

GSLV-D2/GSAT-2 MISSION

GSLV-D2

Salient Features :

- ★ Overall height (m) : 49.1
- ★ Lift-off Mass (t) : 414
- ★ Lift-off Thrust (kN) : 6773
- ★ No. of Stages : 3
- ★ Payload : GSAT-2
- ★ Payload mass (Kg) : 1825
- ★ Orbit : GTO

GSLV-D2 / GSAT-2 MISSION

The Geosynchronous Satellite Launch Vehicle, GSLV, is designed to place 2 tonne class of satellites into Geosynchronous Transfer Orbit (GTO)

GSLV-D2, the Second developmental flight, carries the communication satellite, GSAT-2



INDIAN SPACE RESEARCH ORGANISATION

GSLV-D2 STAGES AT A GLANCE

Stage Parameter	First Stage, GS1		Second stage GS2	Third stage GS3
	S139 booster	L40H strapon		
Length (m)	20.13	19.7	11.6	8.7
Diameter (m)	2.8	2.1	2.8	2.9
Total mass (t)	161.33	47.44	44.1	15.18
Useful Propellant mass (t)	138.15	42.25	39.3	12.64
Case/Tank Material	M 250 steel	Aluminium Alloy	Aluminium Alloy	Aluminium Alloy
Propellant	HTPB & Ammonium perchlorate	UH25 & N ₂ O ₄	UH25 & N ₂ O ₄	LH ₂ & LOX
Burn time (s)	106.5	149	135	707
Thrust (kN in Vacuum)	4736 (pk)	765	804	Up-rated Phase : 81.6 Nominal Phase: 73.6
Control system	Engine gimbaling in one plane		Engine gimbaling for Pitch and Yaw control; Reaction thrusters for Roll control	Vernier engine gimbaling for Pitch, Yaw and Roll control : Reaction thrusters for coast phase
Separation system	Flexible linear shaped cord (FLSC)		Pyro actuated collet release mechanism	Merman band and spring thrusters



Nozzle-end segment of S139 motor along with Core Base Shroud (S139 motor comprises 5 segments)

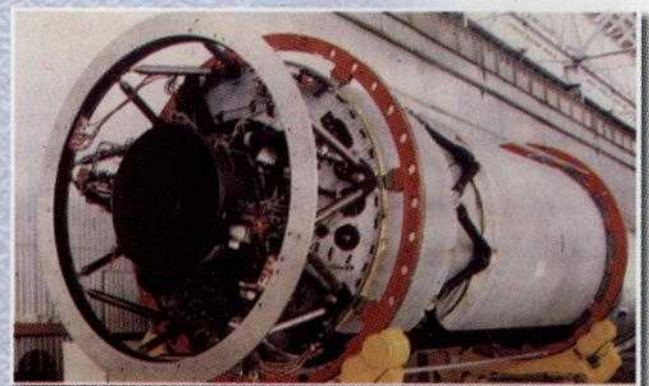
GSLV-D2 STAGES



GSLV Second stage (GS2)



GSLV Strap-on stage (L40H)



GSLV Third stage (GS3)

TECHNOLOGICAL IMPROVEMENTS IN GSLV-D2

GSLV-D2 incorporates major technological changes vis-a-vis GSLV-D1 to boost the vehicle's performance and to increase its payload capability. Payload of GSLV-D1 weighed only 1540 kg, which is now enhanced to 1825 kg in GSLV-D2. The modifications include:

- Replacement of S125 motor by S139, increasing the propellant loading by 9 tonnes and reducing the inert mass by 1 tonne.
- Introduction of high pressure engine in L40 and GS2 stages. Both stages use UH25 in place of UDMH and propellant loading is revised accordingly.
- Removal of SITVC system in GS1
- Replacement of metallic payload adaptor with CFRP payload adaptor.
- Bringing down EB mass to 495 kg from 556.5 kg.

GSLV SYSTEMS

GSLV is a 3 stage vehicle. The first stage (GS1) consists of a solid core stage (S139) and 4 liquid stages (L40 H) strapped to the core. The second stage (GS2) is a liquid stage and third stage (GS3) is a cryogenic stage. The configuration of GSLV is denoted as: S139 & 4L40H + L37.5H + C12.5. The spacecraft (GSAT-2) and the equipment bay (EB) are mounted above the cryo stage. They are enclosed by a payload fairing, which protects them during vehicle's ascent through the atmosphere and provides aerodynamic shaping to the vehicle.

