

Mission Book

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Mission-At-A-Glance

LAUNCH WINDOW 21 Nov, 10:24:00 / 10:24:21 PST
(22 seconds)

LAUNCH SITE Vandenberg AFB,
Calif. SLC 2

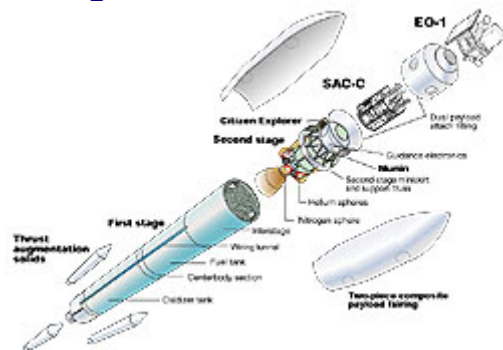
LAUNCH VEHICLE Boeing Delta II 7320-10
CUSTOMER PAYLOAD NASA: EO-1 Earth-Observing Mission
Argentina: 1st Earth-Observing satellite SAC-C
Sweden: Munin nanosatellite

Dual Payload Attachment



Fitting

Delta 7320-10 Dual Payload Configuration



LAUNCH SEQUENCE

hrs:min:sec	Event
0:00:00	Liftoff
0:00:35.9	Mach 1 (738 mph)
0:00:50.2	Maximum dynamic pressure
0:01:04.0	Three solid rocket motors (SRMs) burnout
0:01:39.0	Jettison SRMs
0:04:24.2	Main engine cutoff (MECO)
0:04:37.7	Stage II Ignition
0:04:57.0	Jettison fairing
0:11:16.6	First cutoff-Second Stage
0:55:35.0	First restart-Stage II
0:55:45.9	Second cutoff-Second Stage
1:00:00	Separate EO-1
1:13:20.0	Separate DPAF portion
1:24:51.6	Second restart-Stage II
1:25:09.0	Third cutoff-Second Stage
1:30:45.0	Separate SAC-C
1:48:20.0	Third restart-Stage II
1:50:00.0	Separate Munin

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EO-1/SAC-C

The Boeing Company takes great pride in launching Earth Observing-1 (EO-1) and *Satelite de Aplicaciones Cientificas-C* (SAC-C). NASA's Goddard Space Flight Center managed the EO-1 spacecraft, and the spacecraft was designed and integrated by their industrial partner, Swales Aerospace. The first of the New Millennium Program Earth Observing missions, EO-1 will demonstrate land remote sensing technologies. SAC-C is an international cooperative Earth science mission between the *Comision Nacional de Actividades Espaciales* (CONAE) of Argentina and NASA. SAC-C will study terrestrial and marine ecosystems, measure space radiation, and perform other earth science measurements.

EO-1 and SAC-C will be launched from Vandenberg Air Force Base (VAFB) on the first flight of the Dual Payload Attach Fitting (DPAF) aboard a Delta 7320. Approximately one hour after launch, EO-1 will be placed into a circular, 705-km orbit. The Delta second stage will then be re-oriented to allow for DPAF separation, and the second stage engine will be restarted to place SAC-C into its intended near circular orbit, separating approximately 30 minutes after EO-1 separation.

The EO-1/SAC-C mission is also launching a secondary payload. *Munin* is a nanosatellite designed and built by the Swedish Institute of Space Physics. Munin will monitor auroral activity on both the northern and southern hemispheres. *Munin* will provide data over the Internet to participating schools. The secondary payload is mounted on the Delta second stage. *Munin* will separate following the depletion burn of the second stage.

EO-1/SAC-C is the seventh launch under the Medium Lite (Med-Lite) contract with NASA KSC ELV Launch Services Project. We are extremely pleased to be selected by NASA for delivering these important payloads to orbit. My congratulations to the entire Delta team for achieving this milestone.

Joy Bryant
Director, NASA Programs
Expendable Launch Systems

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EO-1/SAC-C Mission Objectives

- Earth Observing-1 (EO-1) is the first of the New Millennium Program Earth-Observing missions. The primary demonstrations are specifically oriented at the land remote sensing technologies, spacecraft, and methodologies that will be used in defining future Landsat-type missions. The three instruments on EO-1 are the Advanced Land Image (ALI), the Hyperspectral Imager (Hyperion), and the Linear Etalon Imaging Spectrometer Array (LEISA) Atmospheric Collector (LAC).
- Satellite de Aplicaciones Cientificas-C (SAC-C) is Argentina's first Earth-Observing satellite that integrates multiple instruments under an international cooperation program. The SAC-C payloads are designed to study terrestrial and marine ecosystems, measure space radiation, and determine variability in the atmospheric structure, provide measurements of the geomagnetic field, and measure the long wavelength component of the gravity field.

