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Initiate, innovate and internalize!!



INDIAN AVIATION PIONEER
DR. V.M. GHATGE

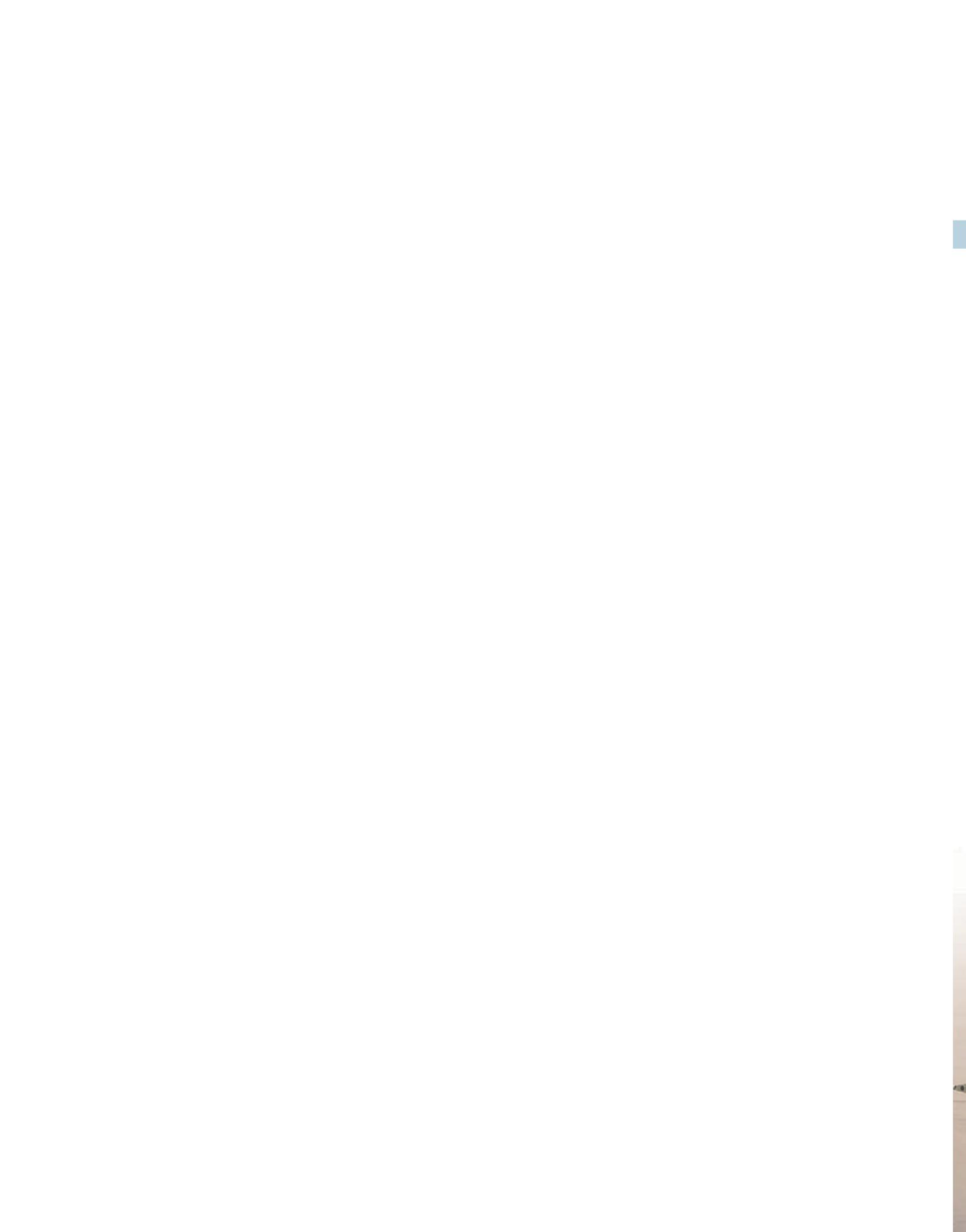


ISRO Successfully Tests

INDIA'S REUSABLE LAUNCH VEHICLE-
Technology Demonstrator (RLV-TD)

NASA

Electric Research Plane
Gets X Number, New Name



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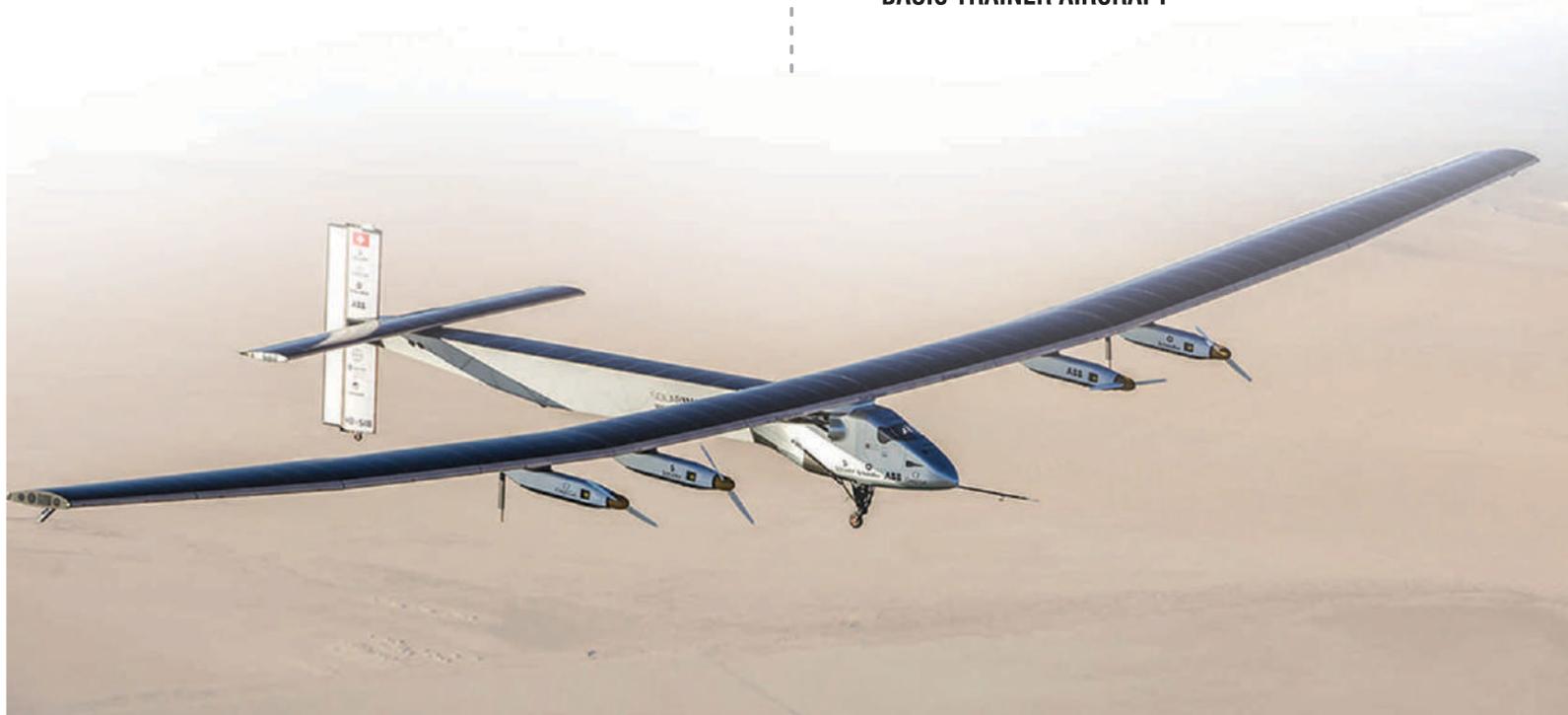
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HAL HTT-40

INDIA'S INDIGENOUS

BASIC TRAINER AIRCRAFT



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EDITORIAL

Dear reader,

You are holding a new issue of the Air Era Magazine, a first of its kind Aviation Magazine aimed at acting as a media for all Aviation related activities as well as to enlighten students and Aviation enthusiasts with the latest trends.

It is our endeavor to bring out stories of our own heroes who have contributed to the Indian Aviation as well as the local industries and R & D institutions.

In this issue, we report on the recent successes of ISRO which has brought global attention. The personality of this issue is the Bhishma Pitamaha of Indian Aviation Dr. V m Ghatge .

We urge you to support us in our endeavor by following every edition of our magazine and providing us with constant feedback and help us to fill the void of an Indian aviation magazine aimed at the student community and the general aviation enthusiasts.

Joffin Jose
Editor in-Chief

MIRAGE 2000 UPGRADED TO FOC: YET ANOTHER HAL PROJECT TAKES-OFF ON SCHEDULE



Continuing its success on various recent projects, HAL has now flown the first FOC upgraded Mirage-2000 aircraft on July 28, 2016 adhering to the scheduled date of today. "We have done it again on time. What it proves is HAL's capability of mid-life upgrade of platforms to overcome obsolescence issues, enhance

the reliability and maintainability of these aircraft. The introduction of state of the art facility created for this project ensures the timely upgradation of the Mirage fleet", says Mr. T. Suvarna Raju, CMD, HAL.

