

GAGANYAAN TEST VEHICLE TV-D1

Test platform for validation of
Crew Escape System

Mission Definition:

“In-flight Abort Demonstration of Crew Escape System (CES)” at Mach number 1.2 with the newly developed Test Vehicle followed by Crew Module separation & safe recovery.

Mission Objectives:

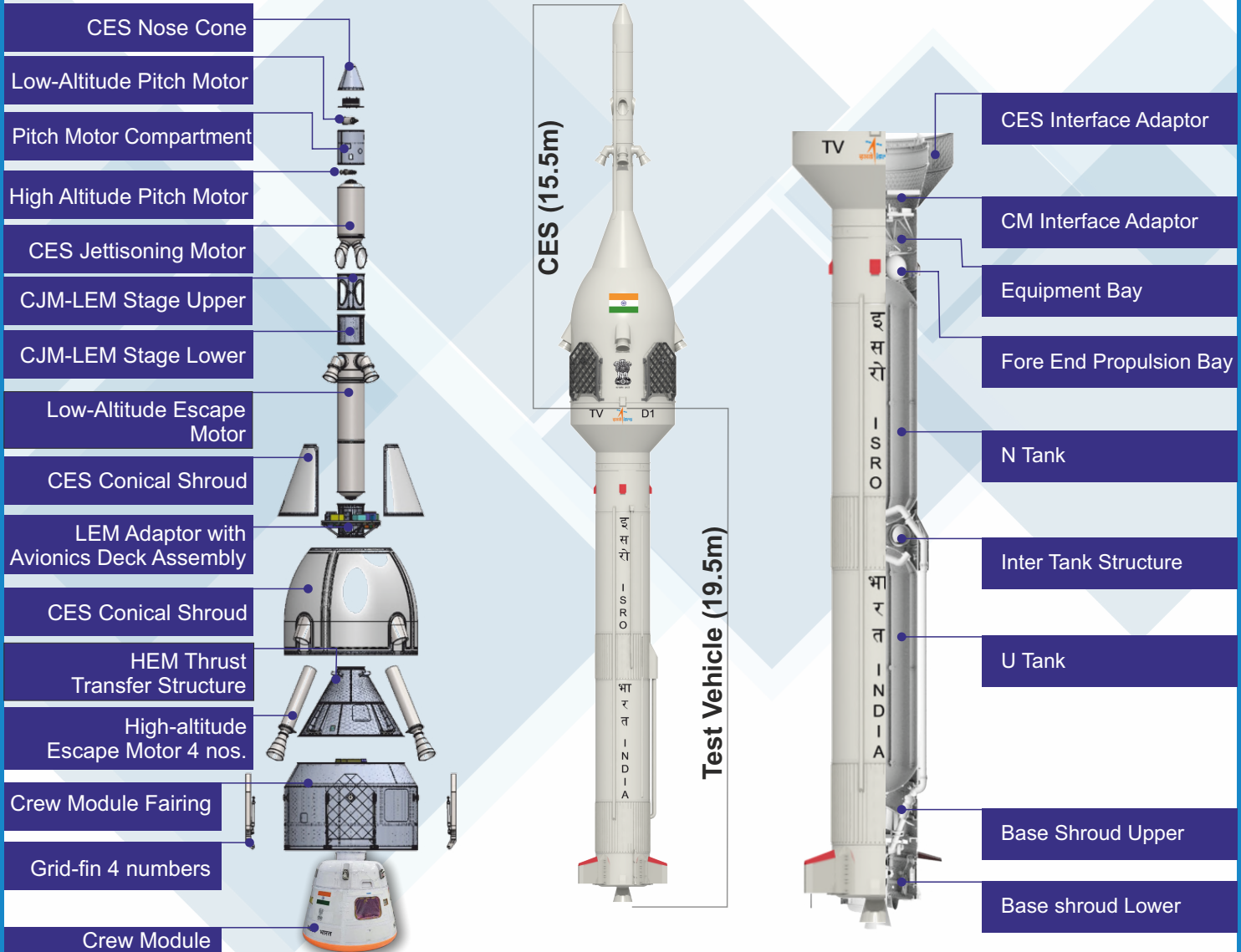
- Flight demonstration and evaluation of Test Vehicle sub systems.
- Flight demonstration and evaluation of Crew Escape System including various separation systems.
- Crew Module characteristics & deceleration systems demonstration at higher altitude & its recovery.