Propulsion Systems

The first stage is propelled by the solid motor of the core S139 stage and the Vikas engines of the four L40H stages. Second stage is also propelled by a Vikas engine while the upper stage is propelled by the cryogenic engine, KBD1.

Stage Auxiliary Systems

For staging, the vehicle is provided with various separation systems such as flexible linear shaped cord (FLSC) for the first stage, pyro actuated collet release mechanism for the second stage and merman band-bolt cutter mechanism for third stage. The payload fairing is separated and jettisoned through merman band and zipcord. Vehicle destruction systems are provided onboard for the first two stages and they can be activated through telecommand in case of malfunction of the vehicle violating safety constraints.

Navigation and Guidance Systems

An Inertial Navigation and Guidance System (IGS) in the equipment bay computes the inertial position and velocity and guides the vehicle from lift-off to spacecraft injection. The digital autopilot (DAP) and closed loop guidance (CLG) scheme resident in the onboard computer ensure the required attitude manoeuvre and guided injection of the spacecraft into the specified orbit. The CLG is initiated about 10 seconds after second stage ignition. The three axis control of the vehicle is achieved by the control systems provided in each stage.

Control Systems

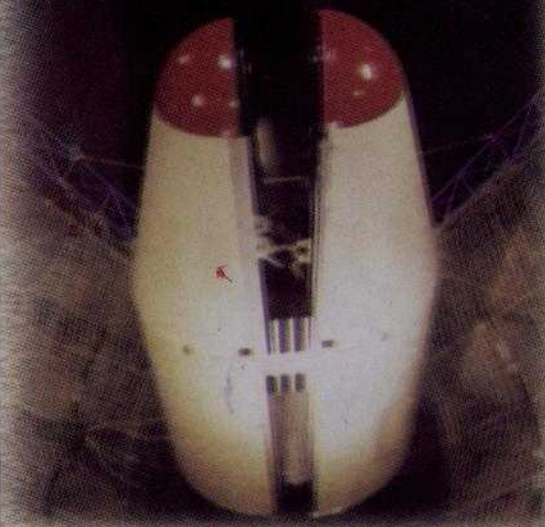
Control during GS1 flight is by L40 engine gimbal control (EGC). In second stage, pitch and yaw control is provided by EGC and roll control by hot gas roll control module (HRCM). Control during thrusting phase of the third stage is provided by two vernier engines with two-plane gimbaling. Control after GS3 burn-out is by the orientation & stabilisation system (OSS) consisting of six cold gas thrusters.

Performance evaluation systems

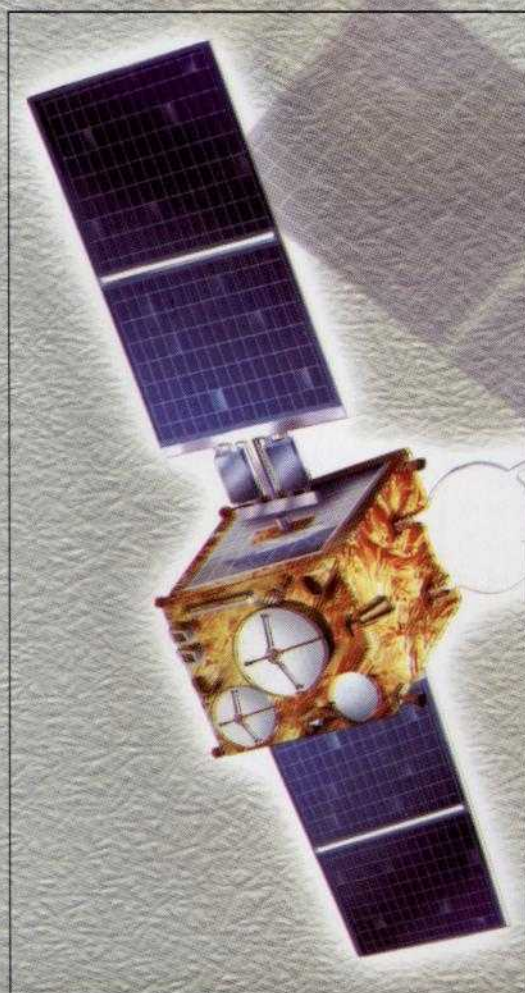
For performance monitoring, tracking, and preliminary orbit determination, the vehicle is provided with extensive instrumentation, telemetry systems and onboard transponders.