The Final Operational Configuration (FOC) design was implemented on an Initial Operational Configured (IOC) aircraft which was received at HAL only about eight months ago. "This significant milestone could be achieved by the dedicated efforts of the HAL's team of designers and engineers with active support from IAF,

RCMA and DGAQA", adds Mr. Raju.

The initial operation configuration was designed by the Dassault and Thales of France. HAL took up the FOC design and development activities. The FOC configuration covers the integration of Indian specific weapons, sensors and EW system. This FOC upgrade on Mirage 2000 gives additional capability of air to ground weapon, training, helmet mounted display etc. The system having a unique feature of integrating different types of data bus for IOC and FOC configuration is achieved without any degradation. The total design and development was done by HAL which includes mission computer hardware, OFP software, system design, aircraft modification etc. The Company is responsible for the IOC and FOC upgrade of the Mirage fleet of IAF.

The first flight of 45 minutes was piloted by Gp. Capt C. Subramaniam (Retd.), Chief Test Pilot of HAL from the front cockpit and Wg. Cdr Haldikar of ASTE, IAF in the rear cockpit. Gp. Capt. A. Mishra of IAF acted as the test director.

Fighter Jet Su-30 flies with BrahMos missile for first time

The country's military scientists test-flew the heavy BrahMos supersonic cruise missile for the first time using a modified Air Force Sukhoi-30 MKI fighter as the air platform. The missile, said to be the heaviest such, had its milestone flight for 45 minutes at the HAL Airport at Nashik, said a statement from Hindustan Aeronautics Ltd, which manufactures the Su-30s. It was not a real warhead but was of the same weight, shape and size.

40 aircrafts to be modified

With the successful integration of BrahMos, Su-30 MKI aircraft has become a lethal weapon delivery platform for the Air Force. Around 40 of these aircraft are expected to be modified, said HAL. History has been made with the 2,500- kg missile,

said Mr. Sudhir Kumar Mishra, CEO & MD, BrahMos Aerospace Pvt Ltd, the company that has designed the missile. He said it was for the first time in the world that such a heavyweight missile was integrated on a fighter aircraft.

T. Suvarna Raju, HAL's CMD, who was among those who witnessed the flight, told The Hindu that they plan to fly and drop a real missile around October or

November, after completing 15-20 flights to evaluate the performance of the fighter. Calling HAL 's modification of two Sukhoi plane "an engineering marvel," Mr. Raju said the Nashik Division generated the required data without the help of the

original Russian manufacturer. Mr. Mishra was quoted as saying, "The world did not believe us that we could do it. We could achieve it today thanks to the vision of the late Dr. A. P. J. Abdul Kalam." Wg. Cdr. Prashant Nair and Wg. Cdr. M.S. Raju, flight test crew of Bengaluru-based Aircraft & Systems Testing Establishment, demonstrated the flight. HAL and BAPL in 2014 signed a contract to modify two Su-30 MKI aircraft for integrating with the missile.

Source: <http://www.thehindu.com>



SUCCESSFUL FLIGHT TESTING OF ISRO'S SCRAMJET ENGINE TECHNOLOGY DEMONSTRATOR

The first experimental mission of ISRO's Scramjet Engine towards the realisation of an Air Breathing Propulsion System was successfully conducted on August 28, 2016 from Satish Dhawan Space Centre SHAR, Sriharikota.

After a smooth countdown of 12 hours, the solid rocket booster carrying the Scramjet Engines, lifted off at 0600 hrs (6:00 am) IST. The important flight events, namely, burn out of booster rocket stage, ignition of second stage solid rocket, functioning of Scramjet engines for 5 seconds followed by burn out of the second stage took place exactly as planned.

After a flight of about 300 seconds, the vehicle touched down in the Bay of Bengal, approximately 320 km from Sriharikota. The vehicle was successfully tracked during its flight from the ground stations at Sriharikota.

With this flight, critical technologies such as ignition of air breathing engines at supersonic speed, holding the flame at supersonic speed, air intake mechanism and fuel injection systems have been successfully demonstrated.

The Scramjet engine designed by ISRO uses Hydrogen as fuel and the Oxygen from the atmospheric air as the oxidiser. Today's test was the maiden short duration experimental test of ISRO's Scramjet engine with a hypersonic flight at Mach 6. ISRO's Advanced Technology Vehicle (ATV), which is an advanced sounding rocket, was the solid rocket booster used for today's test of Scramjet engines at supersonic conditions. ATV carrying Scramjet engines weighed 3277 kg at lift-off.

ATV is a two stage spin stabilised launcher with identical solid motors (based on Rohini RH560 sounding rocket) as the first as well as the second stage (booster and sustainer). The twin Scramjet engines were mounted on the back of the second stage. Once the second stage reached



the desired conditions for engine "Start-up", necessary actions were initiated to ignite the Scramjet engines and they functioned for about 5 seconds. Today's

ATV flight operations were based on a pre-programmed sequence.

Some of the technological challenges handled by ISRO during the development of Scramjet engine include the design and development of Hypersonic engine air intake, the supersonic combustor, development of materials withstanding very high temperatures, computational tools to simulate hypersonic flow, ensuring performance and operability of the engine across a wide range of flight speeds, proper thermal management and ground testing of the engines.

India is the fourth country to demonstrate the flight testing of Scramjet Engine. The successful technology demonstration of air-breathing Scramjet engines in flight by ISRO today is a modest yet important milestone in its endeavour to design and develop advanced air breathing engines including engines for ISRO's future space transportation system.

BOEING AND TATA ADVANCED SYSTEMS JOINT VENTURE-(TBAL)



production facility will eventually be the sole producer of AH-64 fuselages globally. The Apache has been flown or selected for acquisition by the United States and 15 other nations, including India.

Boeing and Tata Advanced Systems rolled out new facility in Hyderabad for its joint venture named TATA Boeing Aerospace Limited (TBAL). The joint venture has been established to co-produce Boeing AH-64 Apache helicopter fuselages and other aerostructures, as well as to pursue integrated systems in aerospace.

According to the statement, the Hyderabad

The joint venture between Tata and Boeing is a significant step in developing India's capabilities for aerospace & defence manufacturing and becoming a global exporter. This is a clear example of the significant progress made towards "Make in India for defence," said Manohar Parrikar, Union Defence Minister.

IAF PLANS TO PUT LCA TEJAS IN COMBAT ROLE BY 2017

The Indian Air Force plans to put much-delayed Tejas in combat role by next year after raising in July the first squadron of the indigenous Light Combat Aircraft which it counts “superior” to Pakistan’s JF 17 fighters. State-run HAL will hand over the first two Tejas aircraft to IAF on July 1 which will make up the Flying Daggers 45, the name of the first squadron of the LCA which will be based in Bangalore for the first two years before being moved to Sulur in Tamil Nadu.

The idea is to have a total of six aircraft this financial year and about eight in the next. Tejas will feature in combat plan of the IAF next year and will be deployed in forward bases also, IAF sources said. They asserted

that Tejas, which still has at least 19, mostly related to maintenance and easier operations, of the 43 deficiencies that the force had highlighted earlier, is “one of the exceptional single-engine fighter aircraft in the world”. Asked how the aircraft fared in comparison to JF 17, jointly developed and built by Pakistan and China, the IAF said it was “better”. “It is a better one since it is mostly made of composite which makes it light and very agile. It also comes with smart ammunitions and bombs which help it to hit targets in a precise manner,” a source said. Sources also said that Tejas will replace the MiG 21s and will be used for air-to-air fight and ground attack and could also be a compliment

to bigger fighter planes such as Su 30 MKI. All squadrons of Tejas will be made up of 20 planes in total, including four in reserve. As per the plan, while 20 would be inducted under the “Initial Operational Clearance”, another 20 will be inducted later with Beyond Visual Range Missile (BVR) and some other features. The IAF plans to induct over 80 aircraft with better specifications known as Tejas 1A. The upgraded version of Tejas, with Active Electrically Scanned Array Radar, Unified Electronic Warfare Suite, mid-air refuelling capacity and advanced beyond the vision range missiles, will cost between Rs 275 crore and Rs 300 crore. While the idea to have an indigenous fighter aircraft was conceptualised in 1970s, the actual work started only in the 80s and the first flight took place in January 2001

Source: <http://newsworldindia.in/>

FAA-AST AWARDS VIRGIN GALACTIC OPERATOR LICENSE FOR SPACESHIP TWO

New Spaceship Conducts Taxi Test as it Nears Start of Flight Test Program



analysis, culminating in FAA-AST approval.

Virgin Galactic Senior Vice President of Operations Mike Moses said, “The granting of our operator license is an important milestone for Virgin Galactic, as is our first taxi test for our new spaceship. While we still have much work ahead to fully test this spaceship in flight, I am confident

The U.S. Federal Aviation Administration’s Office of Commercial Space Transportation (FAA-AST) has awarded Virgin Galactic an operator license for SpaceShipTwo. The license award, which will ultimately permit

commercial operations of the vehicle, was the culmination of several years of in-depth interaction with the FAA. The license review process consists of an in-depth review of the vehicle’s system design, safety analysis and flight trajectory

that our world-class team is up to the challenge.”