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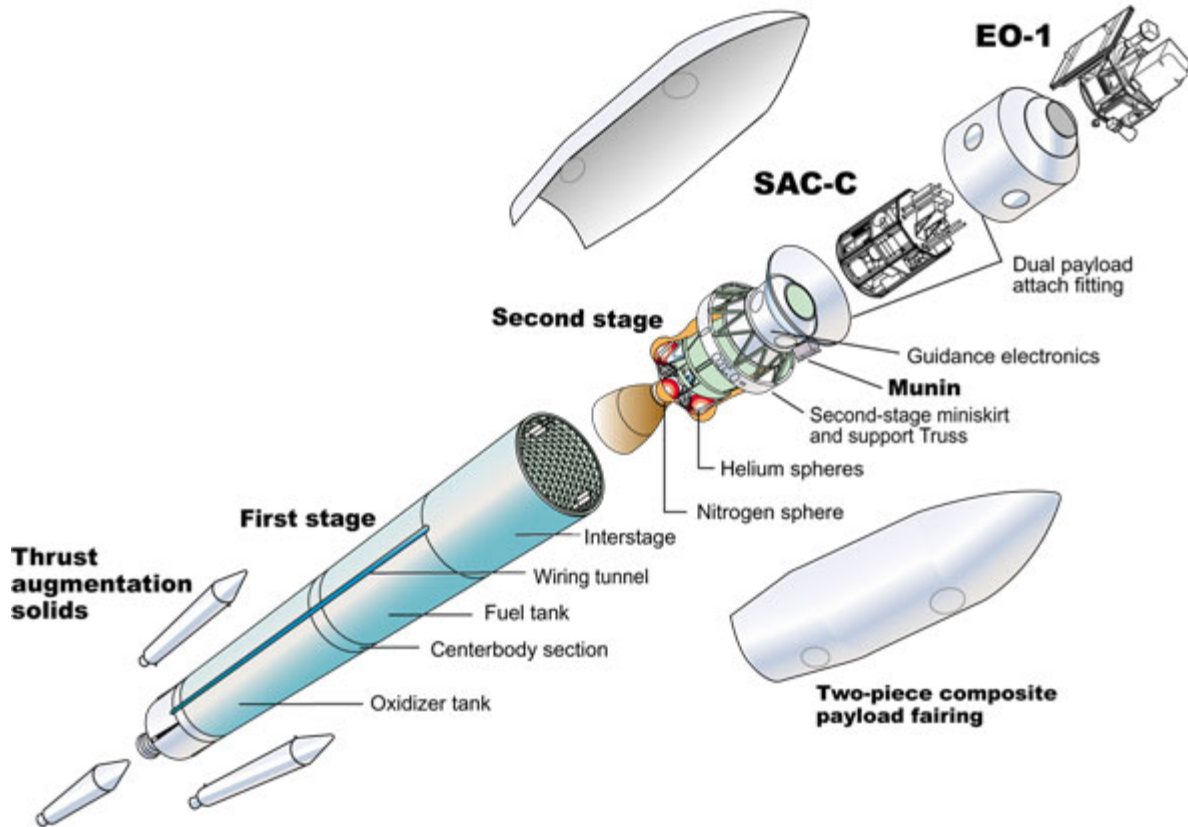


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Delta 7320-10 Dual Payload Configuration



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EO-1/SAC-C Mission Objectives

Munin, named after one of the Nordic God Odin's ravens, is a nanosatellite designed and built by the Swedish Institute of Space Physics in cooperation with students at Umea University and Lulea University, Sweden. The primary objectives include gathering space weather data, monitoring auroral activity, and serving as a testbed for very small autonomous monitoring satellites

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EO-1/SAC-C Mission Requirements

- **Launch Parameters:**
 - Date 21 November 2000
 - Time (PST) 10:24:00 (hr:min:sec)
 - Location VAFB (SLC-2W)

- **EO-1 Ascending Node Orbit:**
 - Circular orbit altitude 705 km (380.7 nmi)
 - Inclination 98.2 deg
 - Mean Local Time (MLT) 22:03:38 (hr:min:sec) ± 30 sec

- **SAC-C Descending Node Orbit:**
 - Orbit altitude 685 x 705 km (369.9 x 380.7 nmi)
 - Inclination 98.28 deg
 - Mean Local Time (MLT) 10:14:00 (hr:min:sec)
-30, +60 sec

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EO-1/SAC-C Mission Requirements (*continued*)

- **Munin's Desired Depletion-Burn Orbit**
 - Apogee: 1200 - 2000 km (647.9 to 1079.9 nmi)
Preferred: 1700 km (917.9 nmi)
 - Perigee: 705 km (380.7 nmi)
80 to 100 deg
 - Inclination: Preferred: 90 deg

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EO-1/SAC-C Mission Requirements (*continued*)

- **Spacecraft Allocated Weight:**
 - EO-1 588 kg (1296.32 lb)
 - SAC-C 476.7 kg (1050.94 lb)
 - Munin 5.95 kg (13.12 lb)

- **DPAF:** 358.9 kg (791.13 lb)
 - Total Weight: 185.8 kg (409.55 lb)
 - Separable Weight

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EO-1/SAC-C Flight Mode Description

- Delta 7320-10 launch from Vandenberg Air Force Base SLC-2W
- Flight Azimuth: 196 deg
- Three GEM solid motors ignited at liftoff
- GEM separation at 1 min 39.0 sec after liftoff
- Payload fairing jettisoned at 4 min 57.0 sec after liftoff
- Second-stage first burn places vehicle in a 185 x 713 km. (100 x 385 nmi) transfer orbit

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EO-1/SAC-C Flight Mode Description (*continued*)

