Atlas V Juno

Mission Overview
Cape Canaveral Air Force Station, FL

ULA
United Launch Alliance

ATLAS

United Launch Alliance (ULA) is proud to be a part of NASA's Juno mission.

Following launch on an Atlas V 551 and a five-year cruise in space, Juno will improve our understanding of the our solar system's beginnings by revealing the origin and evolution of its largest planet, Jupiter.

Juno is the second of five critical missions ULA is scheduled to launch for NASA in 2011. These missions will address important questions of science — ranging from climate and weather on planet earth to life on other planets and the origins of the solar system.

This team is focused on attaining Perfect Product Delivery for the Juno mission, which includes a relentless focus on mission success (the perfect product) and also excellence and continuous improvement in meeting all of the needs of our customers (the perfect delivery).

My thanks to the entire ULA team and our mission partners, for their dedication in bringing Juno to launch, and to NASA making possible this extraordinary mission.

Go Atlas, Go Centaur, Go Juno!

Jim Sponnick
Vice President,
Mission Operations

JUNO SPACECRAFT | Overview

The Juno spacecraft will provide the most detailed observations to date of Jupiter, the solar system's largest planet. Additionally, as Jupiter was most likely the first planet to form, Juno's findings will shed light on the history and evolution of the entire solar system.

Following a five-year long cruise to Jupiter, which will include a gravity-assisting Earth fly-by, Juno will enter into a polar orbit around the planet, completing 33 orbits during its science phase before being commanded to enter Jupiter's atmosphere for mission completion. In its highly elliptical 11-day orbits, Juno will come within 3,100 miles of Jupiter's cloud tops while measuring magnetic and gravity fields, atmospheric composition and performing infrared, ultra-violet and visible light photography.

The Juno spacecraft is unique in several ways. It is the first solar-powered, versus nuclear, spacecraft to perform operations this far from the Sun. To accomplish this, Juno is equipped with three very large solar panels, which when extended, give the spacecraft a diameter of 66 feet. To combat its exposure to radiation during its year orbiting Jupiter, most of Juno's electronics have been housed inside a titanium vault in the center of the spacecraft. Juno will also be spin-stabilized throughout its mission in order to maximize scientific observations.

NASA's Jet Propulsion Laboratory, Pasadena, Calif., manages the Juno mission for principal investigator, Scott Bolton of the Southwest Research Institute in San Antonio, Tex. JPL is a division of the California Institute of Technology in Pasadena. The Juno mission is part of the New Frontiers Program managed at NASA's Marshall Space Flight Center in Huntsville, Ala. Lockheed Martin Space Systems in Denver, Colo., built the spacecraft. Launch management is the responsibility of NASA's Launch Services Program at the Kennedy Space Center in Fla.

Image Courtesy of Lockheed Martin

ATLAS V 551 LAUNCH VEHICLE | Overview

The Atlas V 551 consists of a single Atlas V booster stage, the Centaur upper stage, five solid rocket boosters (SRB), and a 5-meter payload fairing (PLF).