Check back soon for more details about the flight test program and what to expect on the ground and in the skies.

NASA

Electric Research Plane Gets X Number, New Name

With 14 electric motors turning propellers and all of them integrated into a uniquely-designed wing, NASA will test new propulsion technology using an experimental airplane now designated the X-57 and nicknamed “Maxwell.”

NASA Administrator Charles Bolden highlighted the agency’s first X-plane designation in a decade during his keynote speech in Washington at the American Institute of Aeronautics and Astronautics (AIAA) annual Aviation and Aeronautics Forum and Exposition, commonly called Aviation 2016.

“With the return of piloted X-planes to NASA’s research capabilities – which is a key part of our 10-year-long New Aviation Horizons initiative – the general aviation-sized X-57 will take the first step

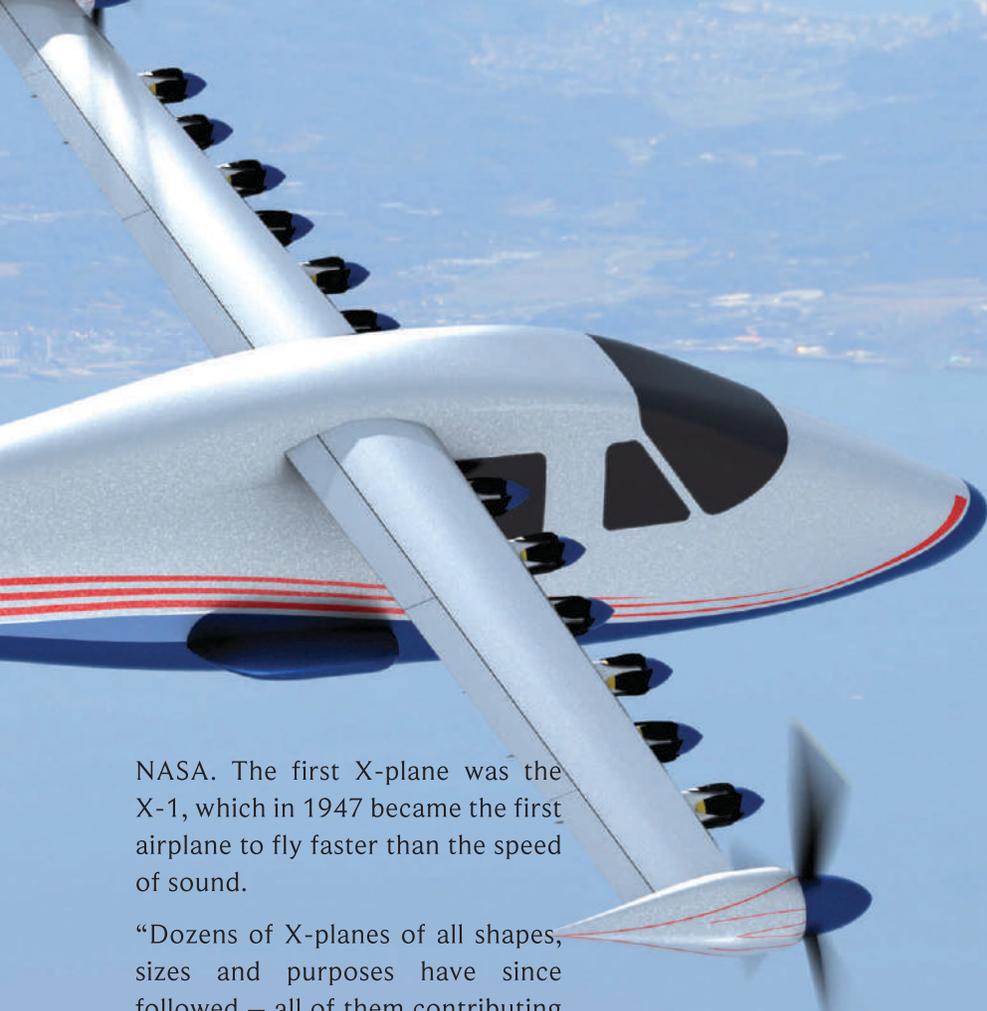
in opening a new era of aviation,” Bolden said.

As many as five larger transport-scale X-planes also are planned as part of the initiative. Its goals – like the X-57 – include demonstrating advanced technologies to reduce

fuel use, emissions and noise, and thus accelerate their introduction to the marketplace.

The X-57 number designation was assigned by the U.S. Air Force, which manages the history-making process, following a request from





NASA. The first X-plane was the X-1, which in 1947 became the first airplane to fly faster than the speed of sound.

“Dozens of X-planes of all shapes, sizes and purposes have since followed – all of them contributing to our stature as the world’s leader in aviation and space technology,” said Jaiwon Shin, associate administrator for NASA’s Aeronautics Research Mission Directorate. “Planes like the X-57, and the others to come, will help us maintain that role.”

This artist’s concept of NASA’s X-57 Maxwell aircraft shows the plane’s specially designed wing and 14 electric motors. NASA Aeronautics researchers will use the Maxwell to demonstrate that electric propulsion can make planes quieter, more efficient and more environmentally friendly.

Credits: NASA Langley/Advanced Concepts Lab, AMA, Inc.

NASA researchers working directly with the electric airplane also chose to name the aircraft “Maxwell” to

honor James Clerk Maxwell, the 19th century Scottish physicist who did groundbreaking work in electromagnetism. His importance in contributing to the understanding of physics is rivaled only by Albert Einstein and Isaac Newton part of a four-year flight demonstrator plan, NASA’s Scalable Convergent Electric Propulsion Technology Operations Research project will build the X-57 by modifying a recently procured, Italian-designed Tecnam P2006T twin-engine light aircraft.

Its original wing and two gas-fueled piston engines will be replaced with a long, skinny wing embedded with 14 electric motors – 12 on the leading edge for take offs and landings, and one larger motor on each wing tip for use while at cruise altitude.

NASA’s aeronautical innovators hope to validate the idea that distributing electric power across a number of motors integrated with an aircraft in this way will result in a five-time reduction in the energy required for a private plane to cruise at 175 mph.

Several other benefits would result as well. “Maxwell” will be powered only by batteries, eliminating carbon emissions and demonstrating how demand would shrink for lead-based aviation fuel still in use by general aviation.

Energy efficiency at cruise altitude using X-57 technology could benefit travelers by reducing flight times, fuel usage, as well as reducing overall operational costs for small aircraft by as much as 40 percent. Typically, to get the best fuel efficiency an airplane has to fly slower than it is able. Electric propulsion essentially eliminates the penalty for cruising at higher speeds.

Finally, as most drivers of hybrid electric cars know, electric motors are more quiet than conventional piston engines. The X-57’s electric propulsion technology is expected to significantly decrease aircraft noise, making it less annoying to the public.

The X-57 research started as part of the NASA Aeronautics Research Mission Directorate’s Transformative Aeronautics Program’s Convergent Aeronautics Solutions project, with the flight demonstrations being performed as part of the Flight Demonstration Concepts project in the Integrated Aviation Systems Program.



INDIAN AVIATION PIONEER DR. V.M. GHATGE

August 5, 1951 is a landmark day in the history of Indian aviation, as on this day, the first Indian designed and constructed aircraft took to the sky at Bangalore. Called HT-2, this piston engined ab-initio trainer aircraft was designed and developed by Hindustan Aircraft Limited under the leadership of Dr.V.M.Ghatge, their Chief Designer. HT-2 was first aircraft designed, developed and manufactured in India, by Indians for Indians.

Dr.V.M.Ghatge is aptly referred as the “*Bhishma pitamaha*” of Indian aviation as he not only served the aviation industry but also contributed to Aeronautical engineering education in India. While he was the Chief Designer at Hindustan Aircraft Limited, he was the founder Head of Aeronautical Engineering Department at the Indian Institute of Science, Bangalore.

Dr.V.M.Ghatge had a distinguished academic career. Born on October 24, 1908 at Hasur, a small village near Kolhapur, Maharashtra, he had his



DR. V.M. GHATGE

schooling at Kolhapur after which he studied at Pune and obtained his BSc. He joined Institute of Science, Mumbai for post graduate studies which he completed with distinction. This made him eligible for a Scholarship for overseas studies. Dr.V.M.Ghatge was already drawn into fluid mechanics. His post graduate thesis work was on Formation of vortex which he carried out at the Kolaba Observatory.

In 1933, Ghatge went to Germany and joined the Kaiser Wilhelm Institute for flow research in Gottingen, which was focussed on fluid dynamics and aerodynamic testing. He worked under the famous aerodynamicist Ludwig Prandtl. For his doctoral research he chose the topic of relative motion of air columns of different temperature and carried model experiments. As this work was related to Cumulus clouds which are of interest to gliding, his research was supported by the Gliding Society of Germany. He secured his doctoral degree in 1936.

Soon after, he returned to India and took up teaching assignments as Professor of Physics at the University of Pune and University of Mumbai for four years. In 1940, he joined Hindustan Aircraft Limited and started his career in Aviation. Dr.Ghatge's first assignment was the development of a troop dropping glider. In 1941, he designed a ten- seat troop dropping glider G-1.



