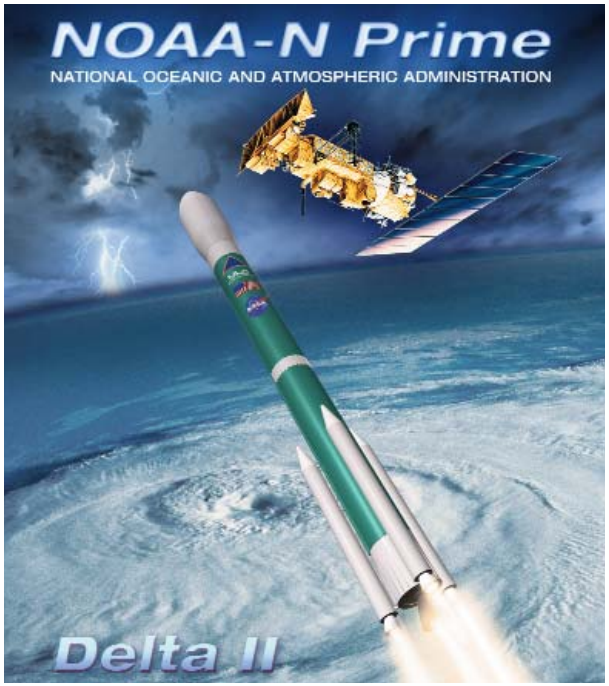
United Launch Alliance

NOAA-N Prime

Mission Overview

Delta II 7320-10C
Vandenberg Air Force Base, CA
Space Launch Complex-2 West



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NOAA-N Prime

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United Launch Alliance (ULA) takes great pride in launching the National Oceanic and Atmospheric Administration (NOAA) satellite NOAA-N Prime. The NOAA-N Prime satellite will be launched aboard a ULA Delta II 7320-10C from Vandenberg Air Force Base (VAFB). The Delta II launch vehicle will place the NOAA-N Prime satellite in a circular 7237.89-km orbit with a sun-synchronous inclination (98.7 deg). NOAA-N Prime will provide continued service to collect data pertaining to the Earth's atmosphere, surface, and cloud cover.

ULA provides the Delta II launch under the National Aeronautics and Space Administration (NASA) Launch Services (NLS) contract with the NASA Kennedy Space Center Launch Services Program. We are pleased that NASA once again selected the Delta II for this mission after many successful commercial, international, and government launches to Earth orbit and destinations throughout the solar system. My congratulations to the entire Delta team for your continued efforts in achieving this milestone. We look forward to continued exploration with Delta-launched spacecraft.

Kristen T. Walsh
Director, NASA/Commercial Programs
Delta Launch Vehicles

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NOAA-N Prime Science Objectives

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- The NOAA N-Prime spacecraft is the last in the Television Infrared Observation Satellite (TIROS) series of polar operational environmental spacecraft for the NASA-Goddard Space Flight Center (NASA-GSFC) Polar Operational Environmental Satellite (POES) Program.

- The NOAA-N Prime spacecraft provides an economical and stable platform for the advanced instruments used in measuring the Earth's atmosphere, its surface, its cloud cover, and proton and electron fluxes near the planet. In addition to storing and transmitting the data from these instruments, the NOAA-N Prime spacecraft receives, processes, and re-transmits data from free-floating balloons, buoys, and remote automatic observation stations distributed around the globe. NOAA-N Prime also receives, processes, and re-transmits search-and-rescue distress signals from users around the world.

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NOAA-N Prime Spacecraft

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Photo courtesy of the Goddard Space Flight Center, POES Program.

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NOAA-N Prime Science Instruments

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- **High Resolution Infrared Radiation Sounder (HIRS/4)**
  The HIRS/4 instrument measures scene radiance in the IR spectrum. The data is also used to determine ocean surface temperatures, total atmospheric ozone levels, precipitable water, cloud height and coverage, and surface radiance.

