed (before it enters the combustion chamber). It is important to highlight that the ramjet engine slows down the velocity of air to subsonic velocities (speeds less than 340 m/s) before combustion takes place; on the other hand, the airflow in a scramjet is supersonic from the start till the end. Therefore, the engine only starts after the hypersonic missile is released at a certain speed. For example, on June 12, 2019, the AGNI-I in the form of a booster rocket carried the HSTDV. DRDO in a statement said[12] that the "missile was launched successfully" and that the data collected would be used to "validate critical technologies". In another test on September 7, 2020, India tested the scramjet-powered HSTDV.[13] After sustained combustion at hypersonic speeds for 20 seconds, the hypersonic cruise vehicle achieved a velocity of 2 km per second. According to the MoD statement, "the critical events like fuel injection and auto ignition of scramjet demonstrated technological maturity". According to the MoD, the scramjet engine performed exactly as per textbook knowledge.[14]

Conclusion

A missile of this nature will compress the observe, orient, decide, act (OODA) lloop of India's adversaries, giving them little time to react. It is not possible to intercept this missile, as no credible technology has yet been developed worldwide for intercepting hypersonic missiles. Radar can detect these hypersonic missiles, but only when the missile is about to reach its intended target. So current command and control systems across the world are unable to track it in order to scrutinize data for intercepting it. Due to the high speeds of a hypersonic missile, a plasma cloud is created due to air pressure in the front section of the missile. This absorbs all radio waves, making it untraceable by radar systems.

As of now, India's HSTDV is going through the rigours of testing. It is too early to predict when it comes to what form of deterrence the HSTDV would take vis-à-vis the two nuclear-armed adversaries of India. This is because it is unknown whether or not the HSTDV will be a conventional-tipped or a nuclear-tipped missile. However, it is clear that this hypersonic cruise missile would be a game-changer for India.

NOTES:

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[7] APJ Abdul Kalam with Arun Tiwari, "Wings Of Fire", Universities Press, 1999, Page 138.

[8] Ibid, Page 151

[9] Snehesh Alex Philip, "DRDO test-fires futuristic missile test, but its success is in doubt", *The Print*, June 12, 2019, https://theprint.in/defence/drdo-test-fires-futuristic-missile-tech-but-its-success-is-in-doubt/249386/. Accessed on February 11, 2023.

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[11] Ibid

[12] Philip, n9.

[13] PIB, n2.

[14] Ibid