GSLV PAYLOAD FAIRING

* Length (m)	:	7.8
* Diameter (m)	:	3.4
* Dynamic Envelope	:	3.05 (dia)
* Static volume (m ³)	:	40
* Volume in cylindrical portion (m ³)	:	23
* Jettisoning system	:	through merman band and zip cord



GSAT-2 SATELLITE



Lift-off mass	:	1825 kg.
Location	:	48 deg E
Application	:	Communication Spacecraft with number of scientific experiments

DIMENSIONS :

East West	-	2130mm.
North South	-	2045mm.
East/anti-earth	-	3220mm.
Main Structure	:	CFRP Cylinder thrust tube

PAYLOADS :

Communication Transponders :	
	: C-Band, 4nos, 15w
	: C-Band, 1no, 70w
	: Ku-Band, 2nos, 70w

Scientific Experiments :

- : Surface potential charge Monitor
- : Total Radiation Dose Monitor
- : Solar X-Ray Spectrometer
- : Co-herant Beacon equipment

Stabilization mode	:	3 axes
Propulsion System	:	Bipropellant – MMH, MON –3
Life time	:	7 years

SYSTEM DEVELOPING AGENCIES OF GSLV & GSAT

GSLV-D2/GSAT-2 MISSION

Vikram Sarabhai Space Centre (VSSC)

Thiruvananthapuram

Lead centre responsible for design, development, testing, integration and launching of GSLV

Liquid Propulsion

Systems Centre (LPSC)

Valiamala.

Design development and integration of L40H and GS2 stages

Sathish Dhawan Space Centre (SDSC)

Sriharikotta

- * Facilities for vehicle integration, satellite preparation, Propellant servicing, launch and tracking
- * Solid motor casting
- * Launch support and logistics

ISRO Satellite Centre (ISAC)

Bangalore

GSAT-2 Development

ISRO Inertial Systems Unit (IISU)

Thiruvananthapuram

Design and development of inertial systems

ISRO Telemetry Tracking and Command Network (ISTRAC)

Bangalore

Telemetry network support

Space Applications Centre (SAC)

Ahamedabad

Payload for GSAT-2

Glavkosmos (GK)