In 1942, Dr.Ghatge moved to the Indian Institute of Science, Bengaluru (IISc) as a professor to establish post graduate courses in Aeronautical engineering. He taught Fluid dynamics, Solid mechanics and Aircraft design and organized wind tunnel experiments there till 1948. This was beneficial to the nascent aviation industry of Independent India. Almost all HAL's designers have been graduates of Indian Institute of Science.

His students remember Prof.Ghatge with great affection and high regard as he was not only an excellent teacher but also a friend, philosopher & guide. He helped the young engineers in their chosen careers and directed their energies in creative pastimes. Ghatge was a multi-faceted man.

In 1948, Dr.Ghatge returned to HAL as its first chief designer and was involved with aircraft design and development till 1967. The same year, HAL, after much deliberation, decided to design and develop a basic trainer aircraft and sent a proposal to the Government of India. Government sanctioned the project and released funds to HAL in October 1948.

Design work on the project soon began and a mock-up of the aircraft was ready by August 1949. The design was frozen quite fast and final aircraft layout drawings were ready by February 1950. By October, assembly of the wings was on the way and soon the fuselage was ready. Following some structural tests on fuselage and the wings, they were mated in May

1951. In July, the aircraft was ready for weighing.

The first prototype was fitted with a Gipsy Major 145hp engine driving a wooden propeller. On July 21, 1951, the first engine run took place. Following this, on August 5, 1951, Capt Jimmy Munshi, the Chief test pilot of HAL, made the maiden flight for about 40 minutes. A week later, on August 13, 1951, HT-2 was flight-demonstrated to the public. Dr.Ghatge was among the invitees present for the event. HT-2 was described by the pilots as akin to a lady; clean and trim to her tips, her proud nose up in the air and her figure slim and strong.

Two years later, on Jan.3, 1953, HT-2 obtained its type certificate. On the occasion of presenting the type certificate, minister of communication, paid tribute to HAL and its team and went on to say that the day signified a definite stage in the development of aircraft industry in India as it marked the day of India's emancipation from dependence on the western countries for aircraft design and construction. Ghatge not only developed the HT-2 but laid the foundation for the aircraft design and development activity in India. The HT-2 aircraft went into production and found service with the Indian Air force for two decades. HAL produced a total of 166 HT-2 aircraft.





HT-2 of the Department of Aerospace Engineering, Indian Institute of Science, Bengaluru

Of these 150 were for Air Force, 12 for Ghana, and four for others.

Dr.Ghatge was involved in many aircraft projects. HT-2 was followed by Pushpak, a piston engined light aircraft for basic training. The Pushpak first flew on 28 Sep. 1958. Much like, HT-2, HAL produced 160 aircraft for Indian flying clubs. Two examples were gifted to Malaysia.

Pushpak was followed by an enlarged, four-seat version of the Pushpak called Krishak. Two prototypes were built, with the first flying in November 1959 and the second a year later. Though the project was initially shelved due to lack of interest from buyers, subsequently it was produced for the armed forces to serve in the observation role. They served the armed forces for nearly a decade

till mid-1970s. During this period, development of a 2500lb thrust, straight jet engine was undertaken under the technical leadership of Ghatge, but unfortunately this did not go beyond the prototype stage.

In the late fifties, the Govt. of India approved the launch of a fighter aircraft development (HF-24). This project was assigned to a German team led by Kurt Tank and many of the Indian designers trained by Dr.Ghatge were transferred to this project. This split the design department and became a great source of unhappiness to Ghatge. After all, he had meticulously nurtured and built a design team to take on more challenging tasks under him.

Dr.Ghatge held very strong views on the way in which the Indian Aircraft

industry should operate which were in variance with those of policy makers of his time. His approach to develop indigenous design capability did not find a favour with govt bureaucracy. With the demands from the defense services became more, the ministry decided to rely heavily on license production.

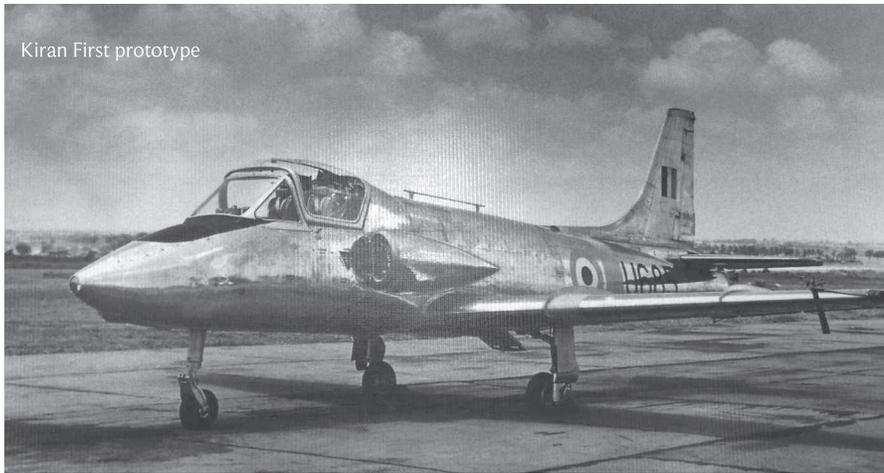
Dr.Ghatge developed HJT-16 Kiran to meet an Indian air force requirement for an intermediate jet trainer. The first aircraft powered by the Rolls Royce Viper Mk 11 had its first flight on 4 September 1964. The production aircraft was designated the **Kiran I**, and first pre-production deliveries were made to the Indian Air Force in March 1968. Later production aircraft were fitted with hardpoints under each wing for weapon training and redesignated as the **Kiran IA**. A total of 190 Mk I and 1A aircraft were built.

An updated version powered by a 4,200lb thrust Bristol Siddley Orpheus enhanced weapon-carrying capability was designated the **Kiran II**, which first flew on 30 July 1976, and deliveries commenced in 1985. Kiran II aircraft was adopted by the Indian Air Force aerobatic team and became famous as SURYA KIRANS.

Dr.Ghatge retired as General Manager and Managing Director of HAL in 1970. After retirement he remained



Krishak of Indian Air force at Air Force museum Delhi photo credit: Rahul Buddala



Kiran First prototype

active in general engineering field rendering consultancy services to industry in the corporate sector.

Dr.Ghatge received the National Design award and Padma Shri in 1965 for pioneering work in the field of aeronautics both in educating and training designers and also for demonstrating Indian ability to design and develop several aircraft in the country without outside help. He was a fellow of the Royal Aeronautical society, the Aeronautical Society of India, and the National institute of Sciences, and the member of the Institute of Engineers India and the Institute of Aeronautical Sciences USA. In 1969, he was recipient of Sir Walter PuKey Indian prize for contribution to production engineering in India.

On the occasion of his 75th birthday, in his honour, HAL along with AR&DB, Indian Institute of Science, and Aeronautical society of India, organised a two day seminar in Oct.1983 on “Design and development in aeronautics”.

Dr.Ghatge died of cancer on 6 Dec. 1991, following its diagnosis in early 1991.

Dr.Ghatge was a multi faceted personality. He was a portrait artist, which he did mostly in water colours. He was equally good at black and white shading and sepia work. He was a Sanskrit scholar, a knowledgeable critic of Indian classical music, and a voracious reader of Marathi literature. As Mr. Raj Mahindra another Chief

designer from HAL, puts it - “He was extremely sociable, the heart and soul of a convivial social gathering in a club and could keep one amused for hours with his forays into diverse subjects.” A keen golfer, he was elected the captain of the Bangalore golf club in 1957, and later was the founder member of the Karnataka Golf Association and its first president.

Dr. Ghatge made HT-2 a household name for decades. Pushpak, Krishak and Kiran made independent India proud. Recollecting his contribution, Former HAL chairman, N.R. Mohanty said - “Dr Ghatge is the father-figure of our design centre. He is the source of inspiration for our present and future designers. His contributions to aeronautics will be remembered for many more generations to come.”

Air Era salutes this great visionary who excelled both in academics and industry and laid a firm foundation for Aeronautics in India.



Kiran MkII



DR.M.S.Rajamurthy
Scientist G (retd.) NAL

Dr.Rajamurthy was associated with many aircraft programmes. This started with LCRA fabrication at NAL, participated in LCA during PDP and was involved in SARAS as Associate Project Director (flight testing).

THE ADORABLE FLYING MACHINE

Air Cmde Sajjad Rahim VSM (Retd.)