- Restart occurs near apogee and places the vehicle into an orbit such that the oscillating orbit at the first ascending node is circular with an altitude of 705 km (380.7 nmi) and an inclination of 98.2 deg
 - Burn is in view of Malindi
 - Following SECO-2, the second stage is reoriented to EO-1's separation attitude and the spacecraft is jettisoned
 - Separation is in view of Malindi

- After EO-1 separation, the second stage is reoriented to the desired attitude and the separable portion of the Dual Payload Attach Fitting (DPAF) is jettisoned

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EO-1/SAC-C Flight Mode Description (*continued*)

- Second restart occurs over Greenland and places the vehicle into an orbit such that the oscillating orbit at the first descending node is 685 x 705.2 km (369.9 x 380.8 nmi) with an inclination of 98.28 deg
 - This burn provides the 2.646-deg RAAN shift required to satisfy the descending node MLT as well as the 0.08-deg inclination shift
 - It is in view of Thule
- Following SECO-3, the second stage is reoriented to the required SAC-C separation attitude and SAC-C is separated
 - Separation is in view of Thule and Poker Flats

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EO-1/SAC-C Flight Mode Description (*continued*)

- Next, the second stage is reoriented to the depletion-burn attitude
- Restart occurs at 1 hr 48 min 20.0 sec into flight and, assuming a nominal burn, places the vehicle into a 696.7 x 1625 km (376.2 x 877.4 nmi) orbit at 96.4-deg inclination
 - Burn is in view of Hawaii
- Following a short coast, Munin is separated at 1 hr 50 min into flight
 - Separation is in view of Hawaii

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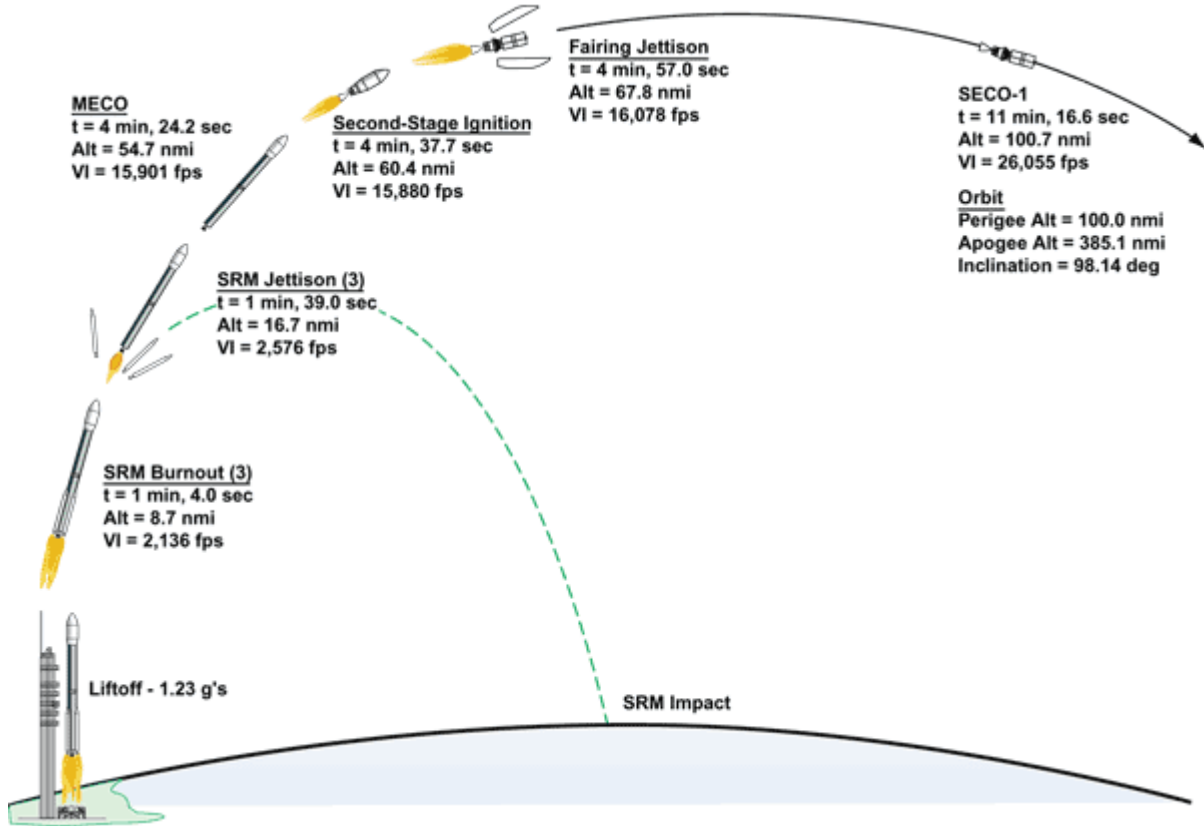