- **Advanced Microwave Sounding Unit-A (AMSU-A)**
  The AMSU-A measures scene radiance in the microwave spectrum. Data from this instrument is used to calculate global atmospheric temperature and humidity profiles from the Earth's surface to the upper stratosphere.

- **Microwave Humidity Sounder (MHS)**
  The MHS is a new instrument for the NOAA series of satellites. It measures profiles of atmospheric humidity, cloud liquid water content, and provides qualitative estimates of the precipitation rate.

- **Solar Backscatter Ultraviolet Radiometer (SBUV/2)**
  The SBUV/2 measures solar irradiance and Earth radiance (backscattered solar energy) in the near ultraviolet spectrum (160–400 nm).

- **Advanced Very High Resolution Radiometer (AVHRR/3)**
  The AVHRR/3 detects energy in the visible and IR portions of the electromagnetic spectrum. The instrument measures reflected solar (visible and near-IR) energy and radiated thermal energy from land, sea, clouds, and the intervening atmosphere.

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NOAA-N Prime
Science Instruments (concl'd)

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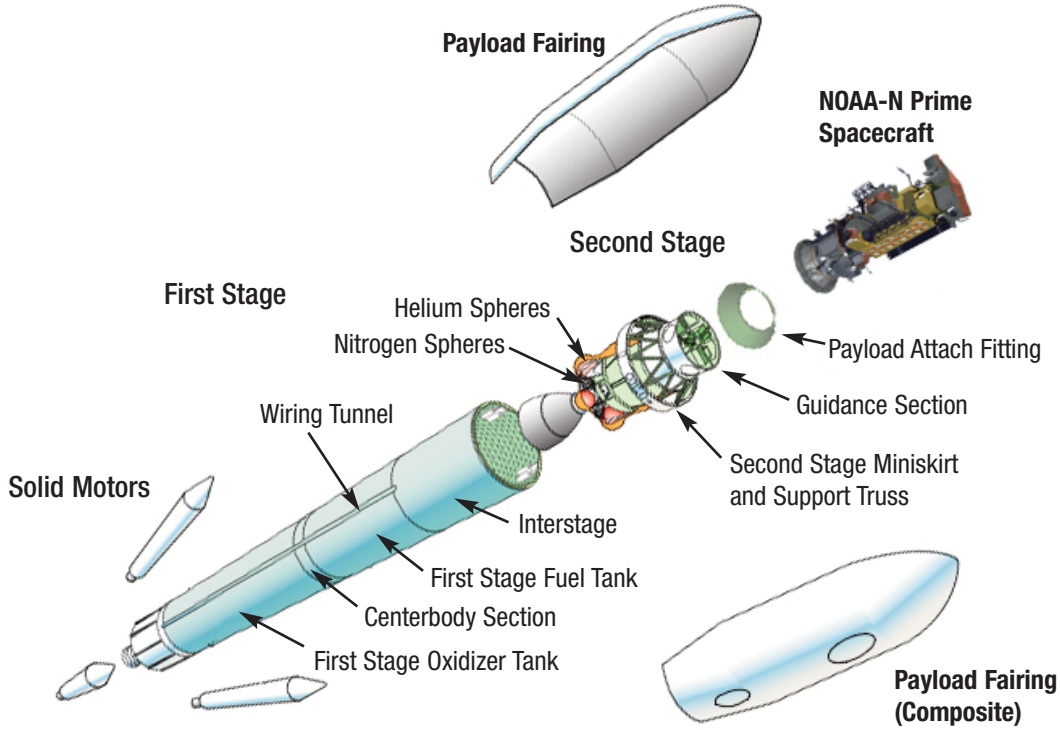
- **Space Environment Monitor (SEM)**
  The SEM measures Earth's radiation belts and charge particles at satellite altitude. The SEM helps to warn of solar winds that may impair long-range communications and high-altitude operations, damage satellite circuits and solar panels, or cause changes in drag and magnetic torque on satellites.

