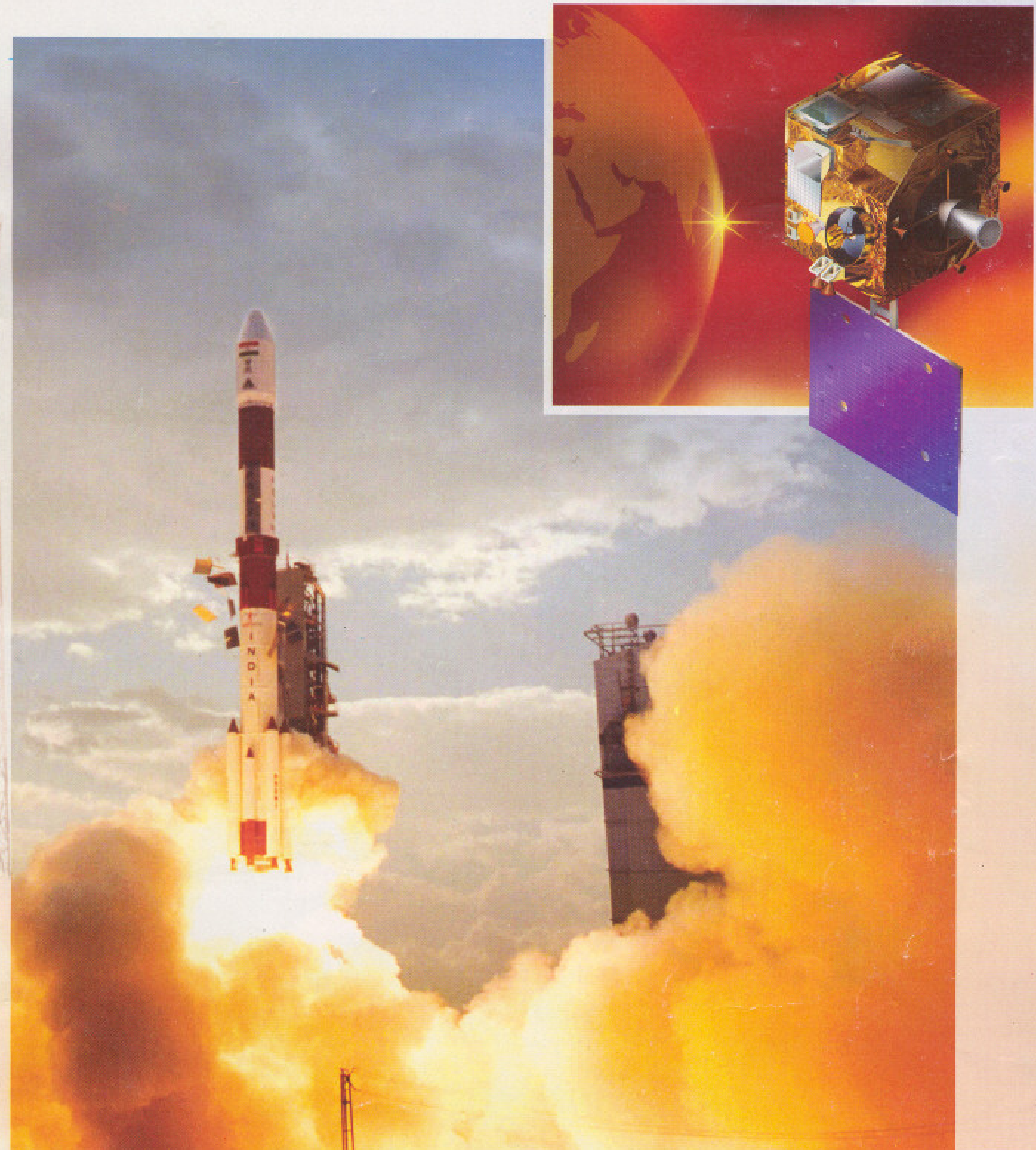
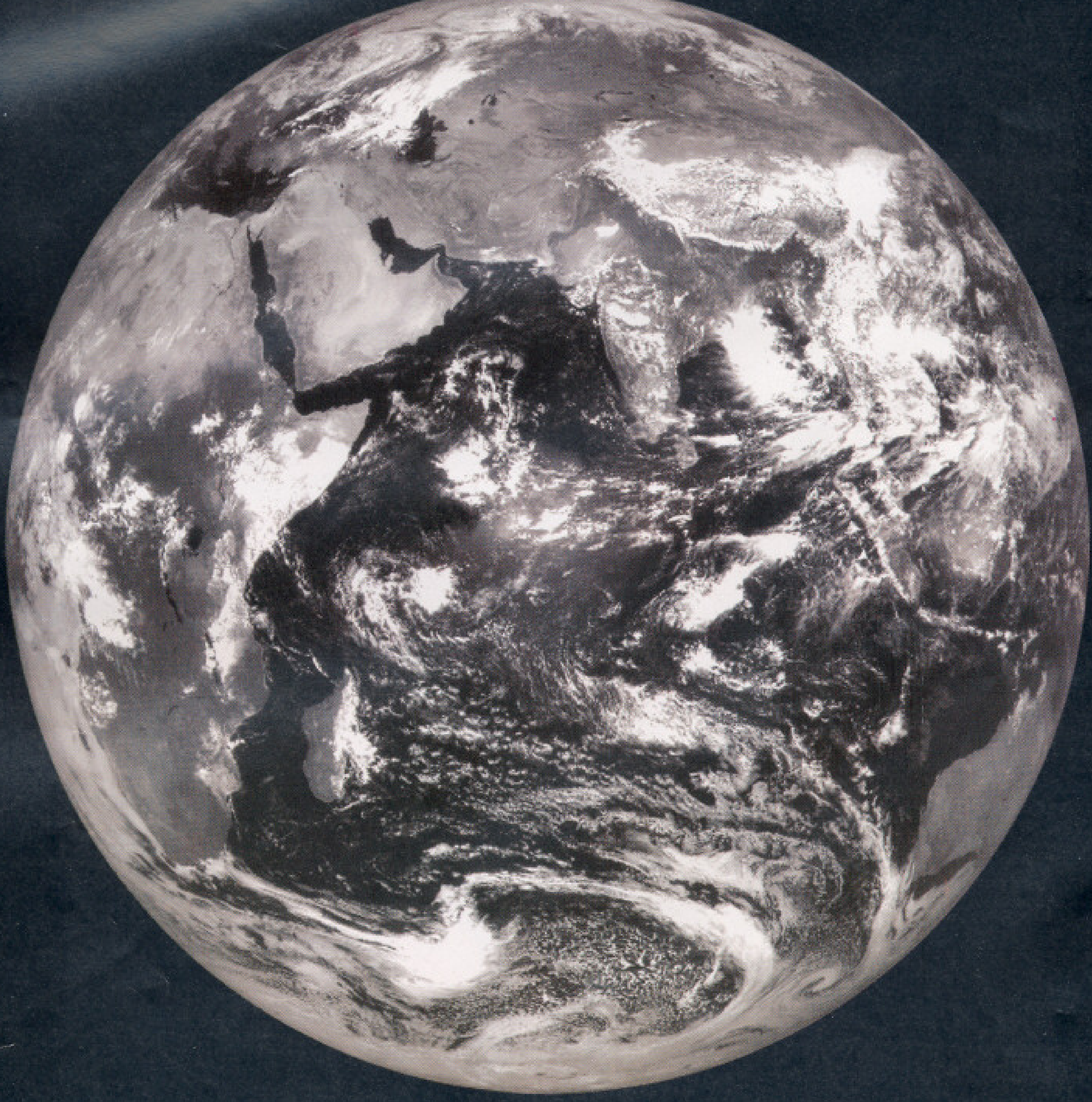
July-September 2002

