

DELTA II OCO-2 MISSION

A United Launch Alliance Delta II 7320-10 launch vehicle will deliver the Orbiting Carbon Observatory (OCO-2) satellite to a 370-nmi (686 km) near-circular orbit. Liftoff will occur from Space Launch Complex 2W at Vandenberg Air Force Base, CA.

OCO-2 will be NASA's first spacecraft dedicated to studying atmospheric carbon dioxide (CO₂), the most significant human-produced greenhouse gas and the principal human-produced driver of climate change. OCO-2 will collect space-based global measurements of atmospheric CO₂ with the precision, resolution, and coverage needed to provide the first complete picture of the regional-scale geographic distribution and seasonal variations of both human and natural sources of carbon dioxide emissions and their sinks- the reservoirs that pull carbon dioxide out of the atmosphere and store it. The OCO-2 mission provides a key new measurement that can be combined with other ground and aircraft measurements and satellite data to answer important questions about the processes that regulate atmospheric CO₂ and its role in the carbon cycle and climate.

The Orbiting Carbon Observatory is managed by NASA's Jet Propulsion Laboratory (JPL), Pasadena, CA for NASA's Science Mission Directorate, Washington, D.C. Orbital Sciences Corporation, Dulles, VA built the spacecraft and provides mission operations under JPL leadership. NASA's Launch Services Program at NASA's Kennedy Space Center in Florida is responsible for launch management.



The ULA team is proud to be the launch provider for NASA's Orbiting Carbon Observatory (OCO-2). OCO-2 is one of a series of Earth-orbiting satellites known as the Earth Observing System Afternoon Constellation, or the A-train, and is NASA's first spacecraft dedicated to studying atmospheric carbon dioxide.

The ULA team is focused on attaining Perfect Product Delivery for the OCO-2 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).

We sincerely thank the entire team, which consists of NASA, the Jet Propulsion Laboratory, Orbital Sciences Corporation, ULA, and major suppliers of ULA.

Go Delta, Go OCO-2!

Jim Spornick
Vice President, Atlas and Delta Programs



Payload Fairing (PLF)

The PLF is a composite bisector (two-piece shell), 10-ft diameter fairing. The PLF encapsulates the spacecraft to protect it from the launch environment on ascent. The vehicle's height, with the 10-ft PLF is approximately 128 ft.

Delta II Second Stage

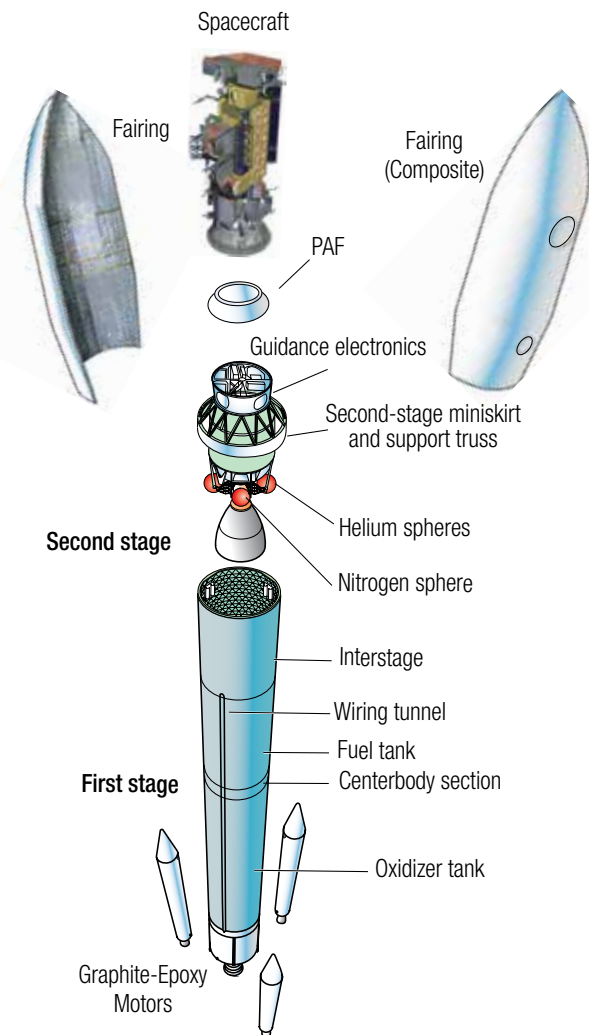
The Delta II Second Stage propellant tanks are constructed of corrosion-resistant stainless steel. The Delta II second stage is a hypergolic- (Aerozine 50 and Nitrogen Tetroxide) fueled vehicle. It uses a single AJ10-118K engine producing 9,850 lb of thrust. The propellant tanks are insulated with Dacron/Mylar blankets. The second stage's miniskirt/guidance section provides the load path for the payload to the booster as well as, the structural support for the second-stage propellant tanks, the PLF, mountings for vehicle electronics, and the structural and electronic interfaces with the spacecraft. The second-stage, other than the mini-skirt, is nested inside the interstage adapter.