Moscow, Russia

Development and supply of cryogenic stage

Industrial Establishments of India

Materials/Fabrication works

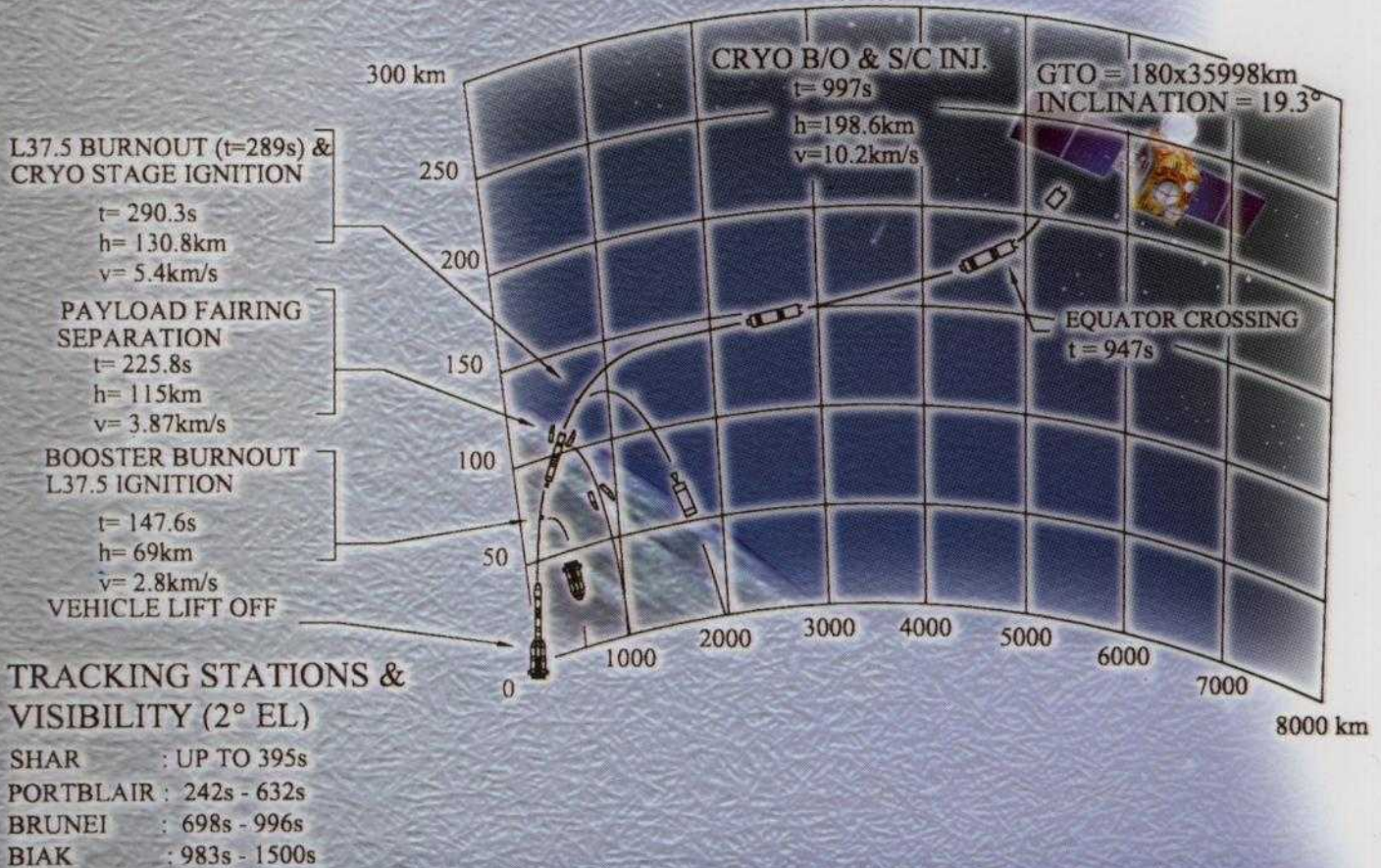
Educational Institutions & National Laboratories

Scientific studies and consultancy services

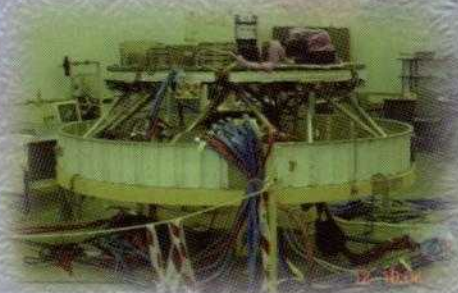
GSLV FLIGHT SEQUENCE

GSLV is launched from SDSC, Sriharikota at launch azimuth of 104°. From lift off to the injection of spacecraft into GTO, vehicle's mission lasts for 1002 seconds. The four L40H engines are ignited at first. S139 motor is ignited 4.8 seconds thereafter (T_0), after confirming the normal operation of each L40H and release of Launch Hold mechanism. The S139 motor burns for 106 seconds and the L40H stages burn for 149 seconds, which together take the vehicle to an altitude of 69 km. The second stage is ignited 1.6 seconds before its separation from first stage and burns for 135 seconds. After about 77 seconds of GS2 operation, at an altitude of 115 km, the payload fairing is jettisoned. The second stage separates from cryo stage (CS) at T+289 seconds, at an altitude of 130km. The cryo stage burns for 707 seconds and attains an altitude of 199 km and required velocity for injecting the spacecraft into the Geostationary Transfer Orbit. After injection of the spacecraft, CS is passivated and tumbled by venting all onboard tanks and gas bottles.

GSLV-D2 TYPICAL TRAJECTORY FOR GEOSTATIONARY TRANSFER ORBIT (CS SINGLE BURN)



VEHICLE INTEGRATION ACTIVITIES AT SDSC, SHAR



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