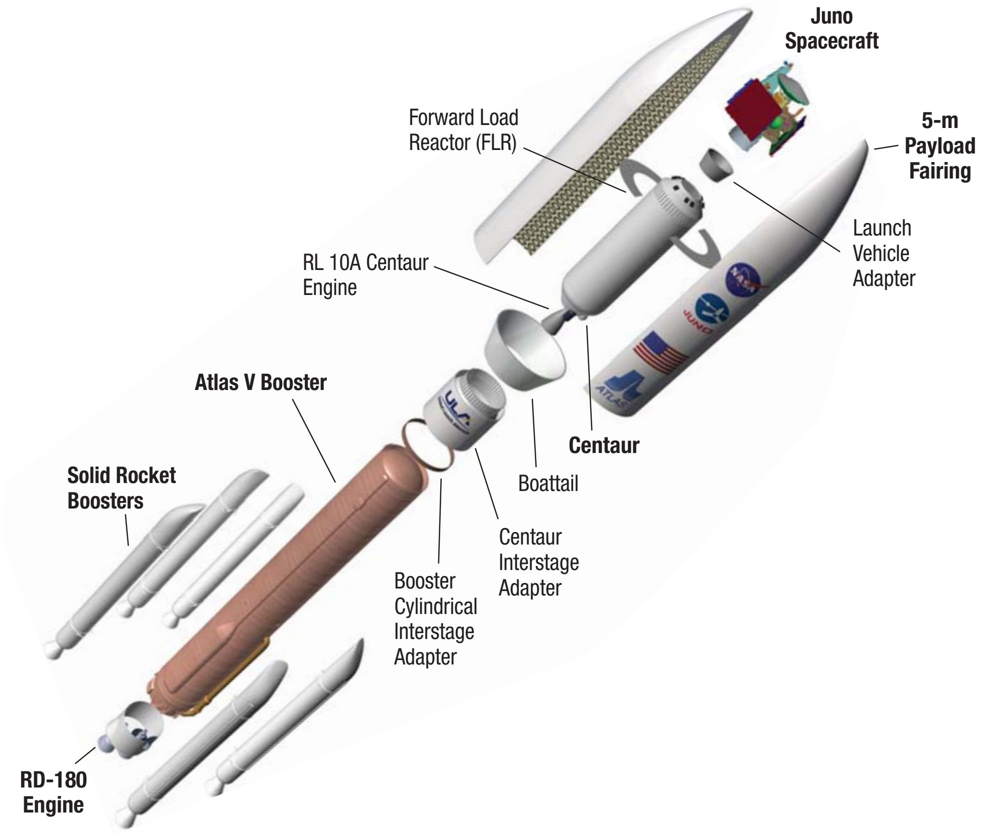
The Atlas V booster is 12.5 ft in diameter and 106.5 ft in length. The booster's tanks are structurally rigid and constructed of isogrid aluminum barrels, spun-formed aluminum domes, and intertank skirts. Atlas booster propulsion is provided by the RD-180 engine system (a single engine with two thrust chambers). The RD-180 burns RP-1 (Rocket Propellant-1 or highly purified kerosene) and liquid oxygen, and it delivers 860,200 lb of thrust at sea level. The Atlas V booster is controlled by the Centaur avionics system, which provides guidance, flight control, and vehicle sequencing functions during the booster and Centaur phases of flight.

The SRBs are approximately 61 in. in diameter, 67 ft in length, and constructed of a graphite-epoxy composite with the throttle profile designed into the propellant grain. The SRBs are jettisoned by structural thrusters following a 92-second burn.

The Centaur upper stage is 10 ft in diameter and 41.5 ft in length. Its propellant tanks are constructed of pressure-stabilized, corrosion resistant stainless steel. Centaur is a liquid hydrogen/liquid oxygen- (cryogenic-) fueled vehicle. It uses a single RL10A-4-2 engine producing 22,300 lb of thrust. The cryogenic tanks are insulated with a combination of helium-purged insulation blankets, radiation shields, and closed-cell polyvinyl chloride (PVC) insulation. The Centaur forward adapter (CFA) provides the structural mountings for vehicle electronics and the structural and electronic interfaces with the spacecraft.

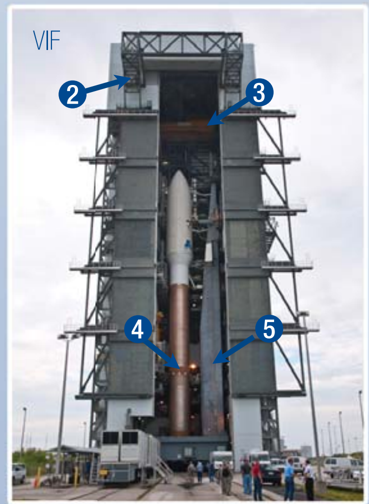
The Juno spacecraft is encapsulated in the Atlas V 5-meter diameter short PLF. The 5-meter PLF is a sandwich composite structure made with a vented aluminum-honeycomb core and graphite-epoxy face sheets. The bisector (two-piece shell) PLF encapsulates both the Centaur and the spacecraft, which separates using a debris-free pyrotechnic actuating system. Payload clearance and vehicle structural stability are enhanced by the all-aluminum forward load reactor (FLR), which centers the PLF around the Centaur upper stage and shares payload shear loading. The vehicle's height with the 5-m short PLF is approximately 197 ft.

