

Integrated Cryogenic Engine Manufacturing Facility (ICMF)

September 30, 2022

In news– The President of India has recently inaugurated Hindustan Aeronautics Limited's (HAL) Integrated Cryogenic Engine Manufacturing Facility (ICMF) in Bengaluru.

HAL's Cryogenic Engine Manufacturing Facility (ICMF)-

- The ICMF is dedicated to Rocket Manufacturing and its assembly for ISRO. The facility will boost self-reliance in the manufacturing of high-thrust rocket engines.
- The facility is set up over an area of 4,500 sq mt housing hi-tech equipment and testing facilities for manufacturing Cryogenic (CE20) and Semi-cryogenic Engines (SE2000) of Indian Space Launch Vehicles.

Cryogenic technology-

- In physics, cryogenics is the production and behaviour of materials at very low temperatures.
- Cryogenic Engines are the most widely used engines world over in space launch vehicles.
- Due to the complex nature of the cryogenic engine, till date **only few countries USA, France, Japan, China and Russia have mastered the cryogenic technology.**
- **In 2014 India successfully flew GSLV-D5 with a cryogenic engine** (made by ISRO through private industries) and **became the sixth country in developing cryogenic engines.**

After a Long Journey...

A brief history of the Indian cryogenic engine

1982	First team to make engine
1986-91	Early experiments
1991	Russian agreement
1993	Russians back out on technology
1994	Indian cryogenic programme formalised
2000	First engine test (failure)
2003	First successful test
2007	First integration with rocket
2010	First flight
2014	FIRST SUCCESSFUL FLIGHT

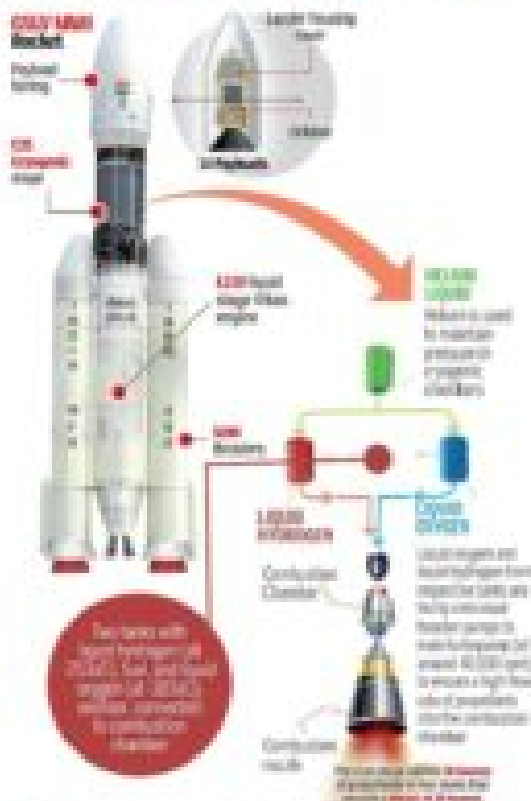
...India Joins a Small Group

FIRST SUCCESSFUL FLIGHT

US	1963
Japan	1977
France	1979
China	1984
Russia	1987
India	2014



THE ABC OF CRYOGENIC UPPER STAGE



- Two small steering engines provide for control of stage during its thrusting phase

Thrust control and mixture ratio control are

MAIN PROBLEMS

Due to large temperature differences, heat transfer is very high. Therefore, lot of insulation needed!

Boiling causes sucking pressure rise in tanks. So

achieved by two independent regulators

Main engine and two steering engines together develop a nominal thrust of 71.55 kN in vacuum

proper venting is required

Material properties vary at low temperatures. Most materials become brittle. So if valve seats or seals become brittle and leak, it causes leaks