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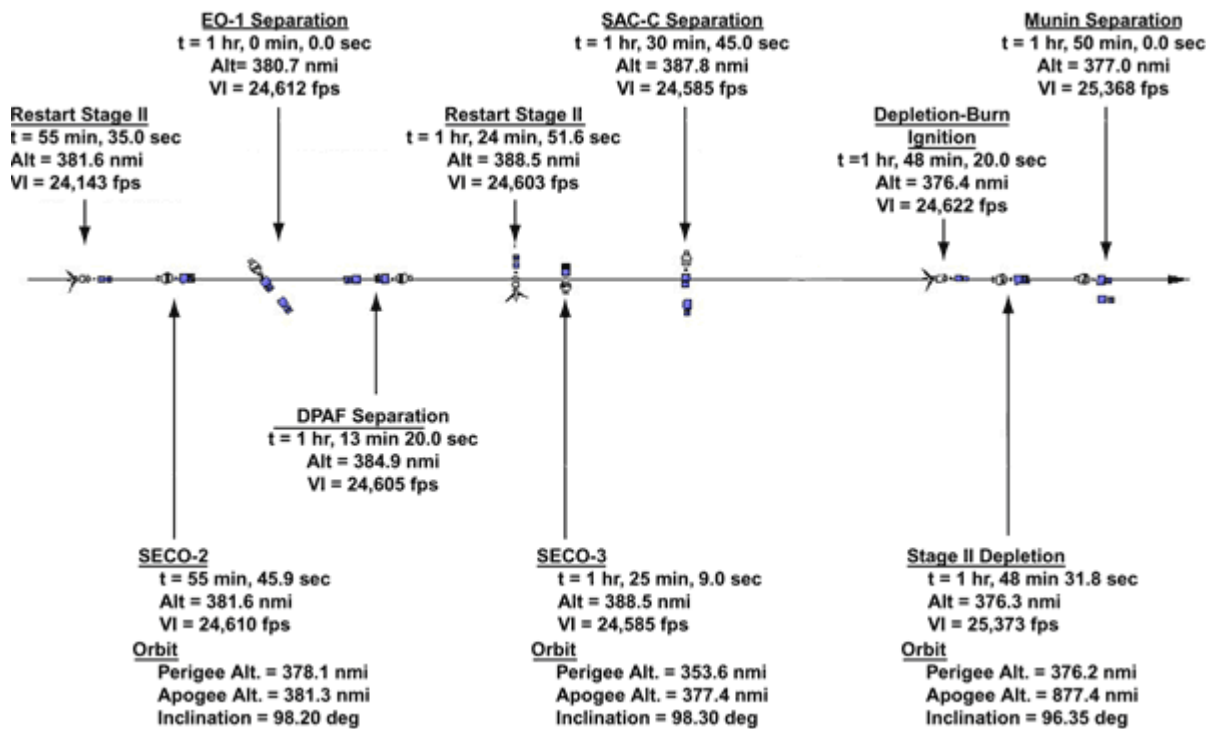


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Separation Profile



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EO-1/SAC-C Sequence of Events

Parameter	Time (min/sec)
Liftoff	00:00.0
Mach 1	00:35.9
Maximum Dynamic Pressure (Q) (1057 psf)	00:50.2
Solid Motor Burnout (3)	01:04.0
Jettison Solid Motor Casings	01:39.0
Begin Dog-Leg Maneuver	01:40.0
Maximum Alphas-Qpress Product	01:50.0
End Dog-Leg Maneuver	02:20.0
Maximum Miniskirt Temperature (382°F)	04:08.5
MECO	04:24.2
Stage II Ignition	04:37.7
Jettison 10-ft Composite Fairing	04:57.0
First Cutoff - Second Stage (SECO-1)	11:16.6
Maneuver for Coast-Phase Sun Pointing	13:20.0 - 19:40.0
Maneuver to Stage II Restart Attitude	48:25.0 - 53:35.0
First Restart - Stage II	55:35.0
Second Cutoff - Second Stage (SECO-2)	55:45.9
Maneuver to EO-1 Separation Attitude	56:00.0 - 59:10.0

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EO-1/SAC-C Sequence of Events *(continued)*

Parameter	Time (hr/min/sec)
Separate EO-1	01:00:00.0
Maneuver to DPAF Separation Attitude	01:07:20.0 - 01:12:30.0
Separate Portion of DPAF	01:13:20.0
Maneuver to Stage II Restart Attitude	01:17:00.0 - 01:22:10.0
Second Restart - Stage II	01:24:51.6
Third Cutoff - Second Stage (SECO-3)	01:25:09.0
Maneuver to SAC-C Separation Attitude	01:25:50.0 - 01:29:55.0
Separate SAC-C	01:30:45.0
Maneuver to Citizen Explorer Sep. Attitude	01:34:10.0 - 01:38:40.0
Separate Citizen Explorer	01:39:30.0
Maneuver to Stage II Restart Attitude	01:42:50.0 - 01:46:20.0
Third Restart - Stage II (Depletion Burn)	01:48:20.0
Fourth Cutoff - Second Stage (SECO-4)	01:48:31.8
Separate Munin	01:50:00.0