ATLAS V 551 LAUNCH VEHICLE | Expanded View



SLC-41 | Overview

1 Vertical Integration Facility (VIF)
  (See call out at right)
2 Bridge Crane Hammerhead
3 Bridge Crane
4 Launch Vehicle
5 Mobile Launch Platform (MLP)
6 Launch Vehicle
7 Centaur LO_2 Storage
8 Gaseous Helium Conversion Plant
9 High Pressure Gas Storage
10 Booster LO_2 Storage
11 Pad ECS Shelter
12 Pad Equipment Building (PEB)



ATLAS V JUNO | Mission Overview

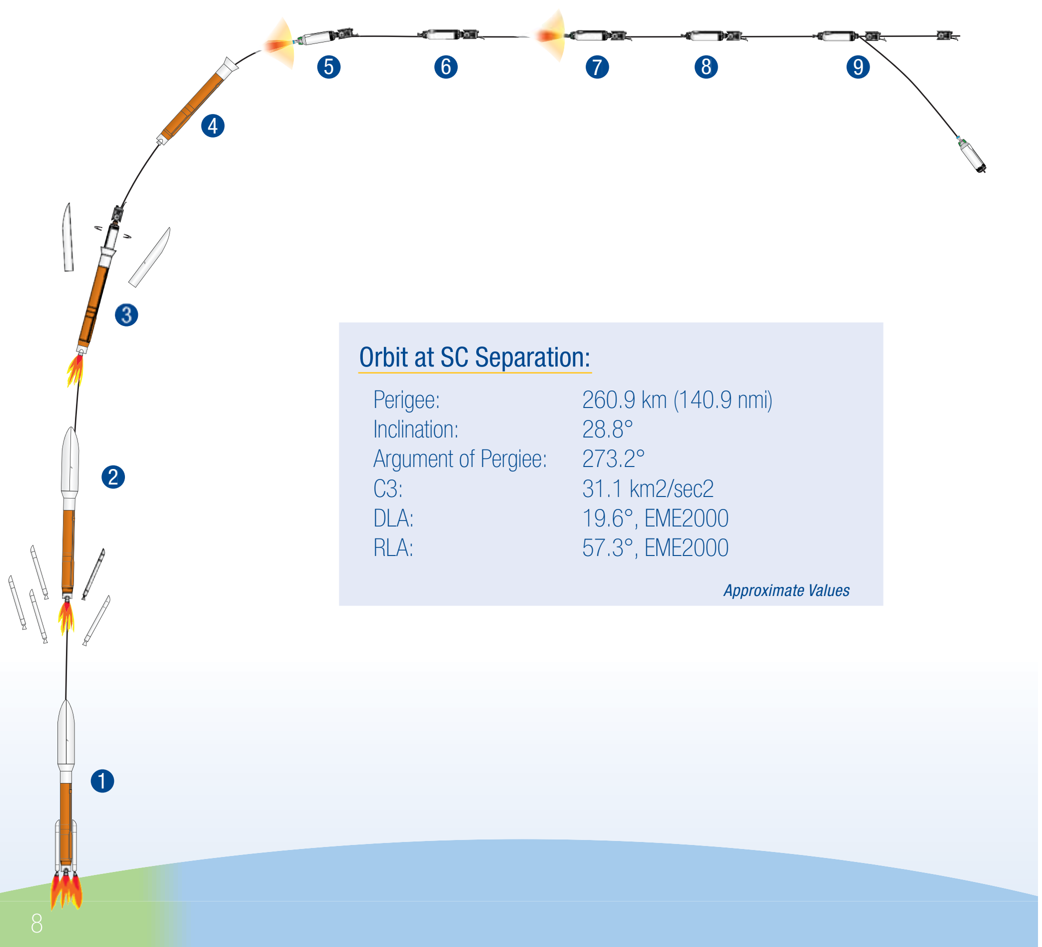
The Juno mission is based on a standard Atlas V 551 ascent profile to an interplanetary hyperbolic departure trajectory. The mission begins with ignition of the RD-180 engine approximately 2.7 seconds prior to liftoff. The flight begins with a vertical rise of 85 feet, after which the vehicle begins its initial pitch-over phase, a simultaneous roll, pitch, and yaw maneuver to achieve the desired flight azimuth. The vehicle then throttles down and begins a nominal zero-pitch and zero-yaw angle-of-attack phase to minimize aerodynamic loads. Following maximum dynamic pressure and SRB burnout, the RD-180 is throttled back up to 100%. Zero pitch and yaw angle-of-attack flight continues until closed-loop guidance takes over, at 110 seconds into flight.