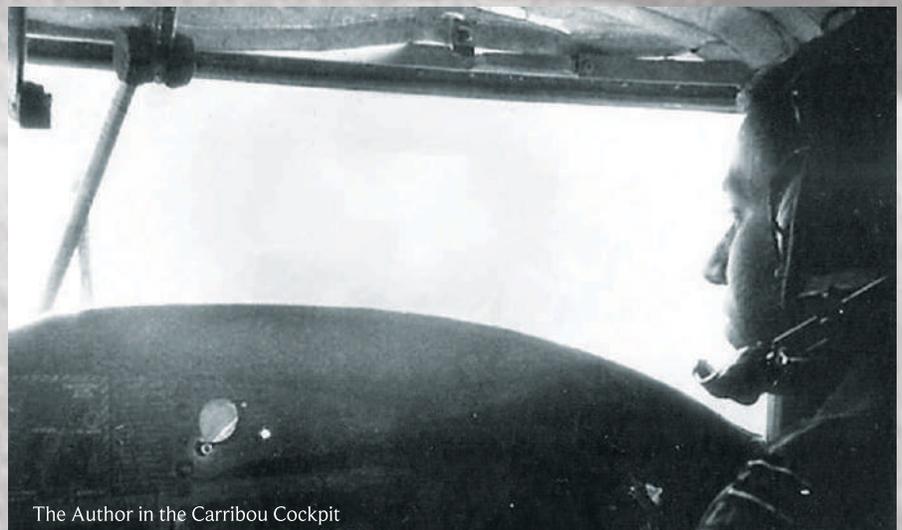
Deep in the Thick forested Hills of the Arunachal Pradesh the whine of robust engines draws the locals from the hamlets and the personnel from the security forces to the ALG at Walong. Unseen the Heavenly Machine descends, taking a tight turn round the hill to touch down while the wings are just levelling. The landing run is cut short by the imposing hill in front. Any mistake would prove disastrous. As the ramp is lowered and cargo door raised we descend to the greetings of the locals and the hospitality of the Army in the form of steaming hot Tea made only of milk no water, so welcome in the early morning low temperature. Quick unload of the cargo consisting of ration, vegetable, medicines and the essentials, it is time to take off before the clouds engulf and turbulent winds set in. There are sick people to take back and the personnel waiting to proceed on leave. Only 8 persons are taken in against 32 seat capacity leaving many unhappy, promising them that they will be taken on the next sortie. How to explain the innocent folk the operational restrictions of carrying due to rule of safety. Fifty percent load has to be ejectionable in case of emergency.

The take off is as perilous, open full power on breaks, role for short distance lift off and immediately turn in the valley avoiding the hill ahead, to get back to the base.

This was the Caribou of Indian Air Force doing Air Maintenance for the services and the civilian population. Undoubtedly it is only an STOL aircraft which could perform this feat. Caribou had been the main stay of the IAF for air drops and ALG landings in the Eastern Theatre, reaching inaccessible locations.

The aircraft had also been serving

wherever the natural calamities struck. One such mission is worth narrating. Killar, a remote pocket of Pangti, sprawled on the terraces of the lower reaches of the lofty peaks is the most inaccessible part of Himachal Pradesh. The main approach to this remote region is through Sach pass at 10,000 ft. height which remains closed due to snow for a major period of the year. The only other approach to Killar is a narrow bridle path from Kishtwar in Jammu division; a trek of 80Km. Transporting a quintal of food grains from Kishtwar to Killar in Pangti by road costed Rs.450/- in 1980, provided the



The Author in the Caribou Cockpit

road was clear.

Hard-hit by drought, the Pangri people clamoured for food and appealed to the State administration who in return requested the Indian Air Force to drop rations and other essential commodities.

The services of Caribou were requisitioned which were operating in far East then. There being no suitable area fit for dropping zone for a Caribou, the local administration had to clear some trees and bushes from a patch of a flat land to be used as dropping zone.

Chetak helicopter was used to carry out the ground recce and to know the surroundings to carry out the hazardous task, keeping in view the terrain and the weather conditions.

It was decided that the air dropping should be carried out from 0600 to 1230 hours daily as the wild winds start lashing the area in the afternoon reducing the visibility and adding more problems for the crew.

The crew were eager and energetic to begin the task of air dropping. The whole operation started on 05 May 1980 in full swing. Air and ground crews worked overtime, including Sundays and holidays, to keep the ageing aircraft operationally fit by sheer hard work. Many of the crew had forgone their leave and personal comforts to complete the emergency operation at the earliest, to help their countrymen.

The first sortie under the command of Squadron Leader Prem Kumar accompanied by Squadron Leader AK Gupta and Flight Lieutenant Sajjad Rahim (Author) was carried out at Killar on 05 May 1980. The Finance Minister and the Secretary for Tribal Development of Himachal Pradesh

Govt. were themselves present at Killar to see the success of operation carried out by Caribou crew and expressed their satisfaction and thanked the Indian Air Force on its success. The Air Force made a total of 23 sorties from Pathankot and 78 Sorties from Jammu, involving 203 hours of flying by Caribou. It was possible only because of the excellent performance of the aircraft with the capability of STOL and short radius of turn notwithstanding the aging engines.

What made caribou to succeed when other aircraft could not, it is the design. Let us note the leading particulars.

General characteristics

- Crew: Three
- Capacity:
 - 32 troops or
 - 24 fully equipped paratroops or 14 casualty stretchers
- Payload: 8,000 lb (3,628 kg)
- Length: 72.58 ft (22.12 m)
- Wingspan: 95.58 ft (29.13 m)
- Height: 31.66 ft (9.65 m)
- Wing area: 912 ft² (84.7 m²)
- Empty weight: 16,920 lb (7,675 kg)
- All up weight: 28,500 lb (12,927 kg)

- Power plant: 2 × Pratt and Whitney R-2000-7M2 Twin Wasp 14-cylinder, 1,450 hp (1,081 kW) each

Performance

Maximum speed: 216 mph (348 km/h)

- Cruise speed: 181 mph (291 km/h)
- Range: 1,280 mi (2,060 km) (240 mi (390 km) with maximum payload)
- Service ceiling: 24,800 ft (7,559 m)
- Rate of climb: 1,355 ft/min (413 m/min)

The plane takes off within 910 feet (280 m); it lands within 850 feet (260 m). By the distance the other aircraft start rolling and picking up the speed, caribou would have reached the climb height. Its tall tail with vast fin comes into view before the aircraft is seen. The only reason the marvellous performer had to retire was the aging piston engines which were used to their last breadth. We look at the history of this fantastic flying machine with great satisfaction and admiration.

The de Havilland Canada DHC-4 Caribou is a specialized cargo designed and produced with short takeoff and landing (STOL) capability. The Caribou



proto type first flew on 30 July 1958 and was designated as DHC-4. U.S. certification was awarded on 23 December 1960. US re designated it as YAK-1. The US Army AC-1 designation was changed in 1962 to CV-2, and then C-7 when the U.S. Army's CV-2s were transferred to the U.S. Air Force in 1967. The Caribou was primarily a military tactical transport. The majority of Caribou production was destined for military operators, but the type's ruggedness and excellent STOL capabilities requiring runway lengths of only 910 feet (280 metres) also appealed to some commercial users. The U.S. Army requirement for a tactical airlifter to supply the battlefield with troops and supplies and evacuate casualties on the return journey was ably met by the Caribou. U.S. and Australian Caribous saw extensive service during the Vietnam War. The Caribou was flown by other countries, apart from

US, Canada and Australia, these are Brazil, India, Malaysia and Spain.

In India the Caribou was inducted in the immediate aftermath of the 1962 India-China War. As part of the emergency aid that the United States and Canada diverted to India to help shore the effort against the Chinese, two Caribous from the USAF were delivered to India, both aircraft arriving on 8 January 1963.

The very next day, Squadron was raised on these two aircraft (BM768 and BM769). Quite soon after their arrival the two Caribous were used in POW evacuation missions from Walong and other forward locations in March 1963. The sorties were not without incidents. A Caribou (BM772) crash landed at Hyuliang Landing

ground due to a down draught just before landing. That aircraft was then cannibalized on-site and components re-used in other aircraft. A second Caribou was extensively damaged in another crash landing at Hyuliang in early 1965 indicating the dangerous area of operation.

During the 1971 war with Pakistan, the Caribous of the Squadron in addition to regular transport duties, operated in a night bomber role as well. The objective was to use them to harass the Pakistani Army and repair teams over the Tezgaon airfield by sporadic night attacks. Additionally the aircraft took part in the Tangail air drop, where the decoy parachutes were dropped, away from the drop zone to distract Pakistani troops on the ground. Once the airdrops were completed, the Caribous used their STOL capabilities to land at Tangail to supply the Paratroopers on the subsequent days. After the surrender of the Pakistani Army in Dacca, the Caribous were the first fixed wing aircraft of the IAF to land at the Tezgaon airfield. The runway at Tezgaon was so badly damaged that only Caribous could land there safely.

