

# Cryogenic Technology

January 8, 2021

## In news

Hindustan Aeronautics Limited has delivered the biggest cryogenic propellant tank (C32 LH2) made by it to the Indian Space Research Organisation, ISRO.

## What is Cryogenic?

- Cryogenic means low temperature.
- The word itself refers to the technology of sub-zero temperatures. Cryogenic engines use liquid oxygen as the oxidizer and liquid hydrogen as the fuel.
- As it is known Oxygen can be kept in the liquid state below – 183 degrees Celsius, while hydrogen requires temperature below – 253 degree Celsius to be in liquid form.
- Since liquid oxygen is extremely reactive and combustible it can be used as a propellant to carry heavy loads.

## Fundamentals of Cryogenic

- It is the study of production and behaviour of materials at extremely low temperatures that is below 150 degrees.
- It is useful for lifting things in space, storing medicines and drugs at low temperatures etc.
- It is used in the last stage of speed launch vehicles, SPVs.
- It also states that the cryogenic stage is the liquid propellant stage or solid propellant stage at extremely low temperatures.

## ISRO and Cryogenic Technology

- **ISRO crossed an important milestone** in the development

of indigenous cryogenic upper stage for the GSLV when the first cryogenic engine was ignited at the Liquid Propulsion System centre, Mahendragiri.

- The engine made by LPSC was expected to be used as the **upper stage in the third launching of the GSLV.**
- Cryogenic engines are very useful in launching heavy satellite launch vehicles like GSLV.
- **India will become self-reliant** in its space programmer after the development of this technology.
- The realization of the cryogenic technology would also help India to become a partner in space explorations and activities of other countries.
- **Commercialization** of this technology will get India precious foreign currency.

#### **What is the Geosynchronous Satellite Launch Vehicle (GSLV)?**

- GSLV is a 49 m tall three stage vehicle with the first stage comprising a solid booster with four liquid strap-on motors, each weighing 40 ton.
- The second stage is a liquid engine and the third stage is the indigenously built Cryogenic Upper Stage (CUS) which uses 15 ton of cryogenic propellants such as Liquid Hydrogen (LH2) as fuel and Liquid Oxygen (LOX) as Oxidiser.
  - The GSLV is capable of injecting 2500 kg. Class communication satellites into Geo-synchronous circular orbits at an altitude of 3600 km.

## **ISRO or Indian Space Research Organisation**

- - India's space agency **founded in 1969** to help develop an indigenous Indian space program.

- **Headquartered in Bengaluru.**

- It is one of the **6 largest space agencies in the world** today.
- ISRO maintains one of the **biggest fleets of remote sensing (IRS) and communication (INSAT) satellites.**
  - **ISRO functions in the following areas:** broadcasting, weather forecasting, disaster management, geographic information systems, navigation, cartography (maps), telemedicine, distance education satellites, etc.

### **Major Achievement ISRO**

- The **first Indian-made sounding rocket** was the RH-75 (**Rohini-75**). It weighed just 32 kg. Series of Rohini Sounding Rockets were developed **by ISRO for atmospheric and meteorological studies.**
- ISRO built its **first satellite in 1975 and named it Aryabhata.**
- The first Indian-built launch vehicle was SLV-3 and it was used to launch the Rohini satellite in 1980.
  - ISRO launched its **first INSAT satellite in 1982.** It was a communication satellite. The next communication satellite INSAT-1B was launched in 1983.
  - ISRO also launched the **first IRS (remote-sensing satellite) in 1988.**
  - ISRO has developed three types of launch vehicles (or rockets) namely, the **PSLV** (Polar Satellite Launch Vehicle), the **GSLV** (Geosynchronous Satellite Launch Vehicle) and Geosynchronous Satellite Launch Vehicle Mark III (**GSLV Mark III or LVM**).
  - ISRO launched its first lunar mission **Chandrayaan I in 2008.**
- It also launched the **Mars Orbiter Mission (MOM) or the Mangalyaan in 2014.** With this, India became the first country to achieve success in putting a satellite in the Mars orbit in its maiden attempt and the fourth space agency and the first space Asian agency to do so.
  - In 2017, ISRO created another world record by launching 104 satellites in a single rocket. It launched its heaviest rocket yet, the Geosynchronous Satellite Launch Vehicle-Mark III and placed the GSAT 19 in orbit. There are future plans for human spaceflight (**Gaganyaan**), interplanetary probes and a solar mission as well.