- **Advanced Data Collection System (ADCS)**
  The ADCS collects messages transmitted by scientific data collection platforms. The platforms relay data such as atmospheric pressure, sea surface temperature and salinity, surface and subsurface ocean currents, sea and river levels, vessel positions, and animal temperature and activity.

- **Search and Rescue (SAR) Instruments**
  The SAR instruments are part of the international COSPAS-SARSAT system designed to detect and locate Emergency Locator Transmitters (ELTs), Emergency Position-Indicating Radio Beacons (EPIRBs), and Personal Locator Beacons (PLBs) operating at 406 MHz.

- **Digital Data Recorder (DDR)**
  The DDR records and stores sensor data during each orbit for later downloading to the NOAA Command and Data Acquisition stations at Wallops Island, VA., Fairbanks, AK., and the European Organization for the Exploitation of Meteorological Satellites (EUMETSAT)-controlled station in Svalbard, Norway.

Delta II 7320-10C Launch Vehicle



NOAA-N Prime
Mission Requirements

• Launch Window Launch window same for each day	02:22:01 - 02:32:01 LMT 10:22:01 - 10:32:01 UTC
Spacecraft Mass (lb) (Including PAF and Sep. System)	3,180
• Orbit Requirements*	
- Semi-Major Axis (km/nmi)	7237.89/3908.15
- Eccentricity	0.0000
• Circular Orbit Altitude (km/nmi)	859.7/464.2
- Inclination (deg)	98.734
• Second Stage Probability of Command - Shutdown (PCS)	>99.7%
• Free Molecular Heating Rate at Fairing Separation	<0.0894 BTU/ft2-sec

*Defined immediately after spacecraft separation

Flight Mode Description
Boost to Orbit

- 7320-10C launch from Vandenberg Air Force Base (VAFB) SLC-2W
- Flight azimuth of 196 degrees
- Three solid motors ignited at liftoff
- Solid motor separation enable to arm OAD at 98 sec
- Separation of three GEM solid motors at 99 sec to assure clearance of coastal oil platforms
- Dog-leg maneuver (1min, 40 sec to 2 min, 20 sec) performed to attain required orbital inclination
- Main engine cutoff (MECO) occurs at first-stage propellant depletion;
  nominally at 4 min 24.2 sec after liftoff
- Second Stage separated 8 seconds after MECO; Ignited 5.5 sec later
- Payload fairing jettisoned when free molecular heating rate <0.0894 BTU/ft^2-sec
- Command Receiver Decoders (CRDs) turned off at 7 min, 28.5 sec
- Second stage first burn places vehicle in a 100 x 468 nmi (185 x 867 km) orbit
  with an inclination of 98.6 deg
  - Mobile Telemetry (MT) required for coverage of last portion of second stage burn

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Sequence of Events
Boost to Orbit

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Event	Time (HR:MIN:SEC)
Liftoff	0:00:00.0
Mach 1	0:00:36.0
Maximum dynamic pressure	0:00:50.0
Three solid motors burnout	0:01:04.0
Jettison three solid motors	0:01:39.0
Begin dog-leg maneuver	0:01:40.0
End dog-leg maneuver	0:02:20.0
Main engine cutoff	0:04:24.2
Stage I/II separation	0:04:32.7
Stage II ignition	0:04:37.7
Fairing jettison	0:04:56.0
Turn off command receiver decoders (CRDs)	0:07:28.5
First cutoff - second stage (SECO 1)	0:11:16.1

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Flight Mode Description
Restart to Separation

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- Following second stage cutoff (SECO 1), vehicle reoriented to desired coast attitude
- At end of reorientation maneuver, thermal roll maneuver of 2 deg/sec initiated
- Following thermal roll maneuver, vehicle reoriented to restart burn attitude
- Second stage restart occurs at 59 min, 21.0 sec over the Hartebeesthoek (HBK) and Malindi (MAL) tracking stations
  - Restart burn duration of 13.3 sec
  - At the end of the restart burn, second stage is in an 463.0 x 466.5-nmi (857.5 x 864.0 km) orbit with an inclination of 98.7 deg
- Following second stage restart burn, vehicle reoriented to spacecraft separation attitude
- Spacecraft separation roll rate initiated at 1 hr, 5 min, 20.0 seconds
- Spacecraft separation occurs at 1 hr, 5 min, 40.0 sec over the Malindi tracking station
  - Relative separation velocity of 3 fps between spacecraft and second stage
  - Elevation angle from Malindi (MAL) tracking station to vehicle is 12.0 deg.
  - Spacecraft is in desired circular orbit of 464.2 nmi (859.7 km) with an inclination of 98.7 degrees.