SPACE india



INDIAN SPACE RESEARCH ORGANISATION



First imagery of the earth taken in the visible spectral band by India's first exclusive meteorological satellite, METSAT, at 12:45 pm on September 19, 2002.

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Cover Page :
PSLV - C4 lift off & METSAT (inset)

Editor
S Krishnamurthy

Editorial Assistance
B R Guruprasad

C O N T E N T S

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PSLV Launches METSAT

ISRO's Polar Satellite Launch Vehicle (PSLV), successfully launched India's first exclusive meteorological satellite, METSAT, into a Geo-synchronous Transfer Orbit (GTO)

In its seventh flight conducted on September 12, 2002 from Satish Dhawan Space Centre, SHAR, Sriharikota, ISRO's Polar Satellite Launch Vehicle, PSLV, successfully launched India's first exclusive meteorological satellite, METSAT, into a Geo-synchronous Transfer Orbit (GTO). It was for the first time that PSLV launched a satellite into GTO; in all its previous flights, PSLV was used to place Indian Remote Sensing satellites and other auxiliary payloads in polar orbits.

PSLV-C4 lifted off from Sriharikota at 3.53 pm with the ignition of the first stage and four strap-on motors. The major phases of the flight included the ignition of the second, third and fourth stages and their smooth separation after burn-out, separation of payload fairing and the injection of METSAT into GTO. The total flight duration from PSLV-C4 lift-off to METSAT separation from the fourth stage of PSLV in GTO was 1211 seconds (about 20 minutes).

PSLV was initially designed for launching 900 kg Indian Remote Sensing satellites (IRS) into a 900 km polar sun synchronous orbit. Since its first launch in 1993, it has been successively improved to enhance its capability. The major changes made in PSLV since its previous launch in October 2001 included the improvements in the performance of the third stage solid propellant motor by optimising the motor case and propellant loading. Also, the propellant in the fourth stage liquid propellant motor had been increased from 2 tonne to 2.5 tonne. Besides, PSLV-C4 employed a carbon fibre composite payload adopter. All these resulted in substantial payload advantage. The vehicle trajectory was modified for the flight of PSLV-C4 to inject the METSAT into a Geo-synchronous Transfer Orbit.

In its PSLV-C4 configuration, the 44.4 metre tall, 295 tonne PSLV has four stages using solid and liquid propulsion systems alternately. The first stage is one of the largest solid propellant boosters in the world and carries 138 tonne of Hydroxyl Terminated Poly Butadiene (HTPB) based propellant. It has a diameter of 2.8 m. The motor case is made of maraging steel. The booster develops a maximum thrust of about 4,628 kilo Newtons (kN). Six strap-on motors, four of which are ignited on the ground, augment the first stage thrust. Each of these solid propellant strap-on motors carries nine tonne of HTPB based propellant and produces 662 kN thrust.

The second stage employs the Vikas engine which carries 40 tonne liquid propellant — Unsymmetrical Di-Methyl Hydrazine (UDMH) as fuel and Nitrogen Tetroxide (N_2O_4) as oxidiser. It generates a maximum thrust of about 725 kN.

The third stage uses 7.6 tonne of HTPB-based solid propellant and produces a maximum thrust of 260 kN. Its motor case is made of polyaramide fibre composite. The fourth and the terminal stage of PSLV has a twin engine configuration using liquid propellant. With a propellant loading of 2.5 tonne (Mono-methyl hydrazine and Mixed Oxides of Nitrogen), each of these engines generates a maximum thrust of 7.4 kN.

The 3.2 m diameter metallic bulbous payload fairing of PSLV protects the spacecraft during the atmospheric regime of the flight.

PSLV flight control system includes : a) First stage — Secondary Injection Thrust Vector Control (SITVC) for pitch and yaw, liquid propellant thrusters for roll with SITVC in two strap-on motors for roll control augmentation, b) Second stage — Engine gimbal for pitch and yaw and, hot gas reaction

PSLV-C4 Salient Features

Overall length	:	44.4 m
Lift-off weight	:	295 t
No. of stages	:	4
Payload	:	METSAT
Orbit	:	Geo-synchronous Transfer Orbit (GTO)

PSLV - C4 ready for lift off

PSLV Propulsive Stages at a Glance

Stage	Nomen-clature	Propellant	Propellant mass (t)	Thrust (kN)	Burn time (s)	Stage Dia(m)	Dimension L(m)
1	PS1	SOLID HTPB	138	4628	107	2.8	20
	+	BASED	+	+			
	PSOM 6 Nos.	SOLID HTPB BASED	6 X 9	6 X 662	45	1.0	10
2	PS2	LIQUID UDMH+ N_2O_4	40.6	725	163	2.8	12.8
3	PS3	SOLID HTPB BASED	7.6	260	109	2.0	3.6
4	PS4	LIQUID	2.5	2x7.4	515	2.8	2.9