The aircraft and crews had the distinction of flying in the Bangladesh interim cabinet into Dacca. The aircraft was also used in transporting of VVIPs into and out of Dacca. Among them the Chief of Army Staff, Gen Sam Manekshaw, and the VIP POWs of the Pakistan Armed Forces - Lt Gen Niazi and his General and Brigade level officers

The last Caribou sorties were supposed to have done in March 1987, and with their withdrawal there were no other fixed wing aircraft that continued the civilian maintenance role to tricky airfields like Walong



The Author with Navigator
Flt Lt. Amin at Jammu Air Base



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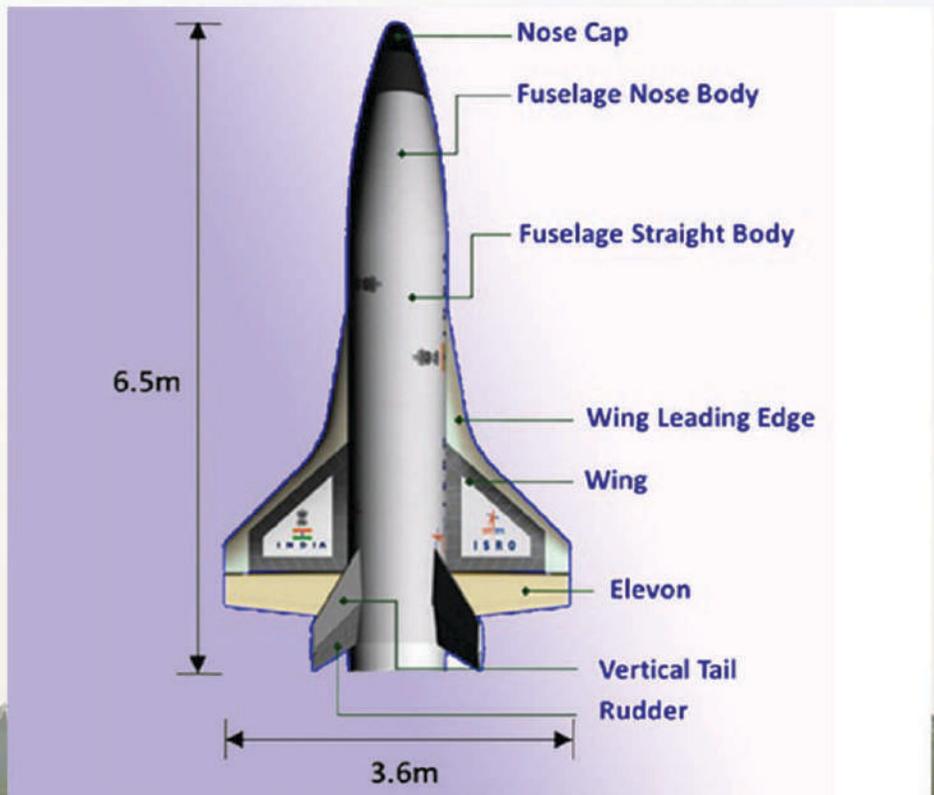
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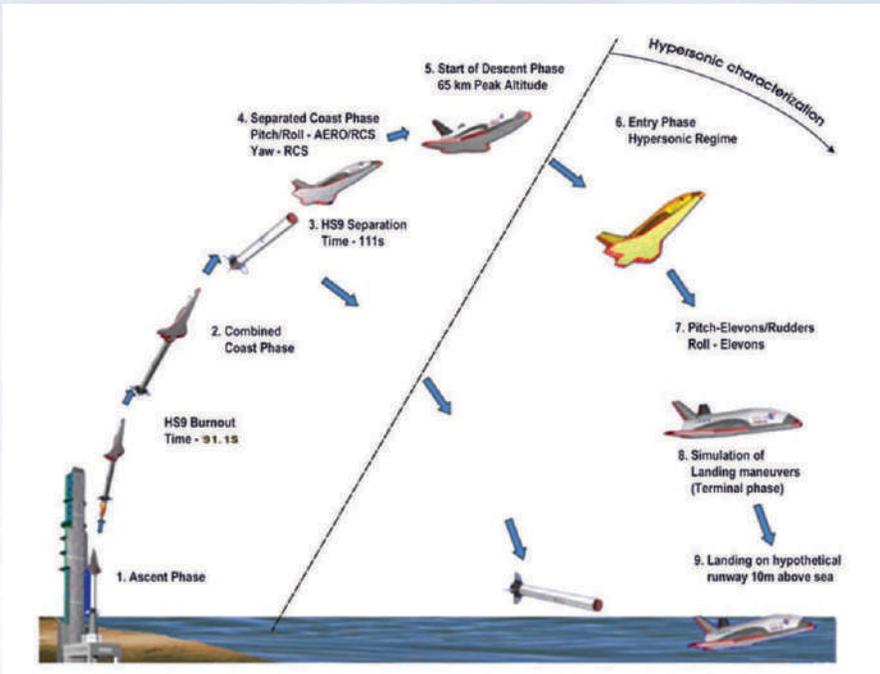
ISRO Successfully Tests INDIA'S REUSABLE LAUNCH VEHICLE-Technology Demonstrator (RLV-TD)

ISRO successfully flight tested India's first winged body aerospace vehicle operating in hypersonic flight regime comparable to the space shuttle.

In this experimental mission, the HS9 solid rocket booster carrying RLV-TD

lifted off from the First Launch Pad at Satish Dhawan Space Centre, Sriharikota at 07:00hr IST on 23rd May 2016. After a successful flight of 91.1second, HS9 burn out occurred, following which both HS9 and RLV-





in this mission.

RLV-TD consists of a fuselage (body), a nose cap, double delta wings and twin vertical tails. It also features symmetrically placed active control surfaces called Elevons and Rudder. This technology demonstrator was boosted to Mach no: 5 by a conventional solid booster (HS9) designed for low burn rate. The selection of materials like special alloys, composites and insulation materials for developing an RLV-TD and the crafting of its parts is very complex and demands highly skilled manpower. Many high technology machinery and test equipment were utilised for building this vehicle.

TD mounted on its top coasted to a height of about 56 km. At that height, RLV-TD separated from HS9 booster and further ascended to a height of about 65km.

From that peak altitude of 65 km, RLV-TD began its descent followed by atmospheric re-entry at around Mach 5 (five times the speed of sound). The vehicle's Navigation, Guidance and Control system accurately steered the vehicle during this phase for safe descent. After successfully surviving high temperatures of re-entry with the help of its Thermal Protection System (TPS), RLV-TD successfully glided down to the defined landing spot over Bay of Bengal, at a distance of about 450km from Sriharikota, thereby fulfilling its mission objectives.

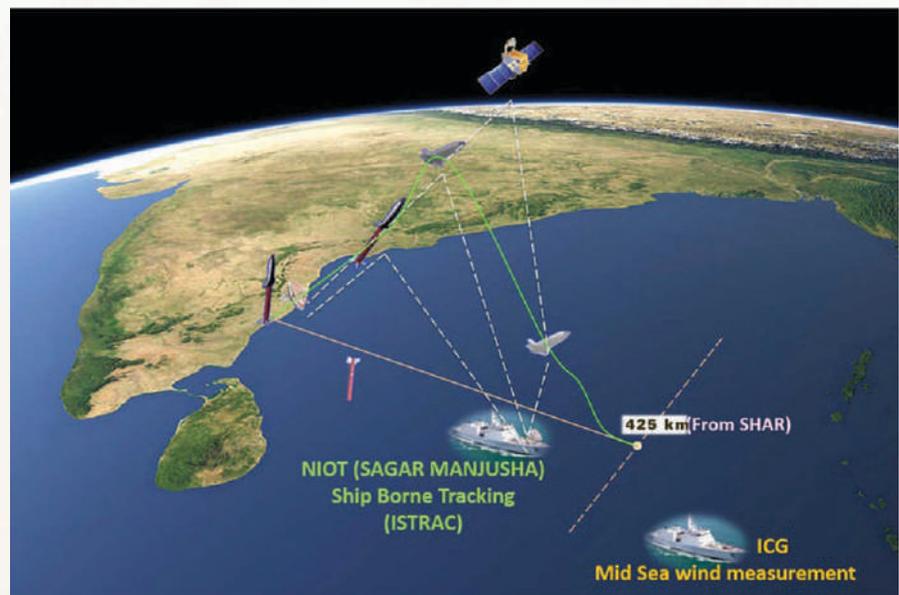
The vehicle was successfully tracked during its flight from ground stations at Sriharikota and a shipborne terminal. Total flight duration from launch to landing of this mission of the delta winged RLV-TD, lasted for about 770seconds.

In this flight, critical technologies such as autonomous navigation, guidance & control, reusable thermal protection system and re-entry mission management have been successfully validated.

ISRO acknowledged the support of Indian coast guard and National Institute of Ocean technology (NIOT) for the mid sea wind measurement and shipborne telemetry respectively

Objectives of RLV-TD:

- Hypersonic aero thermodynamic characterisation of wing body
- Evaluation of autonomous Navigation, Guidance and Control (NGC) schemes
- Integrated flight management
- Thermal Protection System Evaluation





Reusable Launch Vehicle—Technology Demonstrator (RLV-TD) is one of the most technologically challenging endeavors of ISRO towards developing essential technologies

for a fully reusable launch vehicle to enable low cost access to space. The configuration of RLV-TD is similar to that of an aircraft and combines the complexity of both launch vehicles

and an aircraft. The winged RLV-TD has been configured to act as a flying test bed to evaluate various technologies, namely, hypersonic flight, autonomous landing and powered cruise flight. In future, this vehicle will be scaled up to become the first stage of India's reusable two stage orbital launch vehicle in other words it would become India's own space shuttle. We at "The Air Era" hope to see a significant hike in the funding of ISRO and we foresee a future when Astronauts are launched into space from India. This could also bring forth more of Indian involvement in the International space station or who knows it could be India's gateway to building its own space station and eventually could become the 4th country to put a man/woman in space.