Mission Highlights

TV Mission Pillbox	<ul style="list-style-type: none">▶ Mach 1.2▶ Altitude 11.7km▶ Flight path angle 60°▶ Dynamic Pressure 22.6kPa
CM-CES separation	<ul style="list-style-type: none">▶ Mach 0.5▶ Altitude 17km▶ Dynamic pressure 2-3kPa
Drogue Parachute deployment	<ul style="list-style-type: none">▶ Altitude 16.7km
Main Parachute	<ul style="list-style-type: none">▶ Altitude < 2.5km

TV-D1 Vehicle

The Liquid propelled single stage Test Vehicle uses a modified VIKAS engine with Crew Module (CM) and Crew Escape System (CES) mounted at its fore end.

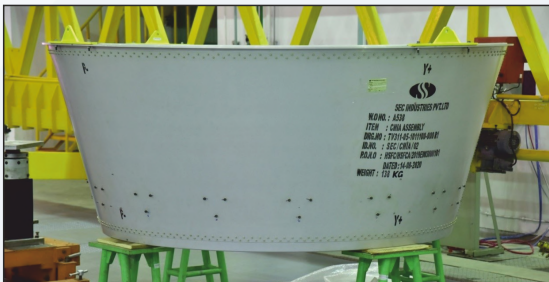


Vehicle Configuration

Length : 34.954m
Diameter : Ø 2.1m (stage)
 Ø 4.05m (CES)
Liftoff mass : 44T
TV inert mass : 7T
CES inert mass : 12.5T
CM inert mass : 4.5T



Test Vehicle



CMIA (Crew Module Interface Adaptor)



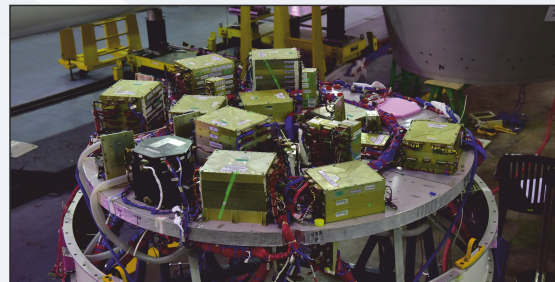
CSIA (CM-CES Interface Adaptor)

Propulsion System

TV : VIKAS Engine with AR6
 N_2O_4 – 12T
 UH-25 – 7T
CES : HEM (4 nos.) + CJM



Crew Module Fairing with Grid Fins



Test Vehicle Equipment Bay (TEB)



Test Vehicle Base Shroud Lower (TBSL)

Major vehicle Sub-Systems Tests



AR 6 VIKAS Engine hot tests



Actuator-in-Loop Simulation Test



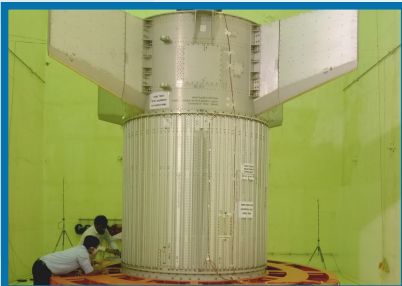
Integrated structural test of Interface Adapters



Aero-elastic Test



Cold Gimbal Test



Integrated Base Shroud Acoustic test



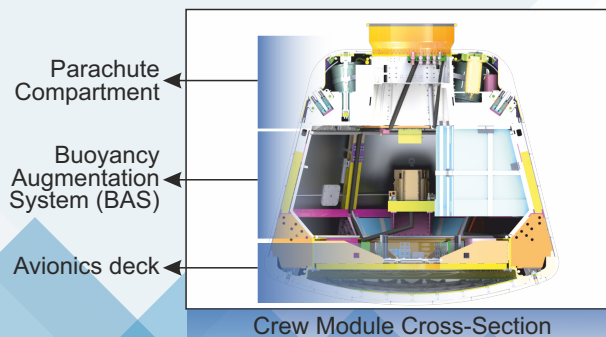
Equipment Bay vibration test



CES Ground Resonance Test

TV-D1 Crew Module (CM)