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Sequence of Events
Restart to Separation

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Event	Time (HR:MIN:SEC)
Begin maneuver to coast attitude	0:13:20.0
End maneuver to coast attitude	0:18:20.0
Begin coast roll maneuver	0:18:30.0
End coast roll maneuver	0:54:10.0
Begin maneuver to restart attitude	0:54:20.0
End maneuver to restart attitude	0:57:20.0
Restart second stage	0:59:21.0
Second cutoff - second stage (SECO 2)	0:59:34.3
Begin maneuver to separation attitude	1:00:40.0
End maneuver to separation attitude	1:04:30.0
Begin spacecraft separation roll rate	1:05:20.0
Spacecraft separation	1:05:40.0

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Flight Profile

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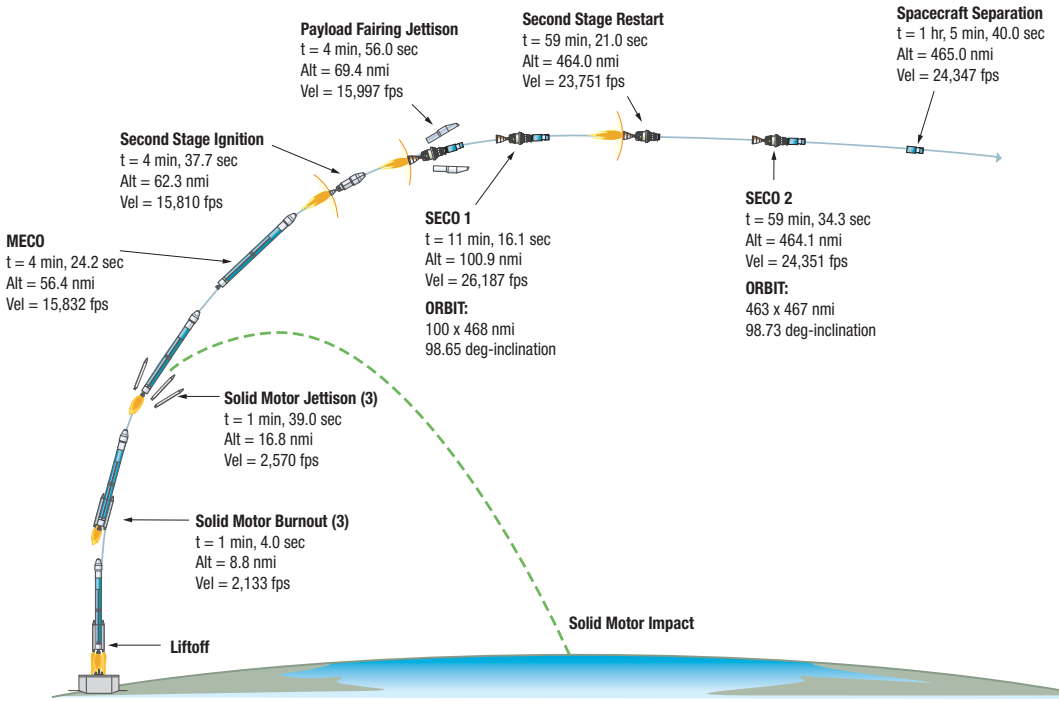