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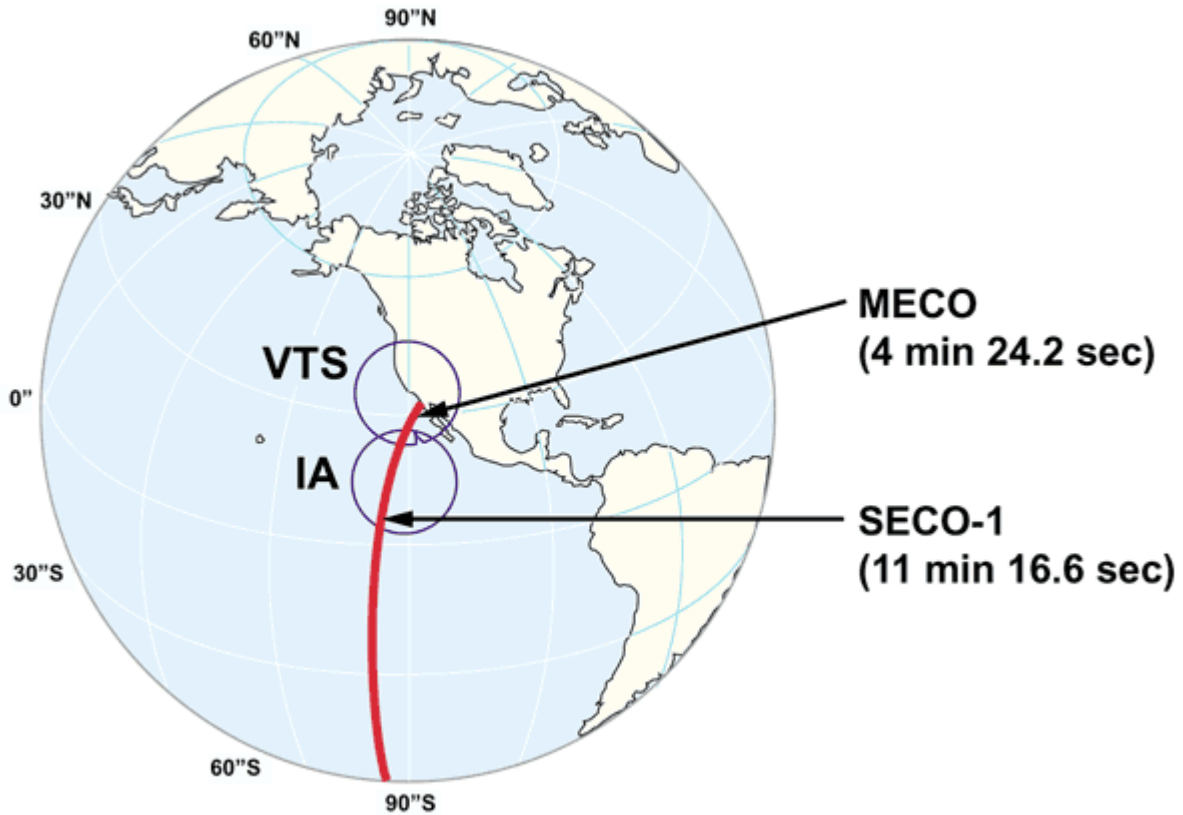


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Orbit Trace 1



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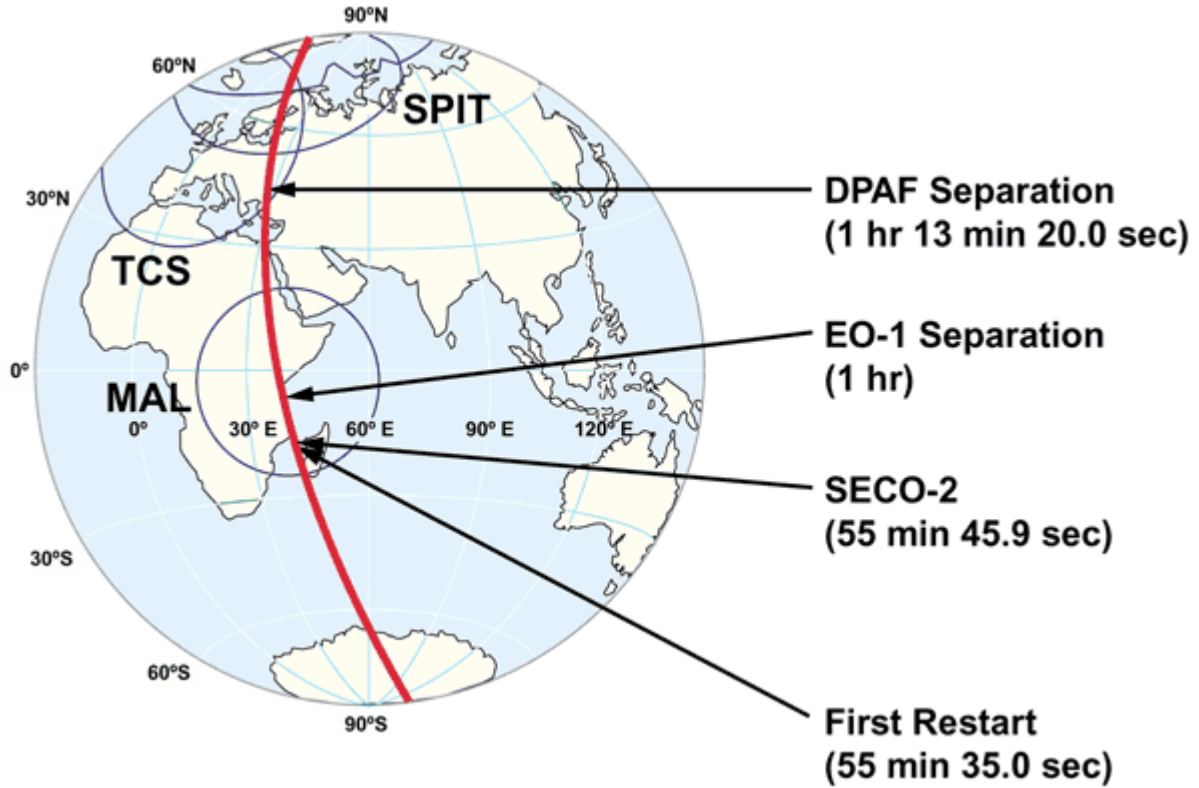