Specifications	
Structure	Single walled unpressurised aluminium structure Simulated thermal protection system using cork
Dimensions	Ø3.1m x 2.97m
Mass	4520 kg
Avionics	Launch Vehicle heritage with dual redundancy
Navigation	Mini Advanced INS augmented by NavIC/ GPS
Deceleration system	Total of 10 parachutes with pyro systems. Parachute deployment Initiation at 17 km altitude
Separation Systems	<ul style="list-style-type: none">• CM/SM separation• CM/CES separation• Apex cover separation• CES - CMF separation
Touch down velocity	8.5 m/s (Nominal)
Floataction system	Buoyancy augmentation system using PUF blocks
Recovery aids	Sea markers and location transmitter



Crew Module Sub-Systems Tests



Crew Module Acoustic Test
at ISITE, URSC



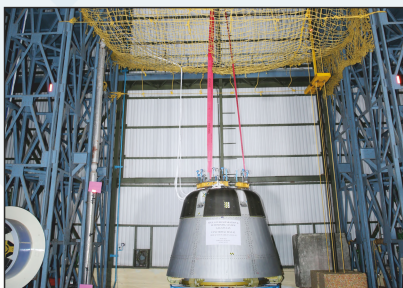
Crew Module Vibration Test
at SDSC, SHAR



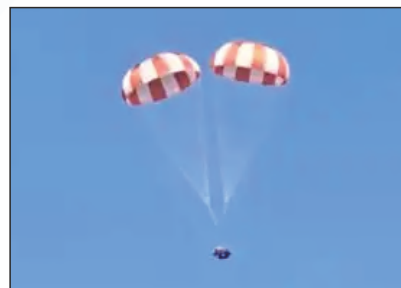
Service Module separation test



Crew Escape System separation test



Apex Cover separation test



4 Main Parachute Air drop tests
conducted using AN32 & IL76
at ADRDE, Agra & BFFR, Jhansi

Crew Escape System (CES)

Crew Escape system consists 5 types of quick acting solid motors namely Crew Escape System Jettisoning Motor (CJM), High-altitude Escape Motor (HEM), Low-altitude Escape Motor (LEM), Low-altitude Pitch Motor (LPM) and High-altitude Pitch Motor (HPM) with PEDCEM formulation, which generate required acceleration for varying mission requirements.