Booster

The Delta II booster is 8 ft in diameter and approximately 87 ft in length. The booster's fuel and oxidizer tanks are structurally rigid and constructed of stiffened isogrid aluminum barrels and spun-formed aluminum domes. The booster structure is completed by the centerbody, which joins the fuel and oxidizer tanks and the LO₂ skirt, which joins the tank structure to the engine section. Delta II booster propulsion is provided by the RS-27A engine. The RS-27A burns RP-1 (Rocket Propellant-1 or highly purified kerosene) and liquid oxygen, and delivers 200,000 lb thrust at sea level. The Delta II booster is controlled by the second-stage avionics system which provides guidance, flight control, and vehicle sequencing functions during the booster and second-stage phases of flight.

Solid Rocket Motors (SRM)

The Delta II 7320-10 launch vehicle uses three SRMs, approximately 40 in. in diameter and 42 ft in length. The SRMs are constructed of a graphite-epoxy composite with the throttle profile designed into the propellant grain. The SRMs are jettisoned by structural thrusters following a 63-second burn.



With more than a century of combined heritage, United Launch Alliance is the nation's most experienced and reliable launch service provider. ULA has successfully delivered more than 80 satellites to orbit that provide critical capabilities for troops in the field, aid meteorologists in tracking severe weather, enable personal device-based GPS navigation and unlock the mysteries of our solar system. Reliable launch, real-world benefits.

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MISSION OVERVIEW

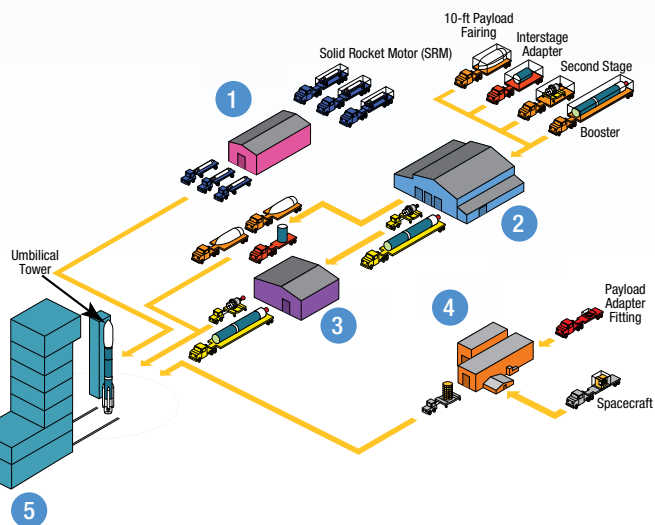
- 152nd Delta II launch
- 51st NASA mission on Delta II
- 42nd Delta II from SLC-2W