Booster flight continues in this guidance-steered phase until propellant depletion. Jettison of the 5-meter payload fairing occurs at approximately 205 seconds, based on thermal constraints. When the vehicle reaches 5.0 G's the RD-180 engine is throttled to maintain this G-level. At approximately ten seconds before the guidance-predicted booster engine cutoff (BECO) time, the RD-180 engine throttles down to 4.6 G's and maintains this G-level until propellant depletion is detected (BECO). The boost phase of flight ends with Atlas/Centaur separation at a nominal time of 6.0 seconds after BECO.

Following Atlas/Centaur separation, the Centaur stage ignites its main engine (MES1). The six-minute long Centaur first burn, which is the shorter of the two Centaur firings, continues and injects the vehicle into a nearly circular parking orbit. Following Centaur first burn main engine cut-off (MECO1), the Centaur and spacecraft enter a coast period of approximately 30 minutes. At a guidance-calculated start time, the Centaur main engine is re-ignited (MES2). The vehicle is then steered by guidance into the desired hyperbolic departure orbit. Second burn main engine cutoff (MECO2) is initiated by guidance command once the targeted orbital parameters are achieved. Between MECO2 and spacecraft separation the vehicle performs a settled turn to the separation attitude and initiates a 1.4 rpm spin for spacecraft stability.

Spacecraft separation is initiated 195 seconds after MECO2.

JUNO | Liftoff to Spacecraft Separation



Orbit at SC Separation:

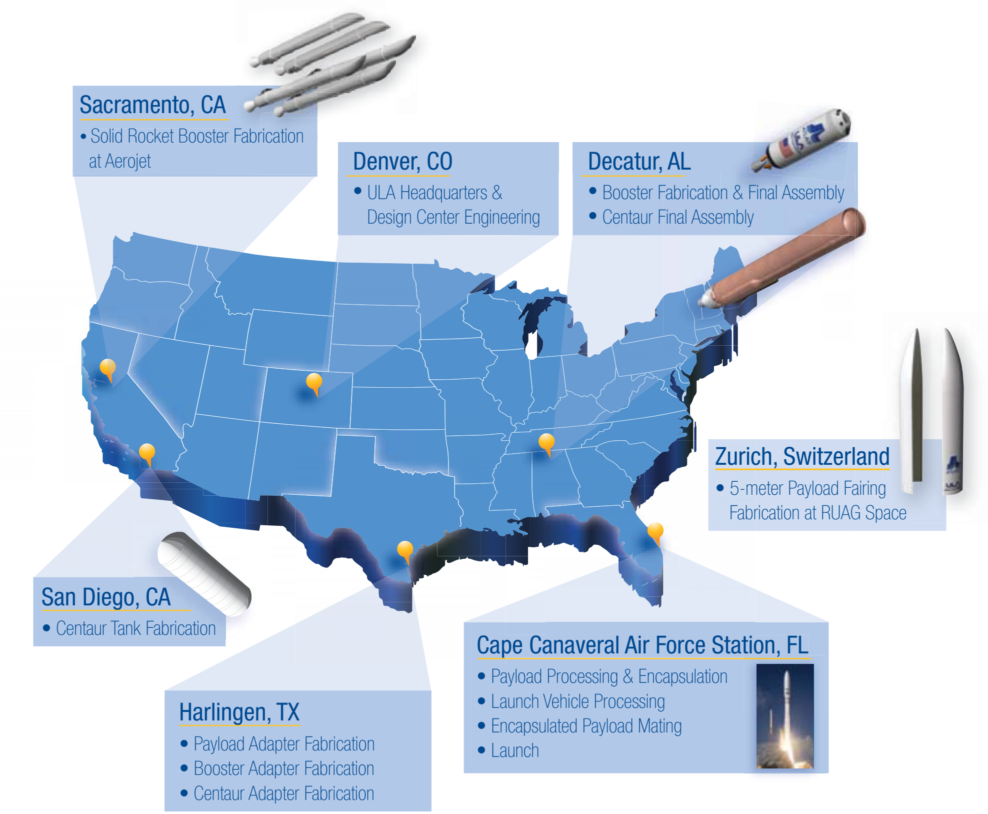
Perigee:	260.9 km (140.9 nmi)
Inclination:	28.8°
Argument of Pergiee:	273.2°
C3:	31.1 km2/sec2
DLA:	19.6°, EME2000
RLA:	57.3°, EME2000

