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ISRO Hot-Tests Indigenous Semi-Cryogenic Engine

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WHY IN NEWS

The Indian Space Research Organisation (ISRO) successfully conducted the 8th hot test of its indigenous Semi-Cryogenic (https://ujiyari.com/vocab/cryogenic/) engine, reaching about 175 tonne thrust, at the ISRO Propulsion Complex (IPRC), Mahendragiri, Tamil Nadu. The test was carried out around June 24, 2026 and reported on June 27.

THE SEMI-CRYOGENIC ENGINE PROGRAMME

The test was performed on the **Semi-Cryogenic Power Head Test Article (PHTA)**, a sub-assembly used to validate the engine's most complex rotating and combustion components before full-engine qualification. In this hot test, the engine reached **175 tonne thrust, roughly 88 per cent of its rated capacity**, a significant step in the development cycle.

The programme is led by ISRO under Chairman **V. Narayanan**, and the testing is conducted at the **ISRO Propulsion Complex (IPRC)** in Mahendragiri, Tamil Nadu.

Test at a Glance

PARAMETER	DETAIL
Test article	Semi-Cryogenic Power Head Test Article (PHTA)
Test number	8th hot test
Thrust reached	About 175 tonne (~88% of rated)
Facility	ISRO Propulsion Complex (IPRC), Mahendragiri, Tamil Nadu
Propellant	ISROSENE (refined kerosene) + Liquid Oxygen (LOX)
Date	Around June 24, 2026

SEMI-CRYOGENIC VS CRYOGENIC VS HYPERGOLIC

Rocket engines are classified by the propellants they burn:

- **Semi-cryogenic engines** use a refined kerosene called **ISROSENE** as fuel and **Liquid Oxygen (LOX)** as the oxidiser. The kerosene is stored at normal temperatures, while only the oxygen needs to be kept very cold.
- **Cryogenic engines** use **Liquid Hydrogen (LH2)** and Liquid Oxygen (LOX), both stored at extremely low temperatures.
- **Hypergolic engines** use toxic, storable propellants such as **Unsymmetrical Dimethylhydrazine (UDMH)** and **Nitrogen Tetroxide (N2O4)**, which ignite on contact.

Semi-cryogenic engines deliver **higher thrust** than hypergolic stages and are far **greener**, since ISROSENE and LOX are non-toxic and avoid the hazardous handling associated with UDMH and N2O4.

WHY IT MATTERS FOR INDIA'S HEAVY-LIFT FUTURE

The semi-cryogenic engine is designed to power the **Next Generation Launch Vehicle (NGLV)**, India's planned heavy-lift rocket intended to carry far larger payloads to orbit than the current fleet. A high-thrust kerosene-LOX booster stage is essential for lofting heavy satellites and supporting human spaceflight infrastructure.

This capability ties directly into India's flagship missions: the **Gaganyaan** human spaceflight programme and the **Bharatiya Antariksha Station (BAS)**, India's planned space station targeted for around 2035. Reliable, high-thrust and economical propulsion is a prerequisite for sustaining such ambitious long-term goals.

ANALYSIS AND WAY FORWARD

Mastering semi-cryogenic propulsion places India among a small group of nations capable of building high-thrust, low-toxicity booster engines. The progressive hot-test campaign, now in its 8th iteration and approaching rated thrust, reflects a methodical, risk-managed development path.

The way forward lies in completing full-engine qualification at 100 per cent rated thrust, integrating the engine into the NGLV stage, and demonstrating reusability features that can lower launch costs. Continued indigenous development of propulsion technology reduces dependence on foreign engines and strengthens India's strategic autonomy (https://ujiyari.com/terms/strategic-autonomy/) in space.

UPSC RELEVANCE

GS Paper 3: Achievements of Indians in science and technology, indigenisation (https://ujiyari.com/vocab/indigenisation/) of technology, and space technology.

Prelims pointers: Semi-cryogenic uses ISROSENE (kerosene) plus LOX; cryogenic uses LH2 plus LOX; PHTA is the Power Head Test Article; tested at IPRC Mahendragiri; intended for the Next Generation Launch Vehicle (NGLV); ISRO Chairman V. Narayanan; Bharatiya Antariksha Station targeted around 2035.

Mains question: "Indigenous propulsion technology is the backbone of a self-reliant space programme. In this context, examine the significance of ISRO's semi-cryogenic engine for India's heavy-lift and human spaceflight ambitions." (15 marks, 250 words)

FACTS CORNER

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Test: 8th hot test of the Semi-Cryogenic Power Head Test Article (PHTA), around June 24, 2026.

Thrust: About 175 tonne, roughly 88 per cent of rated capacity.

Facility: ISRO Propulsion Complex (IPRC), Mahendragiri, Tamil Nadu.

Propellant: ISROSENE (refined kerosene) plus Liquid Oxygen (LOX), non-toxic and high-thrust.

Contrast: Cryogenic uses LH2 plus LOX; hypergolic uses toxic UDMH plus N_2O_4.

Application: Next Generation Launch Vehicle (NGLV) for heavy payloads.

ISRO Chairman: V. Narayanan.

Context: Supports Gaganyaan and the Bharatiya Antariksha Station (BAS), targeted around 2035.

Sources: Indian Space Research Organisation (https://www.isro.gov.in), Press Information Bureau (https://pib.gov.in), The Hindu (https://www.thehindu.com).

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