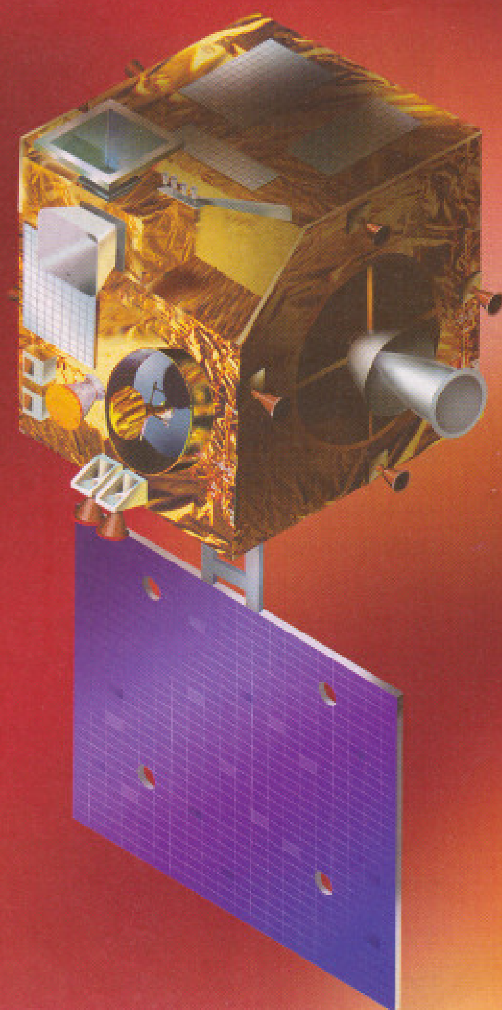
control for roll, c) Third stage — flex nozzle for pitch and yaw and liquid propellant thrusters in pulse mode for roll control, d) Fourth stage — Engine gimbal for pitch, yaw and roll, and, liquid propellant thrusters in pulse mode for control during the coast phase.

The inertial navigation system in the equipment bay, which is located on top of the fourth stage, guides the vehicle from lift-off to spacecraft injection into orbit. The vehicle is provided with instrumentation to monitor the vehicle performance during the flight supported by S-band PCM telemetry. C-band transponders cater to the tracking requirement. The ground based radar tracking system provides real-time information for flight safety. PSLV employs a large number of auxiliary systems for stage separation, heat-shield separation and jettisoning, etc.

Indian Launches So Far

	Vehicle	Launch Dates	Result
1.	SLV-3 E1	August 10, 1979	Unsuccessful due to a jammed valve in II Stage control system.
2.	SLV-3 E2	July 18, 1980	Successful
3.	SLV-3 D1	May 31, 1981	Successful
4.	SLV-3 D2	April 17, 1983	Successful
5.	ASLV-D1	March 24, 1987	Unsuccessful due to non-ignition of first stage
6.	ASLV-D2	July 13, 1988	Unsuccessful. Flight normal till 46 seconds after lift off
7.	ASLV-D3	May 20, 1992	Successful
8.	ASLV-D4	May 4, 1994	Successful
9.	PSLV-D1	Sept 20, 1993	Unsuccessful due to software error in guidance and control processor
10.	PSLV-D2	October 15, 1994	Successful
11.	PSLV-D3	March 21, 1996	Successful
12.	PSLV-C1	Sept 29, 1997	Successful
13.	PSLV-C2	May 26, 1999	Successful
14.	GSLV-D1	April 18, 2001	Successful
15.	PSLV-C3	October 22, 2001	Successful
16.	PSLV-C4	Sept 12, 2002	Successful

METSAT



METSAT is the first exclusive meteorological satellite built by ISRO. So far, meteorological services had been combined with telecommunication and television services in the INSAT system. METSAT will be a precursor to the future INSAT system that will have separate satellites for meteorology and telecommunication & broadcasting services. This will enable larger capacity to be built into INSAT satellites, both in terms of transponders and their radiated power, without the design constraints imposed by meteorological instruments.

METSAT carries a Very High Resolution Radiometer (VHRR) capable of imaging the Earth in the visible, thermal infrared and water vapour bands. It also carries a Data Relay Transponder (DRT) for collecting data from unattended meteorological platforms. METSAT will relay data sent by these platforms to the Meteorological Data Utilisation Centre at New Delhi. Such platforms have been installed all over the country. The 1060 kg METSAT was designed using a new spacecraft bus employing lightweight structural elements like Carbon Fibre Reinforced Plastic (CFRP). The satellite has a solar array generating 550 Watt of power.

METSAT was injected into orbit with a perigee (nearest point to Earth) of 218 km and an apogee (farthest point to Earth) of 34,700 km with an orbital inclination of 17.7 deg. with respect to the equator. The orbital period was 10.5 hours.

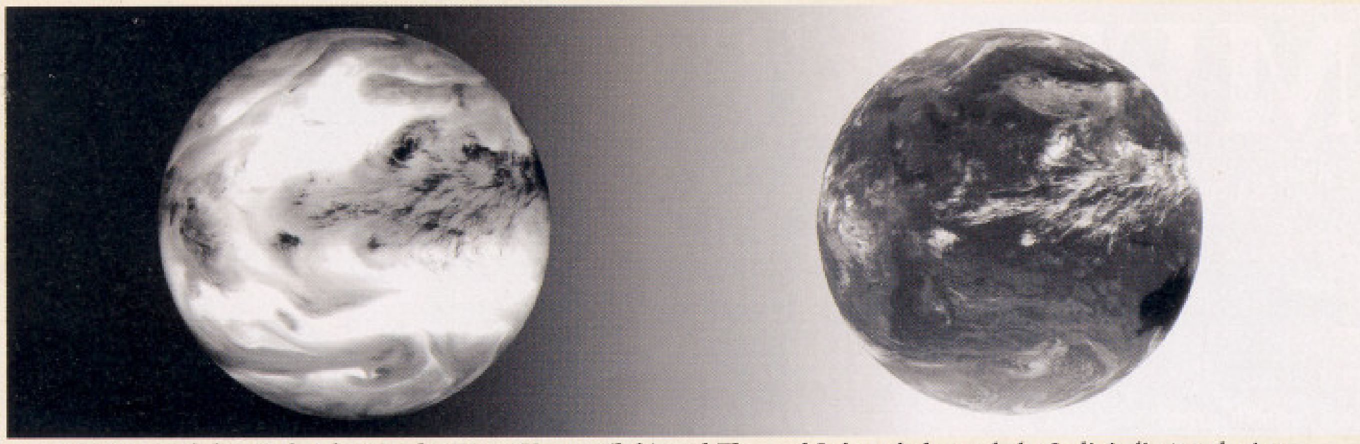
METSAT's solar array was automatically deployed immediately after its injection into Geo-synchronous Transfer Orbit (GTO) by PSLV-C4. The successful deployment of the array as well as the general health of the satellite were monitored by a ground station of the ISRO Telemetry, Tracking and Command network (ISTRAC) located in the Indonesian island of Biak.

The Master Control Facility (MCF) at Hassan in Karnataka took control of METSAT for all its post-launch operations. Ground stations at Lake Cowichan (Canada), Fucino (Italy) and Beijing (China) supported MCF in monitoring the health of the satellite and its orbit raising operations.