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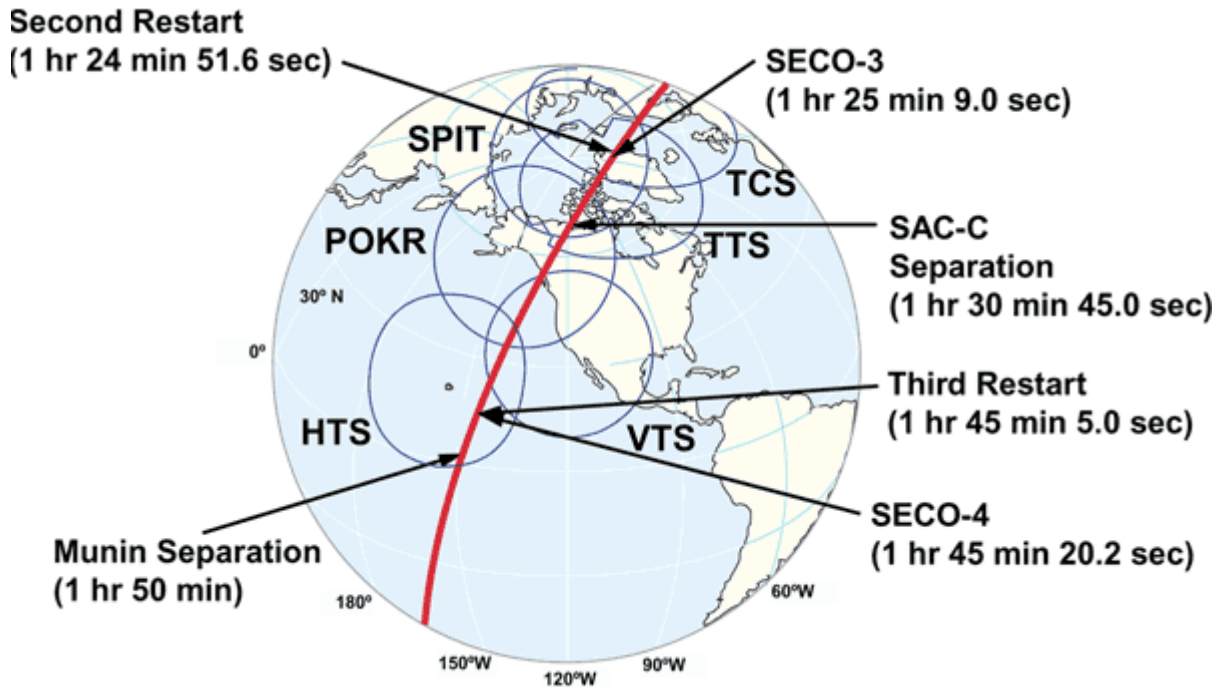


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Orbit Trace 3



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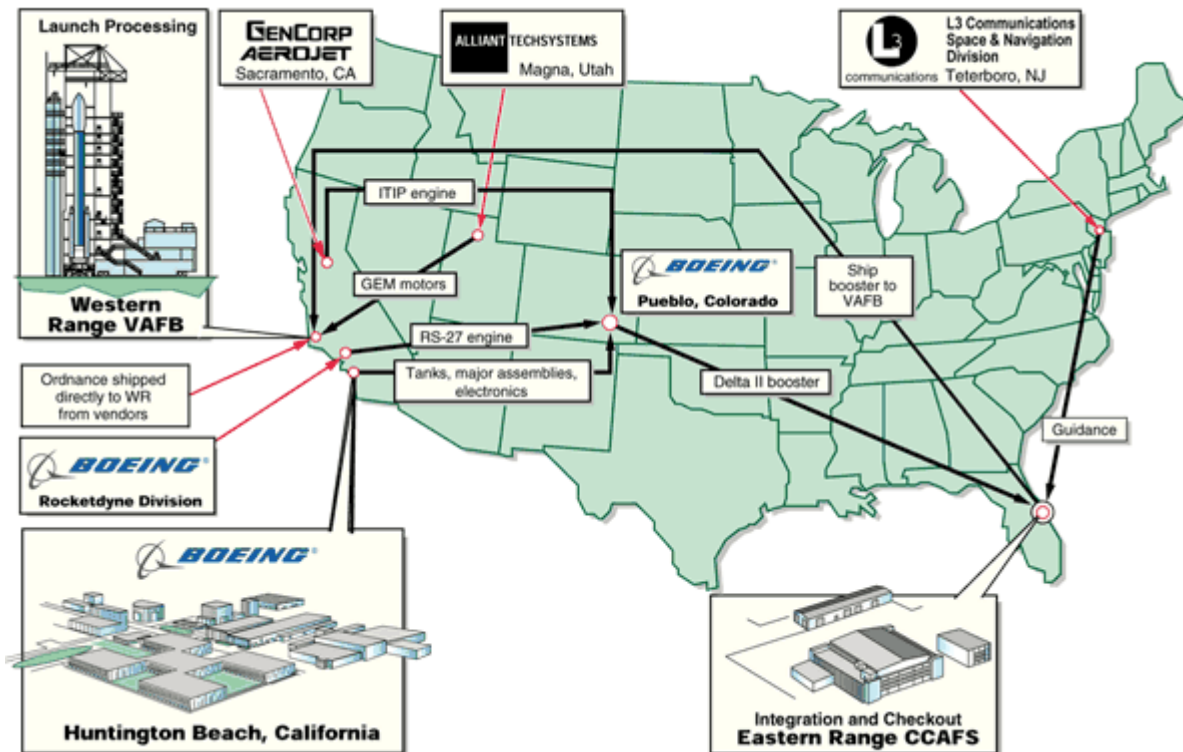