Approximate Values

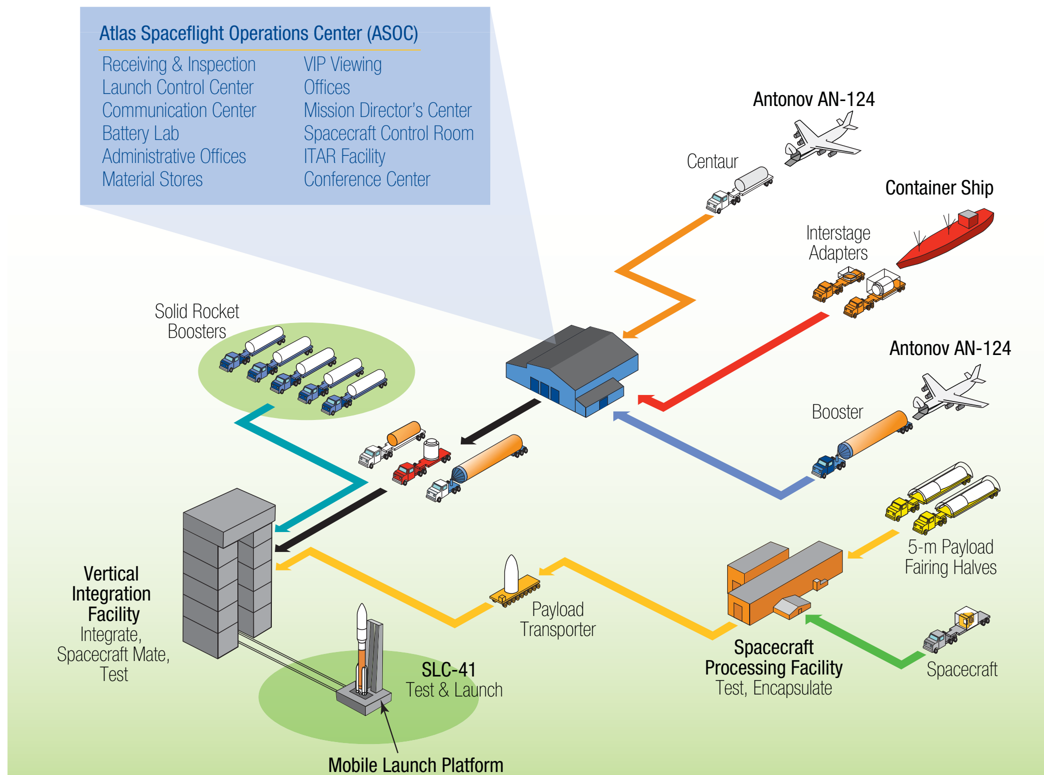
SEQUENCE OF EVENTS | Liftoff to Spacecraft Separation

	Event	Time (seconds)	Time (hr:min:sec)
1	RD-180 Engine Ignition	-2.7	-0:00:02.7
	T=0 (Engine Ready)	0.0	0:00:00.0
	Liftoff (Thrust to Weight > 1)	1.1	0:00:01.1
	Full Thrust	2.1	0:00:02.1
	Begin Pitch/Yaw/Roll Maneuver	3.8	0:00:03.8
	Mach 1	34.5	0:00:34.5
	Maximum Dynamic Pressure	46.4	0:00:46.4
2	Solid Rocket Booster Jettison	104.0	0:01:44.0
3	Payload Fairing Jettison	204.9	0:03:24.9
	Begin 5.0 G-Limiting	233.0	0:03:53.0
4	Atlas Booster Engine Cutoff (BECO)	267.2	0:04:27.2
	Atlas Booster/Centaur Separation	273.2	0:04:33.2
5	Centaur First Main Engine Start (MES1)	283.2	0:04:43.2
6	Centaur First Main Engine Cutoff (MECO1)	645.3	0:10:45.3
7	Centaur Second Main Engine Start (MES2)	2493.5	0:41:33.5
8	Centaur Second Main Engine Cutoff (MECO2)	3034.2	0:50:34.2
9	Spacecraft Separation	3229.2	0:53:49.2