DELTA II PRODUCTION AND LAUNCH

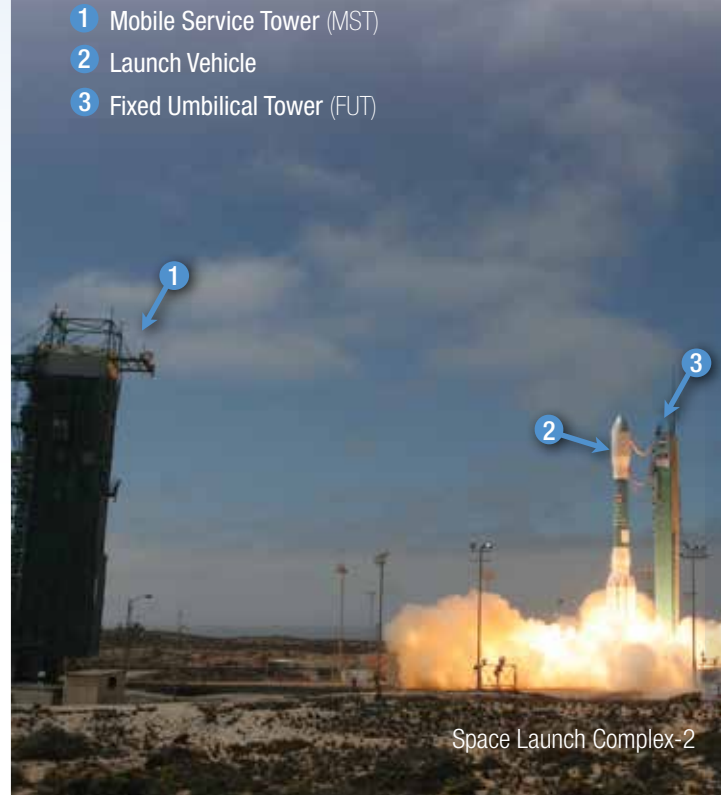
- 1 Vandenberg Air Force Base, CA**
 - Payload Processing & Encapsulation
 - Launch Vehicle Processing
 - Encapsulated Payload Mate
 - Launch
- 2 Brigham City, UT**
 - Solid Rocket Motor Fabrication at Alliant Technologies
- 3 Denver, CO**
 - ULA Headquarters & Design Center Engineering
- 4 Decatur, AL**
 - Booster, Payload Fairing and Second Stage Fabrication



- 1 Building 1670** | Receiving, inspection, staging, final processing and material stores
- 2 Building 936** | Receiving, inspection and booster transfer
- 3 Hazardous Processing Facility** | Receiving, inspection, destruct installation and stage 2 nozzle installation
- 4 Spacecraft Processing Facility** | Spacecraft processing, testing and encapsulation
- 5 Mobile Service Tower** | Launch vehicle integration and testing, spacecraft mate and integrated operations