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Delta II Operations Flow



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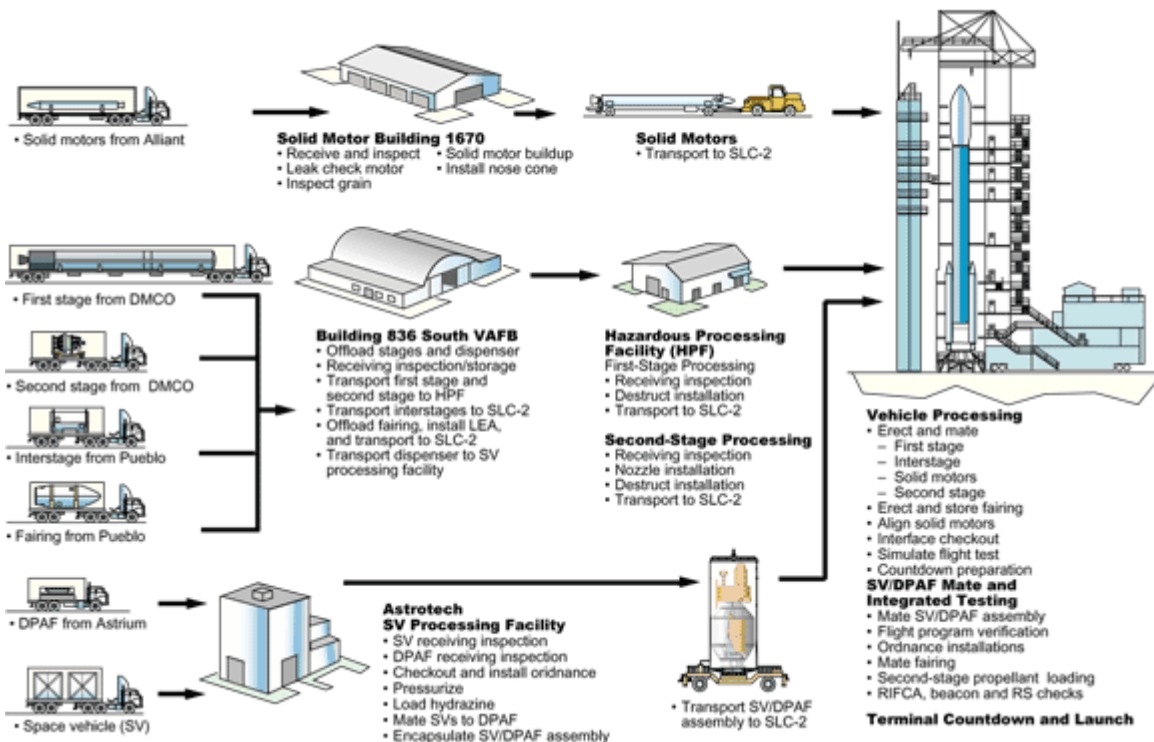