The orbit raising manoeuvres were started on September 13, 2002 and through three firings of the Liquid Apogee Motor (LAM) on board the METSAT for a total duration of 50 minutes 19 seconds, the satellite was placed in near geo-synchronous orbit on September 15, 2002. The spacecraft, which had 560 kg of propellant at the time of its injection into GTO, has still about 100 kg of propellant left,

Salient Features

Mission payload	:	Meteorological
Orbit	:	Geostationary
Location	:	74° E Longitude
Mass at lift-off	:	1060 kg
Dry Mass	:	498 kg
Size	:	Cuboid of Size 1475 x 1505 x 1530 (mm) (E-W) (EV-AEV) (N-S)
Length when fully Deployed	:	3416 mm (along North-South)
Power	:	Solar array generating 550 W at End Of Life. 18 Ah Ni-Cd battery for full payload operations during eclipse
Mission Life	:	7 years



First imageries of the earth taken in the Water Vapour (left) and Thermal Infrared channels by India's first exclusive meteorological satellite, METSAT.

sufficient for its station keeping operations during its design mission life of 7 years. The spacecraft was put in 3-axis stabilisation mode on September 16, 2002 and the VHRR instrument was turned on for the first time on September 19, 2002. The first pictures received at MCF, Hassan, indicate excellent functioning of VHRR. The METSAT has since been located at 74 deg east longitude from where regular operations are expected to commence from the first week of October 2002.

The successful launch of METSAT into Geo-synchronous Transfer Orbit has proved the versatility of PSLV to launch both Polar and Geostationary satellites. Together with GSLV, it will enable India to launch communication, meteorology and remote sensing satellites of different weight classes. The exclusive meteorological satellite, METSAT, once commissioned, is expected to vastly improve the meteorological services being provided by INSAT system.

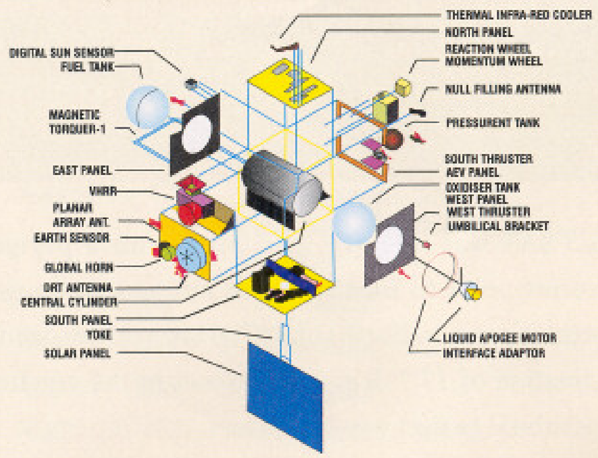
Very High Resolution Radiometer (VHRR)

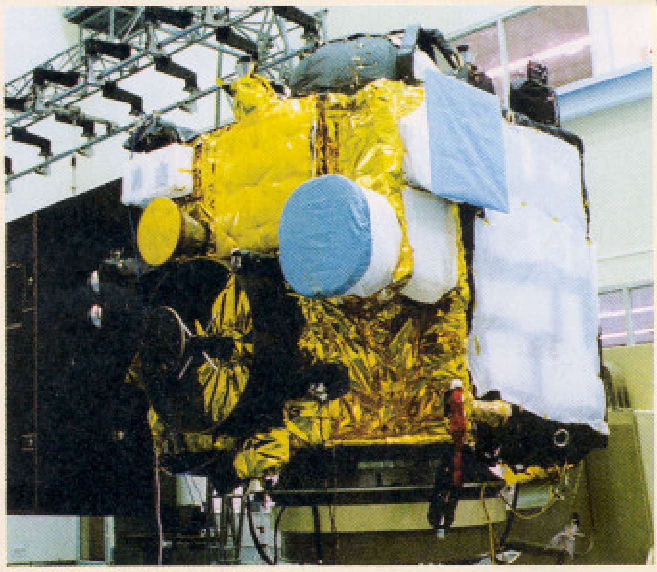
Spectral Bands	: 3
• Visible	: 0.55 to 0.75 μm
• Thermal Infra-red	: 10.5 to 12.5 μm
• Water Vapour	: 5.7 to 7.1 μm
Spectral Resolution	
• Visible	: 2 km
• Infra-red & Water Vapour	: 8 km
Imaging Modes & Coverage	
Full Scan	
• Coverage	: 20° N-S & 20° E-W
• Repeatability	: 33 min
Normal Scan	
• Coverage	: 14° N-S & 20° E-W
• Repeatability	: 23 min
Sector Scan	
• Coverage	: 4.5° N-S & 20° E-W
• Repeatability	: 23 min
Data Transmission	
Downlink	: 4503.05 MHz
EIRP	: 18 dBW
Data rate	: 526.5 kbps

Data Relay Transponder (DRT)

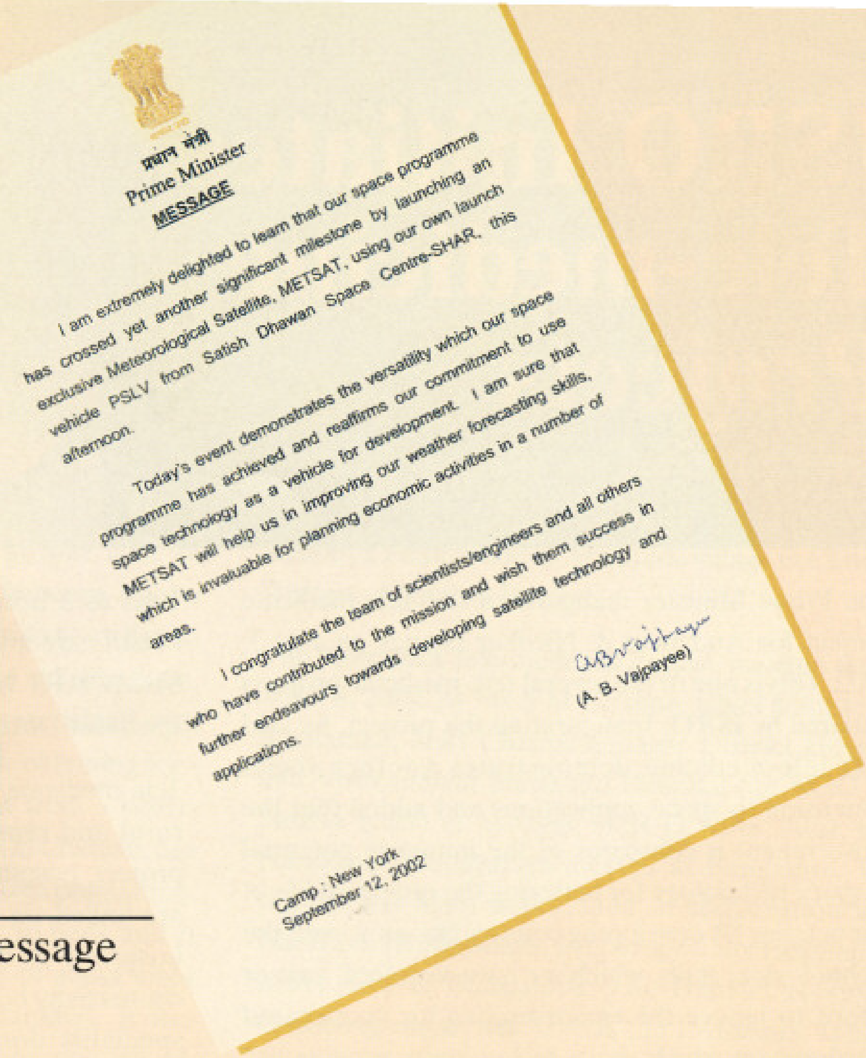
Uplink frequency	: 402.75 MHz
Downlink frequency	: 4506.05 MHz
Bandwidth	: ± 100 kHz
EIRP	: 21 dBW (Min).