Qualification of Solid Motors



Low-altitude Escape Motor (LEM) Static Test

Propellant Mass [Kg]	: 2098
Max Vacuum thrust (kN)	: 875.1

High altitude Escape Motor (HEM) Static Test

Propellant Mass [Kg]	: 271
Max Vacuum thrust (kN)	: 260.7



CES Jettisoning Motor (CJM) Static Test

Propellant Mass [Kg]	: 2098
Max Vacuum thrust (kN)	: 875.1

Qualification of Parachutes



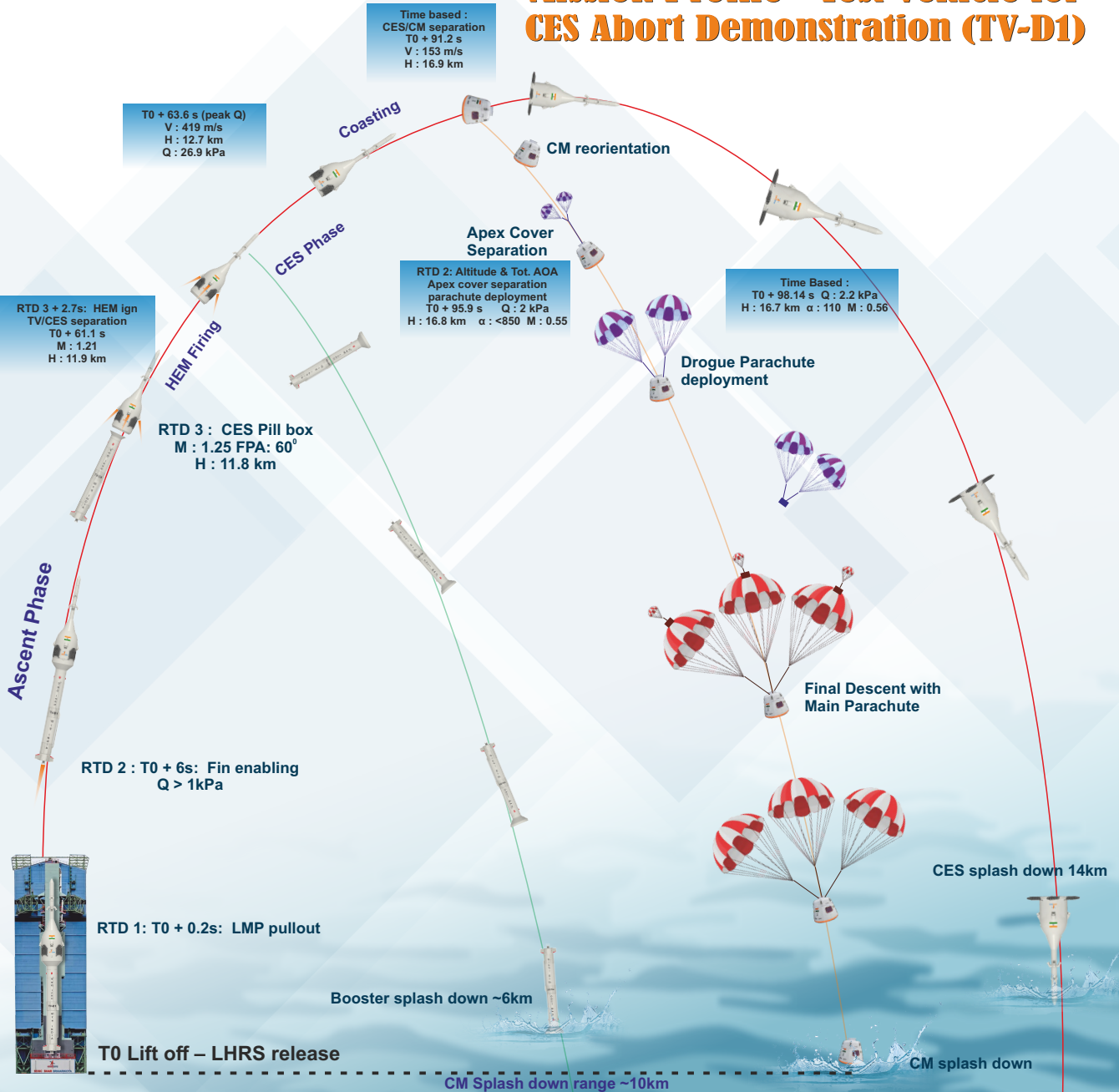
12 Qualification tests conducted for Drogue, Pilot & Apex cover parachutes using Rail Track Rocket Sledge [RTRS] system at TBRL, Chandigarh

Crew Module Recovery Trials

Indian Navy team will lead the recovery of TV-D1 Crew Module after touchdown, approximately 10 km from Sriharikota coast. Recovery ships positioned at a safe range in sea waters will approach the Crew Module and a team of divers will attach a buoy, hoist the Crew Module using a ship crane and bring to the shore.



Mission Profile - Test Vehicle for CES Abort Demonstration (TV-D1)



TV-D1

Flight Events

Events	Flight Time (s)	Altitude (km)	Relative velocity (m/s)
Ignition	-6.00	0.0	0.0
Lift-off	0.00	0.0	0.0
TV-CES separation	60.6	11.7	363
CM-CES separation	90.6	16.7	147
Mortar Ign. for ACS Parachute deployment	95.9	16.6	148.7
Apex Cover Separation	96.2	16.6	149.3
Mortar Ign. for Drogue Parachute deployment	98.2	16.5	152
Drogue Parachute release	296.1	2.4	62.8
Mortar Ign. for Pilot Parachute Deployment	296.3	2.38	64.1
Main Parachute Deployment	296.5	2.37	64.1
CM Touchdown	531.8	0.0	8.5



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