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ISRO

SUCCESSFULLY LAUNCHES 20 Satellites in a Single Flight

In its thirty sixth flight (PSLV-C34), ISRO's Polar Satellite Launch Vehicle successfully launched the 727.5 kg Cartosat-2 Series Satellite along with 19 co-passenger satellites (June 22, 2016) from Satish Dhawan Space Centre SHAR, Sriharikota. This is the thirty fifth consecutively successful

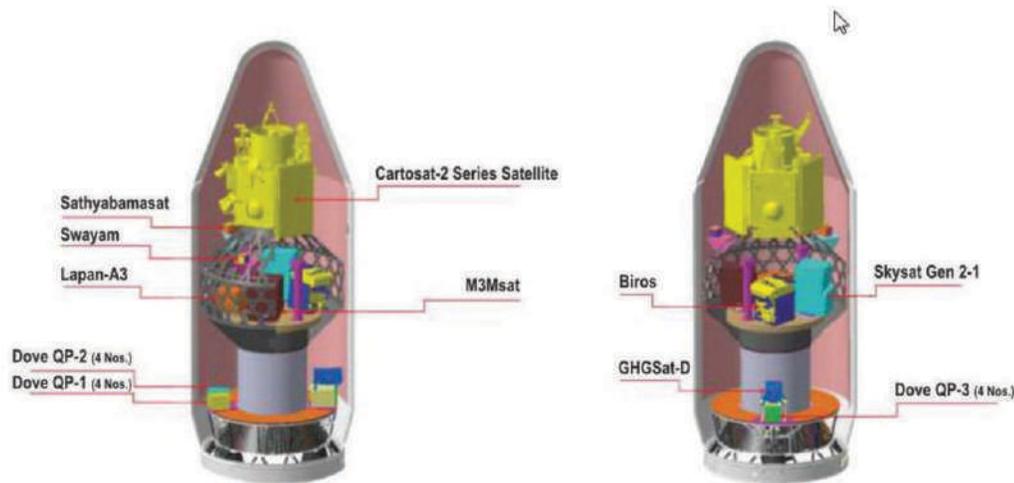
mission of PSLV and the fourteenth in its 'XL' configuration. The total weight of all the 20 satellites carried on-board PSLV-C34 was 1288 kg.

After PSLV-C34 lift-off at 0926 hrs (9:26 am) IST from the Second Launch Pad with the ignition of the first stage,

the subsequent important flight events, namely, strap-on ignitions and separations, first stage separation, second stage ignition, heat-shield separation, second stage separation, third stage ignition and separation, fourth stage ignition and cut-off, took place as planned. After a flight of 16

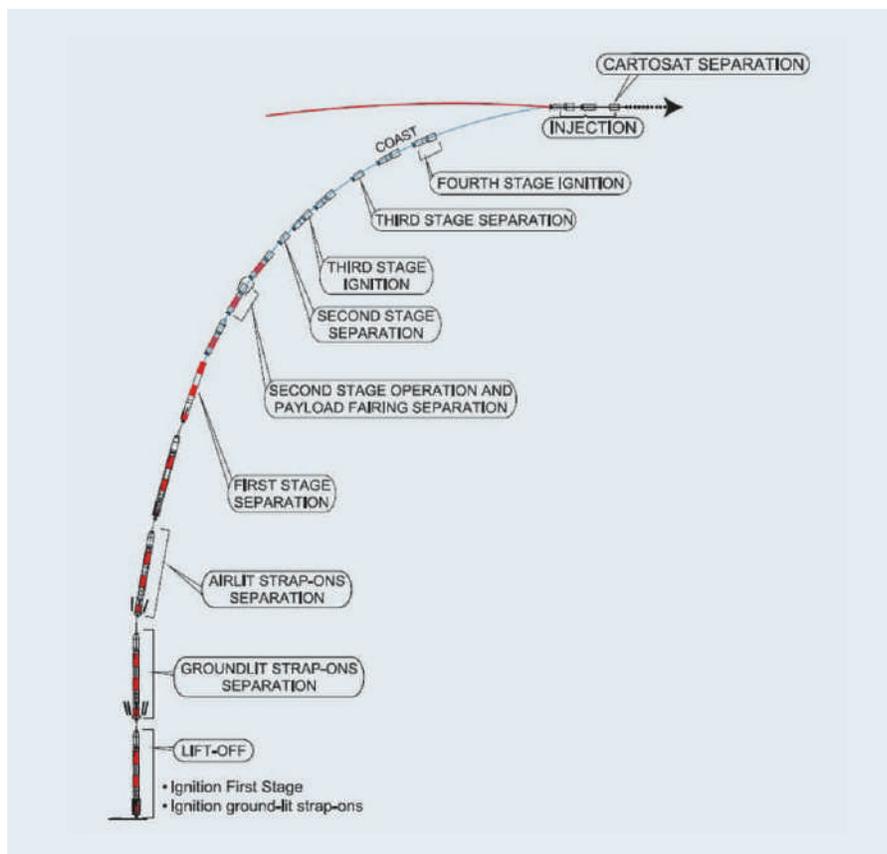
minutes 30 seconds, the satellites achieved a polar Sun Synchronous Orbit of 508 km inclined at an angle of 97.5 degree to the equator (very close to the intended orbit) and in the succeeding 10 minutes, all the 20 satellites successfully separated from the PSLV fourth stage in a predetermined sequence.

After separation, the two



solar arrays of Cartosat-2 series satellite were deployed automatically and ISRO's Telemetry, Tracking and Command Network (ISTRAC) at Bangalore took over the control of the satellite. In the coming days, the satellite will be brought to its final operational configuration following which it will begin to provide remote sensing services using its panchromatic (black and white) and multispectral (colour) cameras.

The imagery sent by the Cartosat-2 series satellite will be useful for cartographic applications, urban and rural applications, coastal land use and regulation, utility management like road network monitoring, water distribution, creation of land use maps, precision study, change detection to bring out geographical and manmade features and various



Payload

Country	Name	Nos	Mass	Type	Objective
Canada	M3MSat	1	85 kg	Microsatellite technology demonstration	Study of AIS from Low Earth orbit.
	GHGSat-D	1	25.5 kg	Earth observation microsatellite	Measuring atmospheric concentration of greenhouse gases.
Germany	BIROS	1	130 kg	Earth observation microsatellite	Remote sensing of high-temperature events.
India	Cartosat-2C	1	727.5 kg	Earth observation satellite	Primary payload. For LIS & GIS uses.
	SathyabamaSat	1	01.5 kg	Earth observation nanosatellite	Collect data on greenhouse gases.
	Swayam	1	01 kg	Earth observation nanosatellite	To provide point-to-point messaging services to HAM community.
Indonesia	LAPAN-A3	1	120 kg	Earth observation microsatellite	For land use, natural resource and environment monitoring.
USA	SkySat Gen2-1	1	110 kg	Earth observation microsatellite	Capable of capturing sub-meter resolution imagery and High-definition video.
	Flock-2P	12	04.7 kg	Earth observation nanosatellites	Earth imaging.

other Land Information System (LIS) and Geographical Information System (GIS) applications.

Of the 19 co-passenger satellites carried by PSLV-C34, two – SATHYABAMASAT weighing 1.5 kg and SWAYAM weighing 1 kg – are University/Academic institute satellites and were built with the involvement of students from Sathyabama University, Chennai and College Of Engineering, Pune, respectively.

The remaining 17 co-passenger satellites were international customer satellites from Canada (2), Germany

(1), Indonesia (1) and the United States (13).

Cartosat-2C is an earth observation satellite placed in a sun-synchronous orbit . The satellite is built at space application centre Ahmedabad. The sun-synchronous orbit can place a satellite in constant sunlight and is useful for imaging, spy, and weather satellites. More technically, it is an orbit arranged in such a way that it precesses once a year.

Though this mission is not technologically ambitious compared to its previous missions, it certainly is one of the greatest milestones

in the history of ISRO in terms of efficiency. Packing 20 satellites in a single rocket and launching them successfully requires a lot of innovative engineering. This however is not a world record . The record for most number of satellites launched in a single rocket is held by Dnepr rocket of Russia for launching 37 satellites. We certainly hope India could establish itself in the niche segment of higher payload launchers using its GSLV infrastructure. That would enable India to emerge as a global competitor in space technologies.” The Air Era “ congratulates ISRO on its successful launch.

Another Success Shift ISRO Launches INSAT-3DR



INSAT-3DR similar to INSAT-3D, is an advanced meteorological satellite of India configured with an imaging System and an Atmospheric Sounder. The significant improvements incorporated in INSAT-3DR are:

- Imaging in Middle Infrared band to provide night time pictures of low clouds and fog
- Imaging in two Thermal Infrared bands for estimation of Sea Surface Temperature (SST) with better accuracy
- Higher Spatial Resolution in the Visible and Thermal Infrared bands

And, like its predecessor INSAT-3D, INSAT-3DR carries a Data Relay Transponder as well as a Search and Rescue Transponder. Thus, INSAT-3DR will provide service continuity to earlier meteorological missions of ISRO and further augment the capability to provide various meteorological as well as search and rescue services.