Disassembled view of METSAT





METSAT during ground test



प्रधान मंत्री
Prime Minister
MESSAGE

I am extremely delighted to learn that our space programme has crossed yet another significant milestone by launching an exclusive Meteorological Satellite, METSAT, using our own launch vehicle PSLV from Satish Dhawan Space Centre-SHAR, this afternoon.

Today's event demonstrates the versatility which our space programme has achieved and reaffirms our commitment to use space technology as a vehicle for development. I am sure that METSAT will help us in improving our weather forecasting skills, which is invaluable for planning economic activities in a number of areas.

I congratulate the team of scientists/engineers and all others who have contributed to the mission and wish them success in further endeavours towards developing satellite technology and applications.

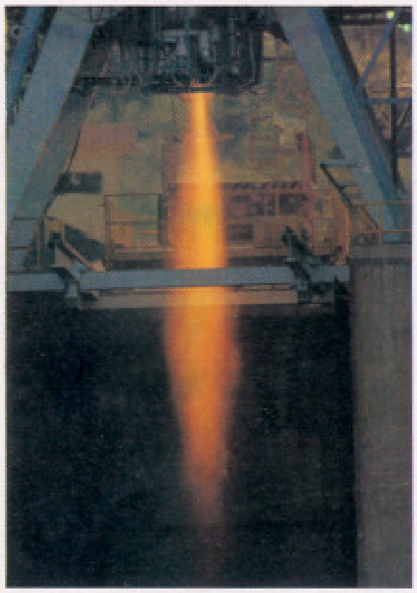
(A. B. Vajpayee)

Camp : New York
September 12, 2002

Prime Minister's Message

Indigenous Cryogenic Engine Tested for 1000 Seconds

Development of ISRO's Cryogenic Upper Stage for GSLV crossed a significant milestone on September 14, 2002 with the successful ground test firing of the engine for a duration of 1000 seconds, the longest so far. The test was carried out at the Liquid Propulsion Systems Centre (LPSC) test complex at Mahendragiri in Tamil Nadu. The performance of the test was normal.

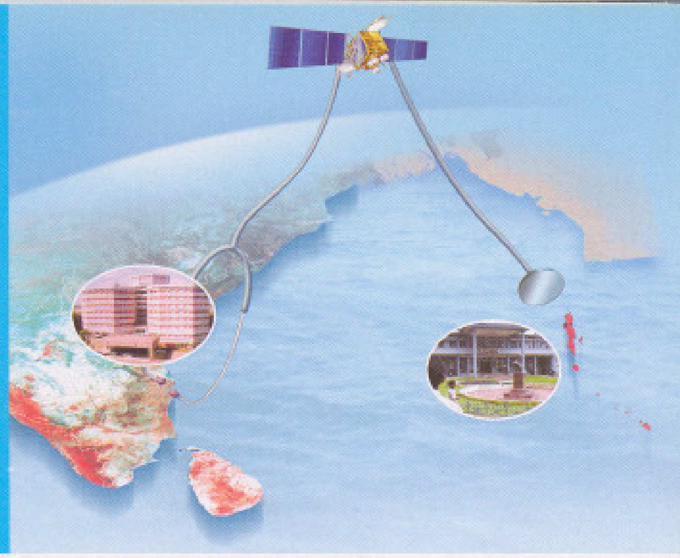


During the test, the thrust of the engine was also increased for part of the test by pre-programmed sequencing. The test is part of a series of evaluation tests to characterise the different performance parameters under various operating conditions.

The cryogenic engine, using a combination of liquid hydrogen and liquid oxygen, is designed to operate for about 700 seconds. This turbo-pump fed, regeneratively cooled engine produces a nominal thrust of 7.0 tonne in vacuum. Cryogenic propulsion has been selected for the third stage of GSLV in view of its higher efficiency compared to solid and earth storable liquid propulsion systems. Cryogenic technology is quite complex and is the preserve of only five other nations. The behaviour of materials at cryogenic temperatures of less than 250 deg below zero, the turbo pump operating at very high speeds of the order of 40,000 rpm, elaborate chilling process for preparing the ground and on-board systems, interplay of critical engine parameters and a host of technical aspects make the development quite challenging.

While the test on September 14, 2002 validated the design adequacy of the engine, further demonstration tests are planned at engine and stage level during this year.

ISRO Initiates Tele-medicine Projects



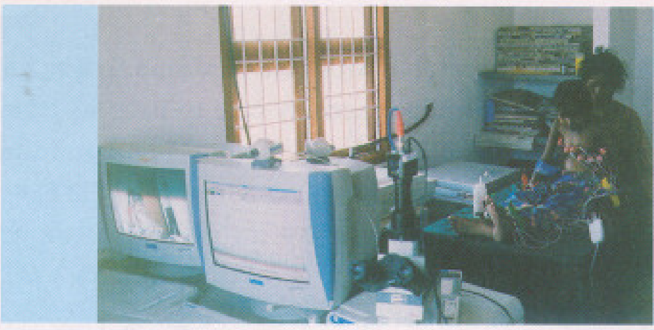
The Prime Minister inaugurated the Tele-medicine Project for Andaman & Nicobar Islands on July 3, 2002. This is one of the several tele-medicine projects initiated by ISRO. Inaugurating the project, he said that tele-medicine demonstrates another social dimension to space applications and added that the Government is conscious of the immense potential of space technology for bettering the quality of life of our people. "A developing country like ours, with the technological skills, which we have acquired, cannot afford to ignore the opportunities for accelerated development which space technologies provide us" he added. Lt Governor of Andaman & Nicobar Islands, Mr N N Jha participated in the function from the Port Blair end.