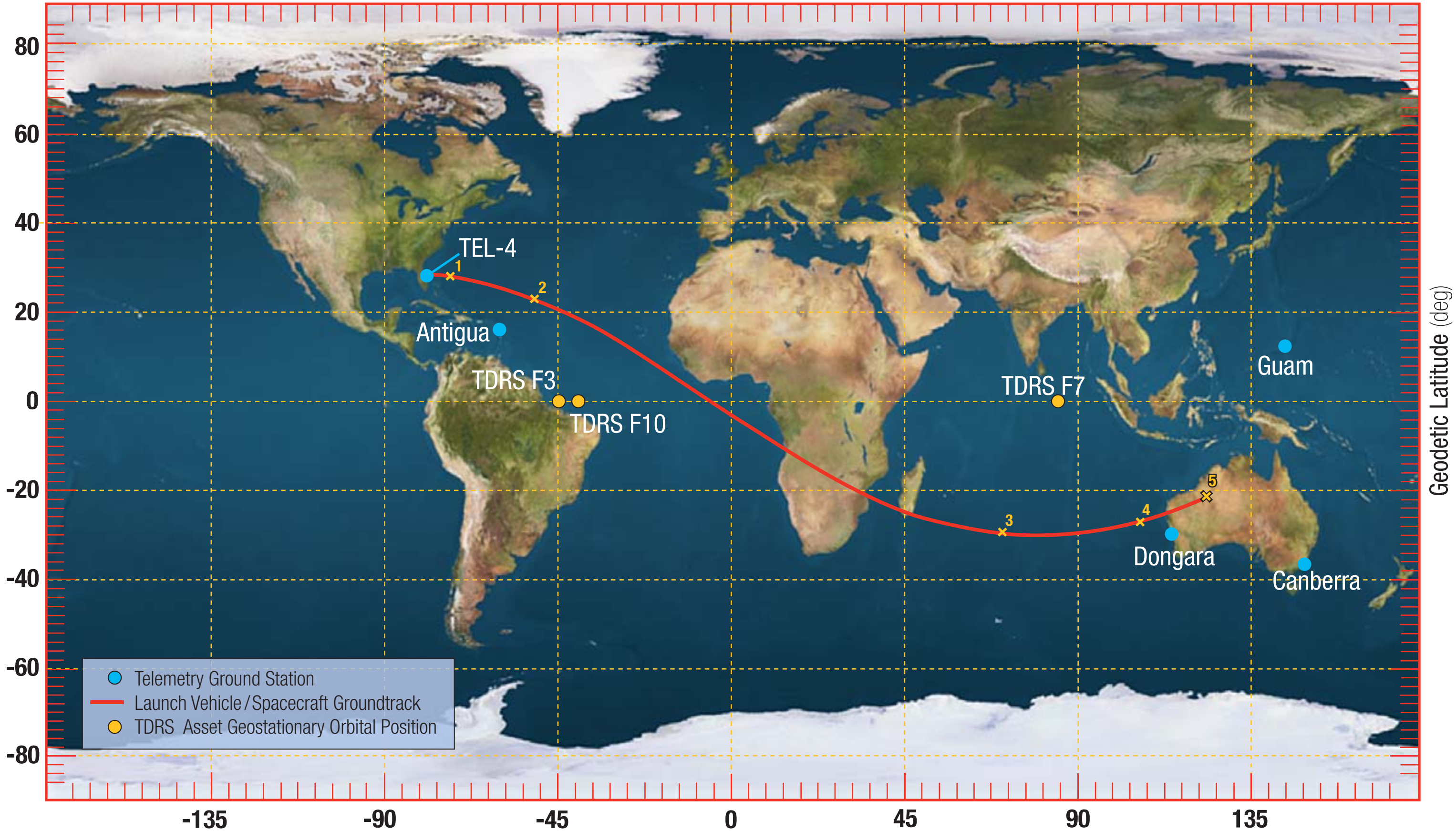
ATLAS V PRODUCTION & LAUNCH | Overview



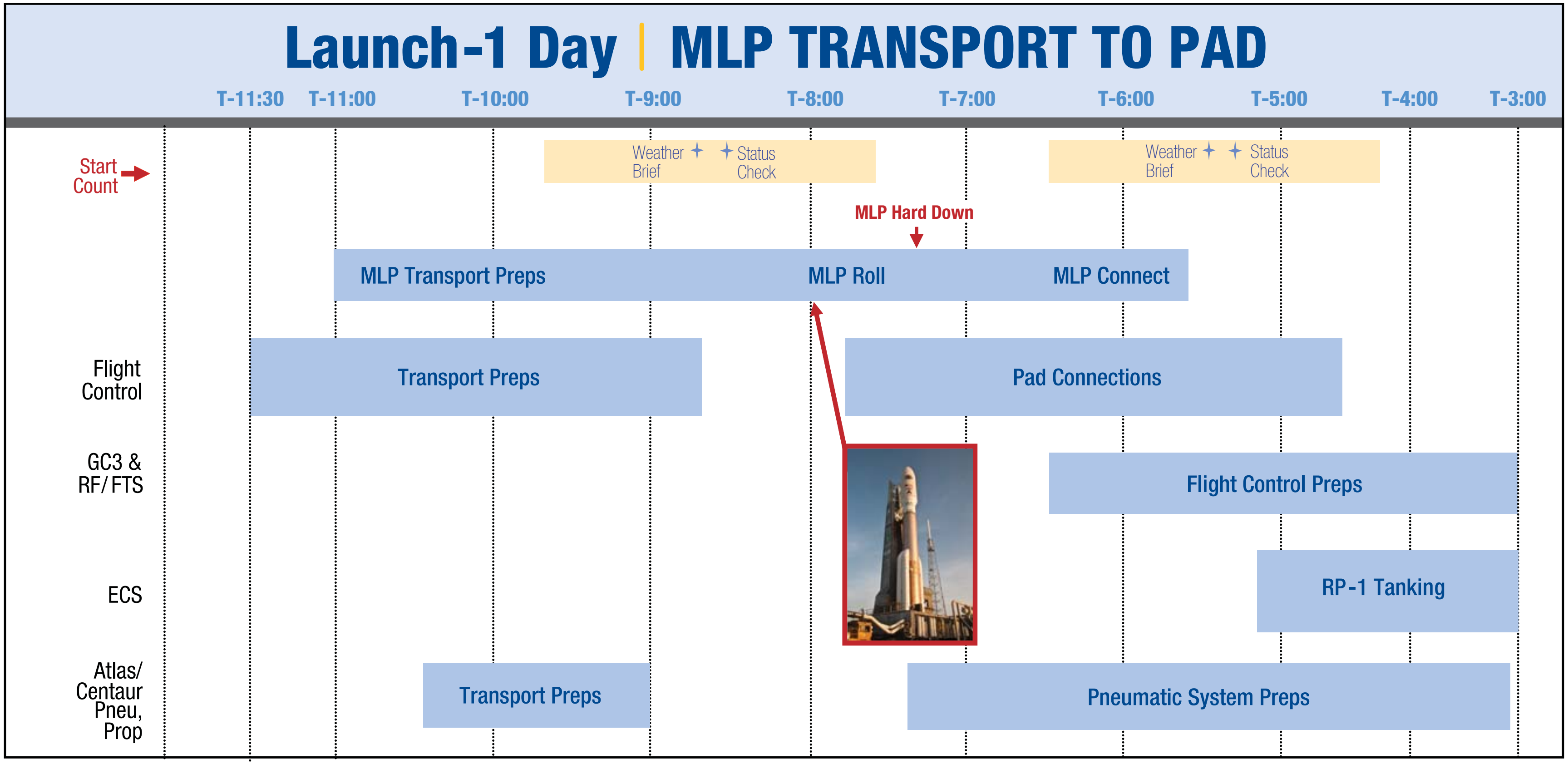
ATLAS V PROCESSING | Cape Canaveral



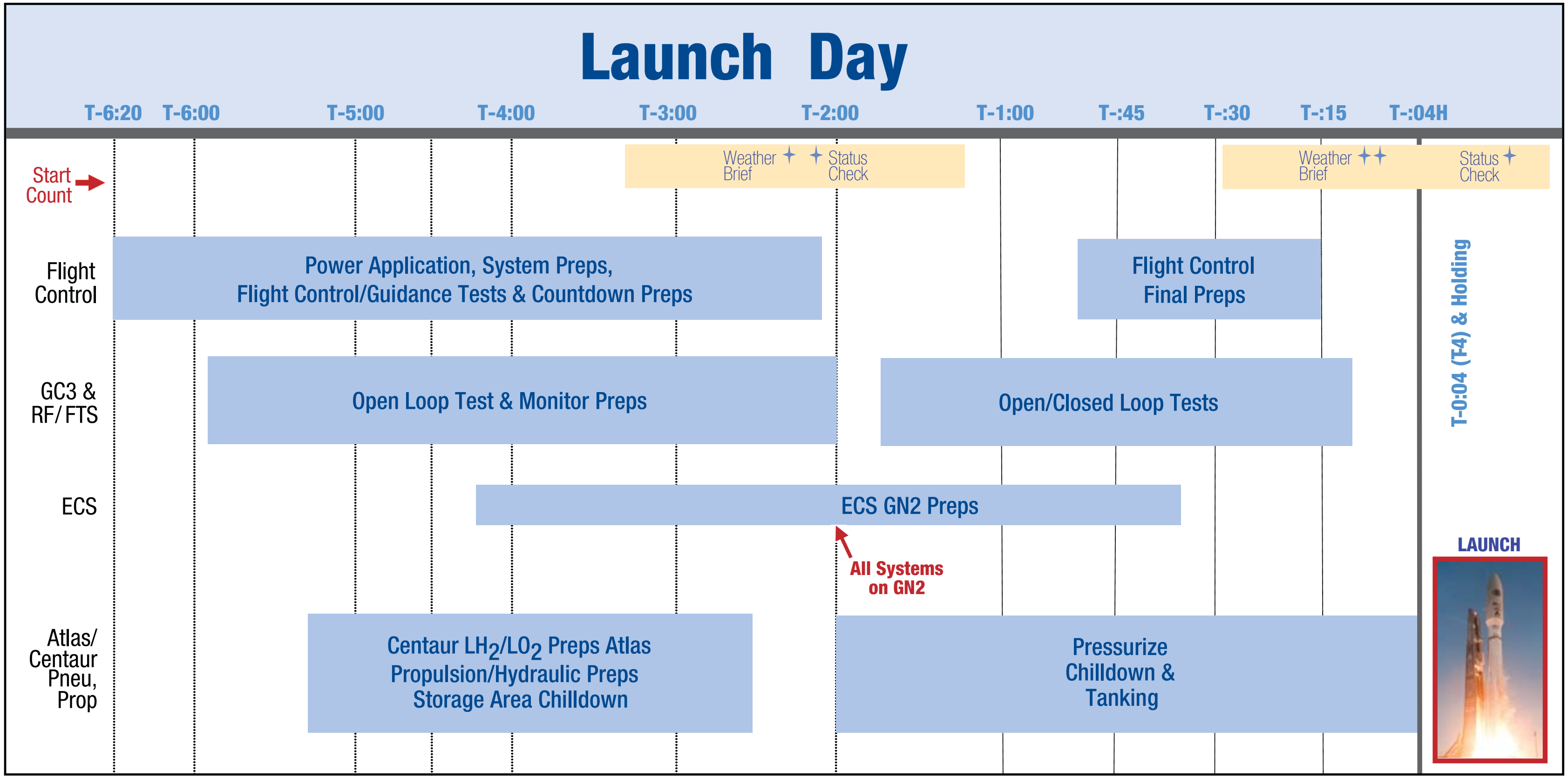
GROUND TRACE | Liftoff to Spacecraft Separation



1 = MES1 (0:04:43.2) | **2 =** MECO1 (0:10:45.3) | **3 =** MES2 (0:41:33.5) | **4 =** MECO2 (0:50:34.2) | **5 =** S/C Sep (0:53:49.2)


Launch-1 Day | MLP TRANSPORT TO PAD
T-11:30
T-11:00
T-10:00
T-9:00
T-8:00
T-7:00
T-6:00
T-5:00
T-4:00
T-3:00
Start Count
Weather Brief
Status Check
Weather Brief
Status Check
MLP Hard Down
MLP Transport Preps
MLP Roll
MLP Connect
Flight Control
Transport Preps
Pad Connections
GC3 & RF/ FTS
Flight Control Preps
ECS
RP-1 Tanking
Atlas/ Centaur Pneu, Prop
Transport Preps
Pneumatic System Preps


Atlas V Juno



Launch Day
T-6:20
T-6:00
T-5:00
T-4:00
T-3:00
T-2:00
T-1:00
T-:45
T-:30
T-:15
T-:04H
Start Count
Weather Brief
Status Check
Weather Brief
Status Check
Flight Control
Power Application, System Preps, Flight Control/Guidance Tests & Countdown Preps
Flight Control Final Preps
GC3 & RF/FTS
Open Loop Test & Monitor Preps
Open/Closed Loop Tests
T-0:04 (T-4) & Holding
ECS
ECS GN2 Preps
All Systems on GN2
LAUNCH
Atlas/ Centaur Pneu, Prop
Centaur LH2/LO2 Preps Atlas Propulsion/Hydraulic Preps Storage Area Chilldown
Pressurize Chilldown & Tanking

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