INSAT-3DR has a lift-off mass of 2211 kg, which includes about 1255 kg of propellant. The propellant carried by INSAT-3DR is mainly required to raise

the satellite from the Geosynchronous Transfer Orbit (GTO) to its final Geostationary Orbit and to maintain the satellite in its orbital slot during its life. The satellite has a solar array generating 1700 Watts of power.

Payloads of INSAT-3DR:

INSAT-3DR carries a multi spectral Imager, 19 channel Sounder, Data Relay Transponder and Search and Rescue Transponder.

Launch Mass:

2211 kg

Launch Vehicle:

GSLV-F05 / INSAT-3DR

Type of Satellite:

Communication

Manufacturer:

ISRO

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Solid State Flight Data Recorder for Su-30MKI



Software Integration Rig for Display and Mission Computer



Antenna Control System for 3D Tactical Control Radar



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HAL HTT-40

India's Indigenous Basic Trainer Aircraft

The HAL HTT-40 aircraft project is a Hindustan Aeronautics Limited (HAL) proposal for an indigenous replacement for the Indian Air Force's retired HPT-32 Deepak as a basic trainer.

DESIGN AND DEVELOPMENT

The HTT-40 will be an all-metal tandem seat aircraft powered by a 1,100 hp (820 kW) turboprop engine.

In early 2012 the company forecast building 106 examples.

By the middle of 2012 the aircraft's future was in doubt as the Indian Air Force ordered 75 Pilatus PC-7 Mk IIs to fill the role envisioned for the HTT-40. In September 2012 the Air Force indicated that it had formally rejected the HTT-40 for service based on its cost per aircraft being double that of the PC-7 Mk II, a proven aircraft

already in service worldwide. An MoD official noted, "We would be willing to pay higher rates to build indigenous capability in strategic defence equipment. But can HAL argue that the capability to build basic trainers is strategically vital[?]"

HAL did not confirm the IAF announcement that it will not buy the HTT-40, nor would the company indicate whether the aircraft's development will be continued. A company spokesman said, "We treat all MOD issues/proposals as confidential...All our projects are conceived with national interest in mind though, at times, some of those take time to fructify".

On 28 February 2015, it was reported that Indian defense ministry has selected 68 HAL HTT-40 trainers and 38 Pilatus trainers to replace its current trainer aircraft fleet stating that this move was "commercially viable"



On 21 June 2015, HAL chose the Honeywell Garrett TPE331-12B turboprop to power the trainer.

HAL rolled out the first prototype on 2 February 2016.

The HAL HTT-40 had its first flight on 31 May 2016. It was piloted by HAL's chief test pilot, Group Capt Subramaniam (Retd). The flight lasted for about 30 minutes. The pilot carried out circuits and the aircraft performance was satisfactory.

HTT-40 made its first public introduction flight on 17 June 2016, with Defence Minister Manohar Parrikar in attendance at the HAL airport in Bangalore.

SPECIFICATIONS (HTT-40)

Data from HAL

General characteristics

- Crew: 2
- Gross weight: 2,800 kg (6,173 lb)
- Powerplant: 1 × Honeywell Garrett TPE331-12B turboprop, 820 kW (1,100 hp)

Performance

- Maximum speed: 600 km/h (373 mph; 324 kn)
- Range: 1,000 km (621 mi; 540 nmi)
- Service ceiling: 6,000 m (19,685 ft)

Armament

Can be armed with a gun, rockets and bombs

Roles

- Basic flying training
- Aerobatics
- Instrument Flying
- Navigation
- Night Flying
- Close formation

Technical Parameters

- Max TOW: 2800 Kg
- Speed: 450 Km/hr
- Range: 1000 KM
- Engine Thrust: 950 SHP
- Cockpit: Tandem seating, Air conditioned cockpit
- Modern Aircraft System: All metal, FADEC control Turbo Prop trainer aircraft with Zero-Zero ejection seats and Multifunction displays
- Projected requirement: 106

HTT-40 WAS BUILT WITHIN THREE YEARS.

It was a thumbs-up for local design and make of military aircraft as Defence Minister Manohar Parrikar watched HTT-40, the basic trainer aircraft for Air Force pilots, ceremonially touch the skies on 31st May 2016.

The small plane, painted bright yellow and piloted by Gp. Captain C. Subramaniam (retd) and Gp Capt. K. Venugopal, was in the skies for about 15 minutes, over the old HAL airport around 9:15

a.m. It first flew unofficially on May 31.

It has to be certified over the next two years.

Generous praise

It was victory for the design team of Hindustan Aeronautics Ltd., as its baby soared and turned. Mr. Parikkar congratulated the young team of “an average age of 30 years” on flying the Hindustan Turbo-prop Trainer in the promised time. He had a special word of praise for Project Manager Prashant Singh Bhadoria for seeing it through its hurdles.

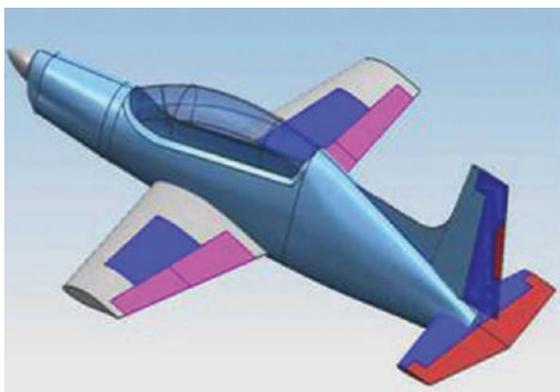
Barely two years ago, during Aero India 2015, its makers were publicly put down by the then IAF dispensation; the aircraft was outright rejected as one that would catapult the IAF's novice pilots into flying and fighting. The Air Force later imported 75 Swiss-made Pilatus PC-7 MkII.

The IAF, which will follow a two-aircraft, three-phase training, may need about 210 trainers against the earlier 181.

It may top up its June 2015 plan to buy 70 HTT-40s with another 30 or 40, Mr. Parrikar said. The trainer could be up to 25 per cent cheaper than the imported trainer and may also generate business of Rs. 3,000-4,000 crore for vendors from Bengaluru and Hyderabad in future.

He said: “The indigenous content on HTT-40 is close to 80 per cent. The young team has taken a calculated risk and has flown the aircraft within one year of assuring me of it.”

With a manufacturing record of seven decades and seven HTT-40 flights done so far, HAL Chairman



& Managing Director T. Suvarna Raju said they aimed to get it operationally certified in 2018.

It would need three flight prototypes, two static versions and would also be weaponised. This would need another Rs. 200 crore apart from HAL's initial investment of Rs. 350 crore in 2013, when it took it up in August 2013.

“It is a remarkable feat that the aircraft in its inaugural flight carried out low speed pass, a series of turns, high speed pass and short-landing using reverse thrust - which is a unique feature available on this engine-propeller combination,” he added.



Mr. Raju, who was Director (R&D) at that time, recalled that the project has glided through many earlier headwinds. (The team has painted his initials 'tsr' on the first prototype.)

A few hundred employees and invitees witnessed the flight.

The Air Era congratulates HAL on its successful test flight.

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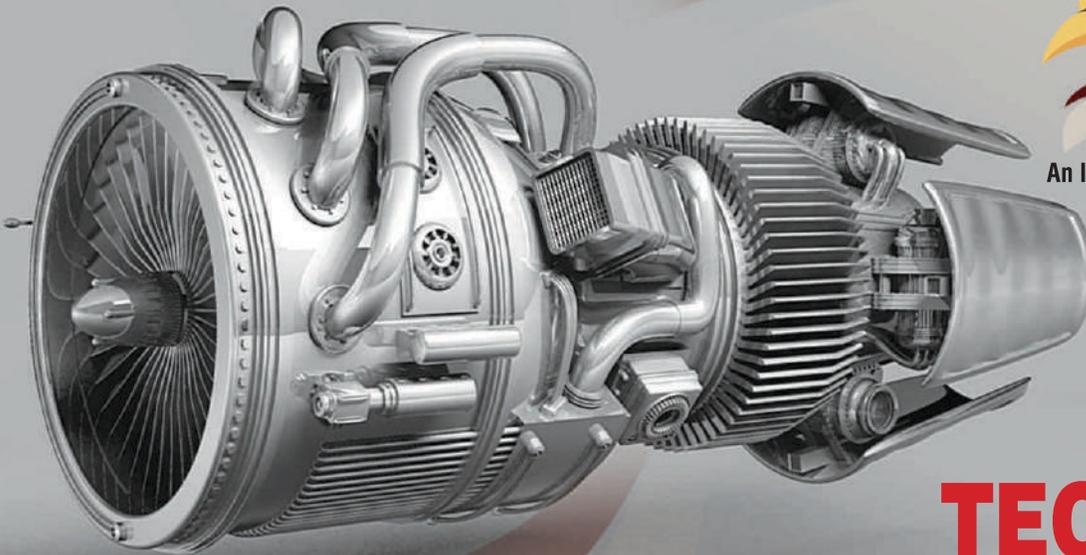
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