The Andaman & Nicobar Islands (A & N) Tele-medicine Project links the G B Pant Hospital, Port Blair with Sri Ramachandra Medical College and Research Institute (SRMC&RI) at Chennai. The project has been undertaken in collaboration with the A & N Administration, and SRMC&RI, Chennai. Located in the premises of the historic Cellular Jail, the G B Pant Hospital at Port Blair is the only referral hospital for the entire group of A & N Islands. Set-up initially in 1963, the Hospital now has about 500 beds. A large number of outpatients are treated at the hospital everyday. The hospital has about 40 doctors including a few specialists. Super specialty services in cardiology, cardio-thoracic surgery, neurology, nephrology, gastro-enterology, urology, plastic surgery, etc are obtained from the mainland. A & N Administration also provides Air Ambulance Services to patients with medical emergencies. Sri Ramachandra Medical College & Research Institute (SRMC&RI), Chennai was established in 1985 as a non-profit Trust for medical education, health care and research. The Hospital wing of the SRMC&RI has over 1500 beds and about 250 specialist Doctors.

Tele-medicine facilitates expert medical services to rural and remote areas. Under the Tele-medicine project, hospitals/health centres in remote locations are linked via INSAT satellites with super specialty hospitals at major towns and cities, bringing in connectivity between patients at remote end with the specialist doctors for medical consultation and treatment. Tele-medicine pilot projects are undertaken by ISRO with the involvement of selected super specialty Hospitals located in major cities and smaller health centres in distant and rural areas.

Tele-medicine mainly consists of customised medical software integrated with computer hardware, along with medical diagnostic instruments connected to the commercial VSAT (Very Small Aperture Terminal) at each location, which in turn, is linked to a super specialty hospital through satellite. The medical records of the patient like medical images and outputs from medical devices are sent to the specialist doctors, who in-turn study them, diagnose and advise on the course of treatment through videoconference with the doctor or a paramedic at the patient's end. The specialist doctor could even guide the doctor at the patient's end during a surgery. Thus, the patients in distant and rural areas can avail timely consultations of specialist doctors without the ordeal of traveling long distances and at large expense.

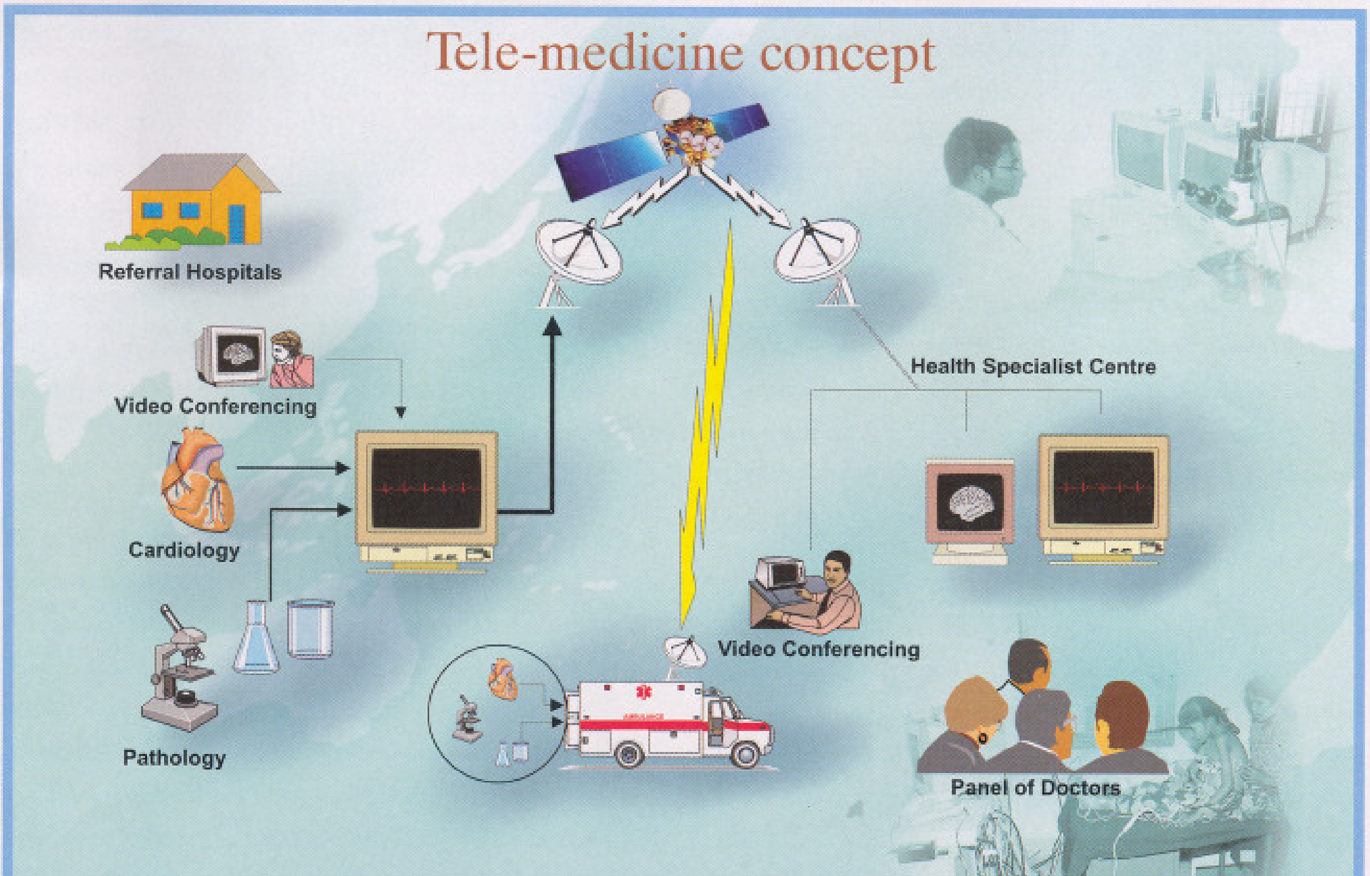
Several tele-medicine projects have been started by ISRO recently. As part of a Memorandum of Understanding between ISRO and the Apollo Tele-



Tele-medicine in progress...

medicine Enterprise Limited, the Apollo-SHAR Tele-medicine Project was inaugurated in May 2002 to establish tele-medicine connectivity between Apollo Hospitals, Chennai and ISRO's hospital at Satish Dhawan Space Centre, SHAR located at Sriharikota. The hospital being located in a remote island with limited facilities and specialist doctors, obtaining tele-medicine consultation and treatment from a super-specialty hospital like Apollo Hospital in Chennai, can improve the healthcare of the Sriharikota population. The Sriharikota hospital has about 50 beds and it caters to the needs of the healthcare of about eight thousand ISRO personnel and their families. It also serves the tribal population inhabiting this Island. Under the same MOU, another tele-medicine project is in operation between the Apollo Hospital, Chennai and Aragonda Apollo Hospital and Educational Research Foundation at Aragonda village in Chittoor District of Andhra Pradesh.