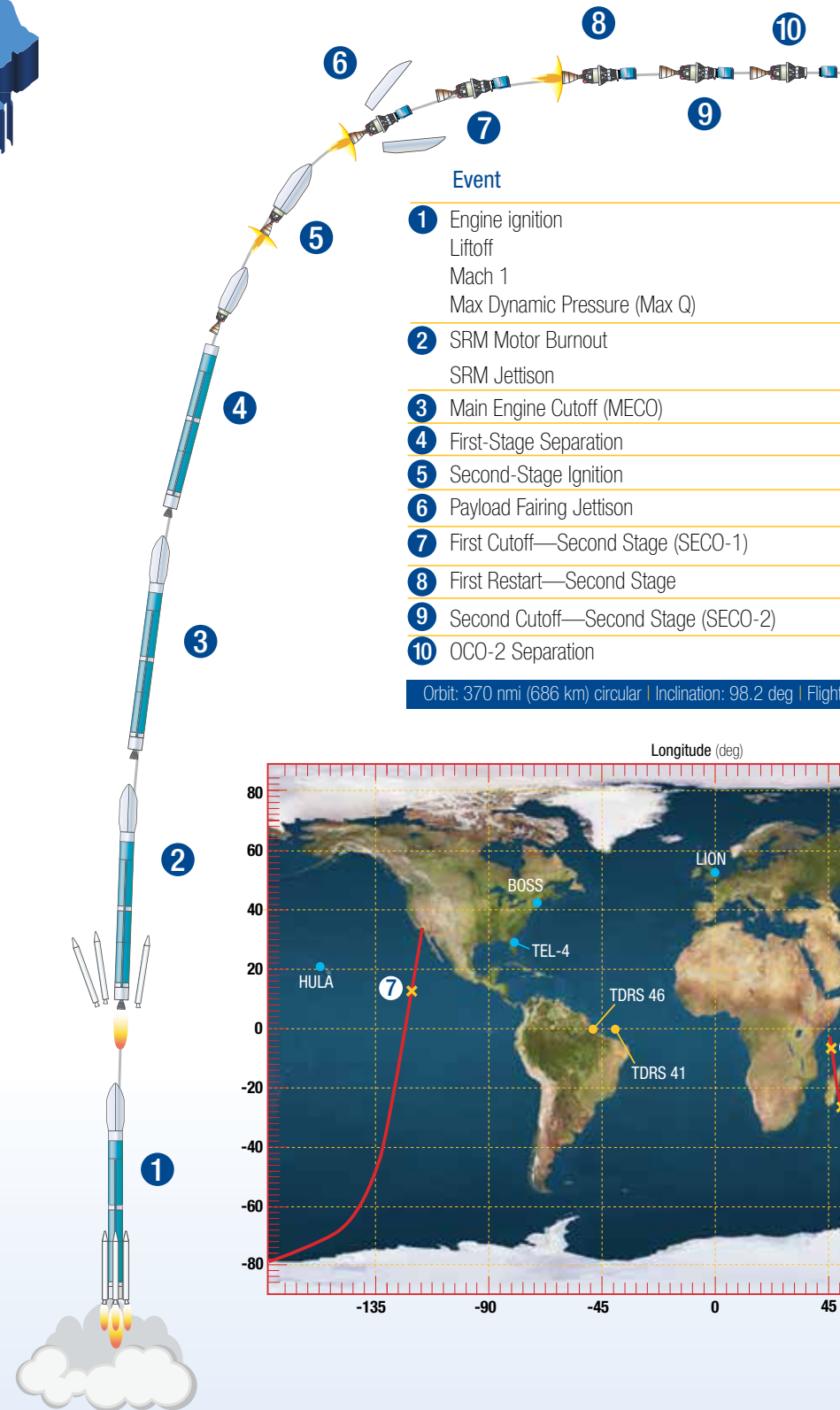


- 1 Mobile Service Tower (MST)**
- 2 Launch Vehicle**
- 3 Fixed Umbilical Tower (FUT)**



Space Launch Complex-2

MISSION PROFILE AND GROUND TRACE



Event	Time (seconds)	Time (hr:min:sec)
1 Engine ignition	-3.0	-00:00:30
Liftoff	0.0	00:00:00
Mach 1	35.7	00:00:35
Max Dynamic Pressure (Max Q)	49.7	00:00:49
2 SRM Motor Burnout	64.0	00:00:64
SRM Jettison	99.0	00:01:39
3 Main Engine Cutoff (MECO)	264.2	00:04:24
4 First-Stage Separation	272.2	00:04:32
5 Second-Stage Ignition	277.7	00:04:38
6 Payload Fairing Jettison	301.0	00:05:01
7 First Cutoff—Second Stage (SECO-1)	620.5	00:10:21
8 First Restart—Second Stage	3050.0	00:50:50
9 Second Cutoff—Second Stage (SECO-2)	3062.4	00:51:02
10 OCO-2 Separation	3375.0	00:56:15

Orbit: 370 nmi (686 km) circular | Inclination: 98.2 deg | Flight Azimuth: 196 deg | Eccentricity: .0013 deg

