Hypersonic Technology Demonstrator Vehicle

drishtiias.com/printpdf/hypersonic-technology-demonstrator-vehicle

The Defence Research and Development Organisation (DRDO) has conducted maiden test of an indigenously developed Hypersonic Technology Demonstrator Vehicle (HSTDV) along with several other technologies.

- The Hypersonic Technology Demonstrator Vehicle (HTDV) project is an ambitious project of DRDO and is intended to serve multiple military and civil purposes.
    - It is an unmanned scramjet demonstration aircraft for hypersonic speed flight, which can cruise at a speed of 6 mach and move up to an altitude of 32.5 kilometres in 20 seconds.
    - While it can be used for launching cruise missiles it will also serve the purpose for launching satellites at a low cost.
- Under this project, a hypersonic vehicle is being developed that will be powered by a scram-jet engine.
    - This is dual-use technology, which when developed, will have multiple civilian applications. It can be used for launching satellites at low cost.
    - It will also be available for long-range cruise missiles of the future. E.g.: Brahmos 2.
- It is being developed by DRDO with assistance from Israel, UK and Russia.

Scramjet Engine Technology Demonstrator

- As of now, satellites are launched into orbit by multi-staged satellite launch vehicles that can be used only once (expendable).
    - These launch vehicles carry oxidiser along with the fuel for combustion to produce thrust.
    - Nearly 70% of the propellant (fuel-oxidiser combination) carried by today's launch vehicles consists of oxidiser.
    - Launch vehicles designed for one time use are expensive and their efficiency is low because they can carry only 2-4% of their lift-off mass to orbit. Thus, there is a worldwide effort to reduce the launch cost.
    - Therefore, the next generation launch vehicles must use a propulsion system which can utilise the atmospheric oxygen during their flight through the atmosphere which will considerably reduce the total propellant required to place a satellite in orbit.
- Ramjet, Scramjet and Dual Mode Ramjet (DMRJ) are the three concepts of air-breathing engines which are being developed by various space agencies.
- **A ramjet is a form of air-breathing** jet engine that uses the vehicle's forward motion to compress incoming air for combustion without a rotating compressor.
    - Fuel is injected in the combustion chamber where it mixes with the hot compressed air and ignites.
    - A ramjet-powered vehicle requires assisted take-off like a rocket assist to accelerate it to a speed where it begins to produce thrust.
    - Ramjets work most efficiently at supersonic speeds around Mach 3 (three times the speed of sound) and can operate up to speeds of Mach 6.
    - However, the ramjet efficiency starts to drop when the vehicle reaches hypersonic speeds.
- **A scramjet engine is an improvement** over the ramjet engine as it efficiently operates at hypersonic speeds and allows supersonic combustion. Thus it is known as Supersonic Combustion Ramjet, or Scramjet.
- **A dual mode ramjet (DMRJ)** is a type of jet engine where a ramjet transforms into scramjet over Mach 4-8 range, which means it can efficiently operate both in subsonic and supersonic combustor modes.