The Karnataka Tele-medicine Project, inaugurated on April 8, 2002, by Mr S M Krishna, Chief Minister of Karnataka, links Chamarajanagar District Hospital and Vivekananda Memorial Hospital (an NGO run Health Unit) at Saragur in H D Kote Taluk with Narayana Hrudayalaya located at Bangalore. This project has been undertaken in cooperation with Narayana Hrudayalaya, a super specialty Hospital for heart care in Bangalore. The District Hospital, Chamarajanagar, has 70 beds and 15 doctors. It has a capacity to treat over 250 outpatients a day. The hospital has facilities for general medical and surgical treatments. An ICU for cardiac care has also been



Tele-medicine Projects of ISRO

Project	Specialty Hospital end	Distant/Rural end
Andaman & Nicobar Islands	Sri Ramachandra Medical College & Research Institute, Chennai	GB Pant Hospital, Port Blair
Apollo-SHAR	Apollo Hospital, Chennai	ISRO's SHAR Hospital, Sriharikota Aragonda Apollo Hospital, Chittoor District, Andhra Pradesh
Karnataka	Narayana Hrudayalaya, Bangalore	District Hospital, Chamarajanagar Vivekananda Memorial Hospital, Saragur, HD Kote Taluk, Mysore District
Tripura	Narayana Hrudayalaya, Bangalore and Rabindranath Tagore International Institute of Cardiac Sciences, Kolkata	Tripura Sundari District Hospital, Udaipur, South Tripura
Assam	All India Institute of Medical Sciences (AIIMS), New Delhi	Guwahati Medical College & Hospital
Ladakh	All India Institute of Medical Sciences (AIIMS), New Delhi	District Hospital, Leh
Union Territory of Lakshadweep	Amrita Institute of Medical Sciences (AIMS), Cochin	Indira Gandhi Hospital, Kavaratti
Orissa	Sanjay Gandhi Post - graduate Institute of Medical Sciences, Lucknow	District Hospital, Cuttack Government Hospital at Sambalpur

integrated with Tele-medicine facility for providing specialty care to patients from all over the district. Vivekananda Memorial Hospital, Saragur in H D Kote Taluk is run by an NGO – Swamy Vivekananda Youth Movement (SVYM). It was set up in 1984 by a group of young doctors for serving the tribal and rural population in the region. The hospital, at present, has 7 doctors and treats over 50 outpatients a day.

In India, only two percent of the specialist doctors are practicing in rural areas where the majority of the patients live. The number of beds is a mere 0.19 per 1000 population in rural areas and 2.2 per 1000 in urban areas. It is in this context, that tele-medicine can be a boon to extend super specialty medical consultations to rural and remote areas.

ISRO Pays Tribute to Dr Vikram Sarabhai

In a nostalgic, simple and solemn function held at Vikam Sarabhai Space Centre, Thiruvananthapuram on July 8, 2002, ISRO paid its humble tribute to the great son of India, late Dr. Vikram Sarabhai, when his bust was unveiled by his wife Mrs. Mrinalini Sarabhai, in the presence of a galaxy of close associates of late Dr. Sarabhai. Unveiling the bronze bust, carved by the seasoned hands of the famous sculptor, Mr. Kanayi Kunhiraman at the Veli Research Complex, she reminisced the early days when her late husband carved out the Indian space programme. She wished that his vision be passed on to younger people so that they too share in the future of the country'.

Welcoming the gathering earlier, Dr. K Kasturirangan, Chairman, ISRO pointed out that the real tribute to Dr. Sarabhai is the four decades of work that have translated what Dr. Sarabhai envisaged, in the way that he would have wanted to. He added that Dr. Sarabhai was a "kind of perpetual being, always with us in our tribulations and in our moments of triumph". Prof M G K Menon,

Dr A P J Abdul Kalam addressing the ISRO community from Veli hills at VSSC. Mrs Mrinalini Sarabhai, Dr Kasturirangan and Director of VSSC Mr G Madhavan Nair are also seen on the dais.

the well known scientist, former Minister and former Chairman of ISRO presided over the function.

The Chief Guest on the occasion was Dr. A P J Abdul Kalam, who was later elected as President of India on July 22, 2002. In his inimitable way Dr. Kalam described Sarabhai as a visionary who was always ahead and an "invisible" leader whose smiling demeanor was a lesson in itself. He pointed out that the ability to think is the real capital of the space community. Another lesson he learnt from Dr. Sarabhai was good leadership – a leader who looks upon a team member's excellence as the success of the team.

Poly-Urethane Technology for Artificial Foot

ISRO signed a Technology Transfer Agreement on July 29, 2002 with Bhagavan Mahavir Vikalanga Sahayatha Samithi, Jaipur, a social organisation, for Poly-Urethane Foot Technology developed by ISRO's Vikram Sarabhai Space Centre (VSSC), Thiruvananthapuram.

VSSC has pioneered the research and development of various polymeric materials and systems of high reliability and quality for launch vehicles and satellites. Poly-Urethane (PU) polymers and its advanced derivatives are extensively used in propellants, cryogenic insulation, thermal insulation pads, structural damping, acoustic insulation, other light weight structural materials for vibration control, shock absorption, liners, adhesives, coatings and so on.

There have been several spin-offs borne out of this research programme that are of direct benefit to the common man. These include polymeric materials and products for the handicapped. VSSC has worked on several polymers like Poly-Urethane, Silicones-Epoxies, Synthetic Rubbers, Adhesive resins and other products for making artificial limbs and orthotic appliances. Modification of the Jaipur Foot, which was pioneered by Dr P K Sethi and his co-workers was one such effort.