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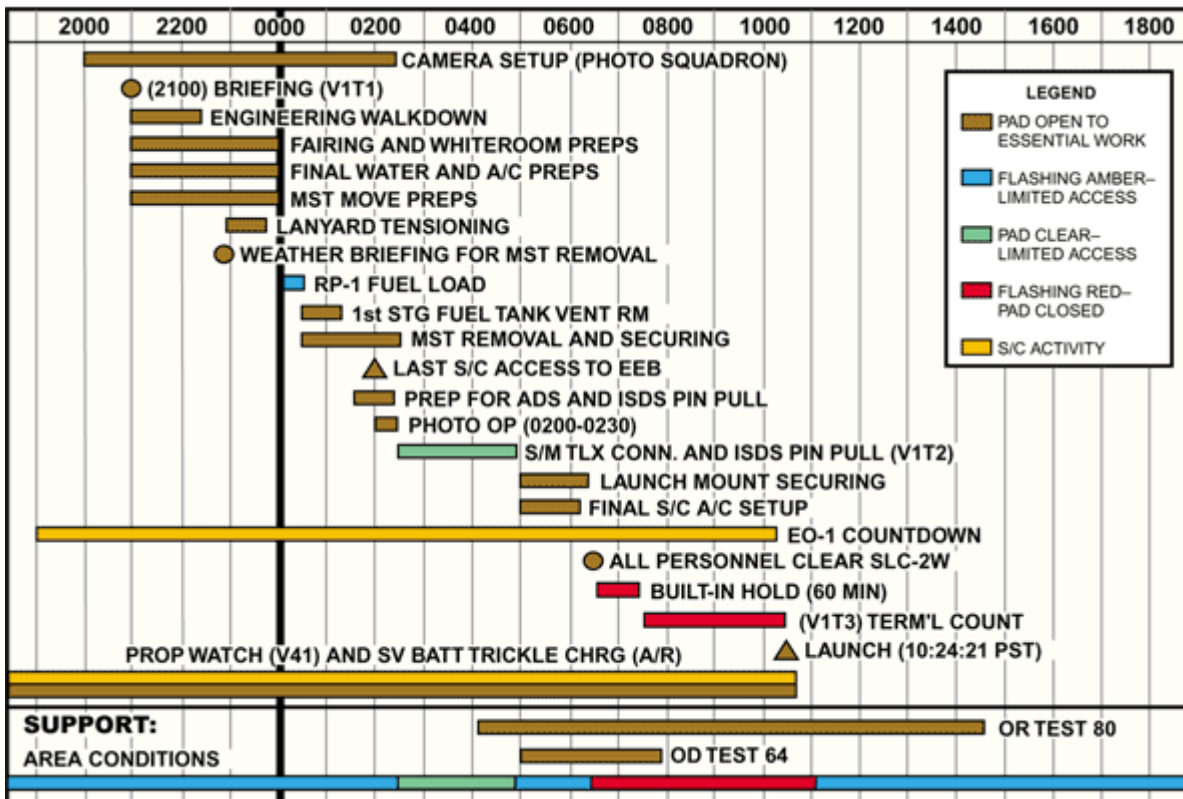


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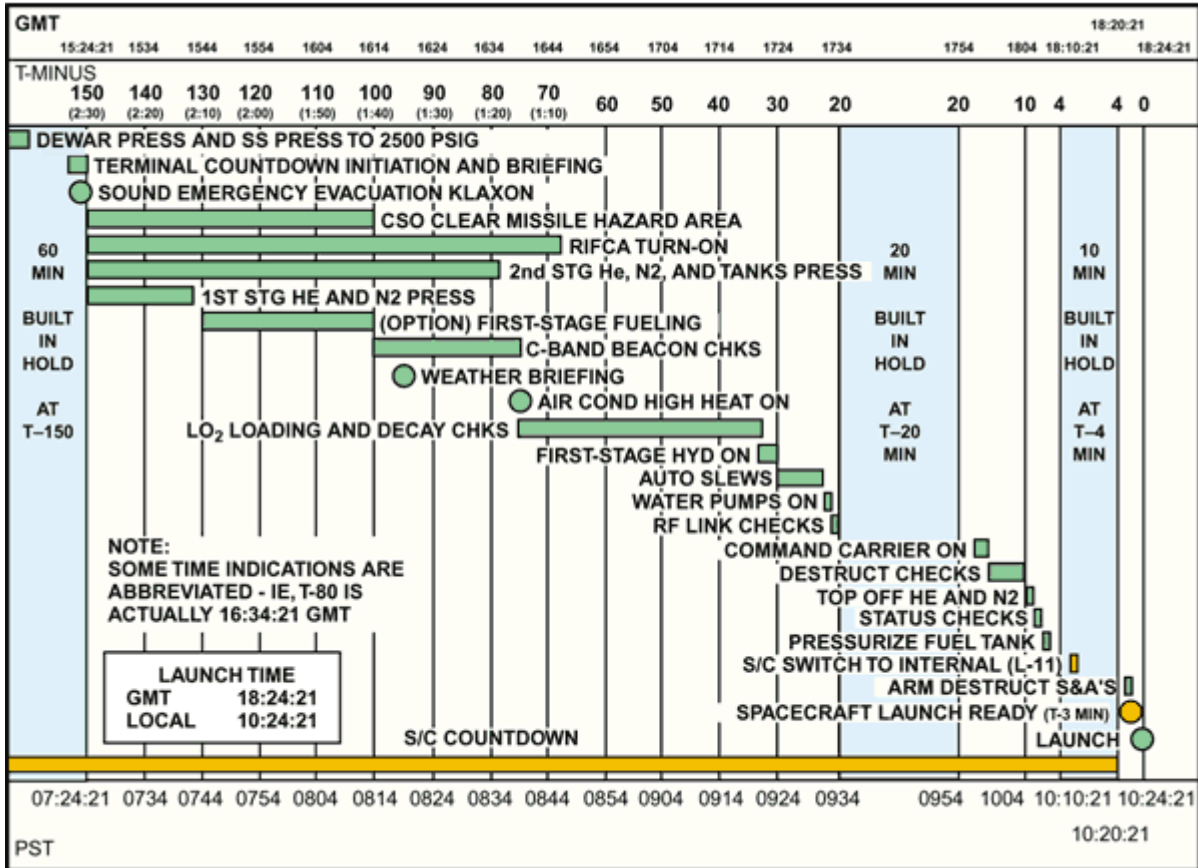


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