As present as the Jaipur foot is made from vulcanized natural rubber compound and wooden ankle block, it is comparatively heavy. Though it is acceptable for the lower limb amputees, especially for the poor in India, there were several defects which needed to be corrected. Its manufacturing process is cumbersome and highly labour intensive and consequently the production is slow. Since it comprises many components like wood, reinforcements, pieces of MCR sheet, tyre cord, cushion compound, etc, ensuring proper quality is difficult. There was a need to make it lighter, durable, cosmetically more attractive and comfortable for the patients.

Poly-Urethanes are versatile polymers, which can be produced in various forms like elastomers, adhesives, flexible and rigid foams and coating material. They can be readily produced by reacting a polyol and an isocyanate. Poly-Urethane foams are produced by using an external blowing agent like Freon, CO_2, Methylene chloride, etc. The isocyanate-containing polymer rapidly reacts with water producing CO_2, which also generally acts as a blowing agent.

PU foot being fitted to an amputee

Boy with a PU foot

Properties of Urethane Polymers

Property	Micro Cellular Urethane Foam	Low density Foam	Polyether urethane elastomer	Polyester urethane elastomer
1. Density (kg/m^3)	750	30	1120	1120
2. Tensile Strength (kg/cm^2)	10-80	0.50-1.6	50-200	75-300
3. Elongation %	50-400	100-280	700-800	600-800
4. Tear strength (kg/cm)	10-50	0.40-0.60	30-40	75-80
5. Compression Load (kg/cm^2) (50% deflection)	8-60	0.05-0.08	35-200	45-250
6. Hardness shore-A	25-85	-	75-85	80-90

The modified Jaipur foot, which has the rubber and wooden ankle block substituted by the more durable Poly-Urethane micro cellular foams are lighter, and could be produced in large numbers in minimum time with improved quality, providing added comfort, gait and durability for the amputees.

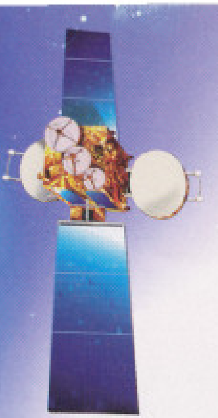
Before transferring the technology, the new Poly-Urethane (PU) foot was subjected to accelerated flex fatigue tests and patient trials. Subsequently, the foot prostheses were sent to Jaipur and successfully fitted to many patients in collaboration with the Department of Physical Medicine and Rehabilitation (DPMR) at the Government Medical College, Thiruvananthapuram as well as in the community based rehabilitation camps.

PU foot prostheses are bio-mechanically advantageous as far as comfort and injury prevention are concerned. Slip resistance of the PU foot is much higher than other materials. Moreover, slip resistance of the PU material studied over wet and oily surface is also found to be much higher in comparison to rubber and allied materials. Thus, amputees using PU foot prostheses can walk more safely on any type of surface. Besides, its abrasion resistance being higher, PU foot also lasts longer. PU foam foot moulded with cosmetically attractive skin covers made of Poly-Urethanes are found to be more acceptable to amputees and a number of amputees were successfully fitted with such prostheses.

The agreement for the transfer of technology, free of cost, will enable Bhagavan Mahavir Vikalanga Sahayatha Samithi, Jaipur, to produce Poly-Urethane Foot in large quantities for the benefit of masses, especially amongst the poor amputees in the country.

PU foot under testing

Prime Minister Dedicates INSAT- 3C to the Nation



The Prime Minister Mr Atal Bihari Vajpayee dedicated ISRO's INSAT-3C to the nation at a function organised at ISRO's Delhi Earth Station on July 3, 2002. Dedicating the satellite, the Prime Minister said that INSAT-3C truly symbolises the national spirit of self-reliance and excellence in modern space technology. "By connecting advanced areas of the country with under-developed and remote locations, the INSAT network helps to reduce the urban-rural divide and deliver the fruits of development to all" he said and cited the Swarna Jayanthi Vidya Vikas Antariksh Upagrah Yojana, which provides education, information and training to people in remote areas, as a good example. He added that this scheme is today poised to grow into a nationwide Gramin Satellite network that will use communications and remote sensing satellites for a wide range of rural development applications, including tele-education and tele-health services. Mrs Vasundhara Raje, Minister of State (Space), also participated in the function.

INSAT-3C was launched by an Ariane launch vehicle of Arianespace from Kourou, French Guyana on January 24, 2002. Following the launch, the satellite was manoeuvred by Master Control Facility, Hassan, in Karnataka, to place it in the geo-stationary orbit. The deployment of the appendages like the solar arrays and antennas, three-axis stabilisation of the spacecraft and testing of all the transponders on board the satellite were also completed and the satellite positioned in its designated slot at 74 deg east longitude by the end of February 2002.

INSAT-3C carries 24 C-band transponders, six extended C-band transponders, two S-band transponders and a Mobile Satellite Service transponder operating in S-band up-link and C-band downlink.

ISRO Centre Named after Prof Satish Dhawan

In a function held at Sriharikota on September 5, 2002, the Prime Minister, Mr Atal Bihari Vajpayee, named the ISRO's launch Centre as ***Satish Dhawan Space Centre, SHAR*** *by remotely unveiling a specially erected plaque at Sriharikota, from his residence in New Delhi.*

Prof Satish Dhawan, who passed away on January 3, 2002, was the Chairman of ISRO from 1972-84, which were its formative years.

Unveiling the plaque from New Delhi, the Prime Minister said that Prof Satish Dhawan was a multi-faceted personality and truly, one of the most distinguished Indians of our times – a brilliant aeronautical engineer, an outstanding space scientist, a philosopher, a humanist, and above all, a great visionary. "His unique human qualities, combining intense personal charm with a deep commitment to social values and an extraordinary objectivity in management, led several generations of students, colleagues and administrators to efforts that, perhaps, would not have been undertaken otherwise" he said and added that scrupulous objectivity and deep concern for the society's problems always marked his leadership.

The Prime Minister said that Sriharikota launch range occupies a prominent position in the space atlas of the world having launched all ISRO satellite launch vehicles so far, and by naming this important space establishment as Satish Dhawan Space Centre, SHAR, India is paying its humble tribute to the man who epitomizes the value system that goes with excellence, professionalism and, above all, deepest commitment to the growth of science and technology and their implications for the society and its overall progress. He expressed confidence that those working in the Indian space programme, especially at Sriharikota, will draw inspiration from late Prof Satish Dhawan's life and take this programme to a higher level of excellence.

Mrs Vasundhara Raje, Minister of State (Space) and Mr Brajesh Mishra, Principal Secretary to Prime Minister were also present at the Prime Minister's residence in New Delhi for the function, besides several dignitaries, space scientists and others at Sriharikota.

Bust of Dr Vikram Sarabhai unveiled at VSSC

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