Ground Trace
Boost to Orbit

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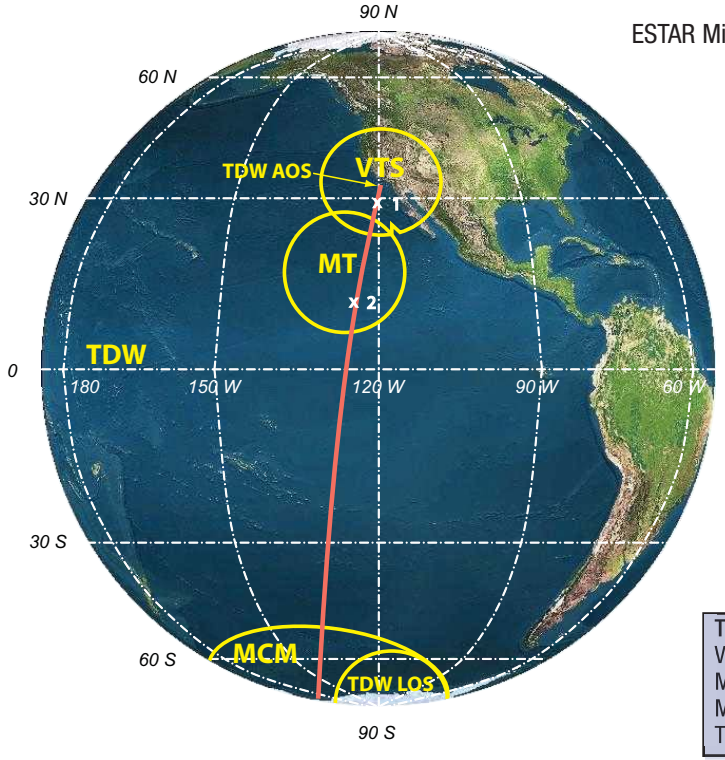
ESTAR Min. for T/M Sites = 2.00 deg



Events (Time, sec)
1 = MECO (264.2)
2 = SECO 1 (0676.1)

T/M Tracking Stations
VTS = Vandenberg AFB
MT = Mobile Telemetry
MCM = McMurdo
TDW = TDRS-W (174 deg W)

Ground Trace
Restart to Spacecraft Separation

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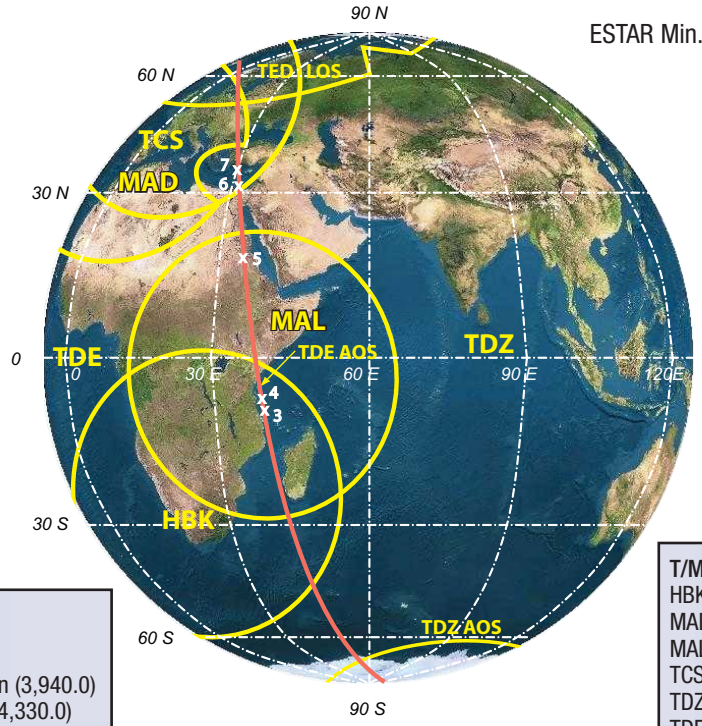
ESTAR Min. for T/M Sites = 2.00 deg



Events (Time, sec)
3 = Restart Ignition (3,561.0)
4 = SECO 2 (3,574.3)
5 = NOAA-N Prime Separation (3,940.0)
6 = Begin Cold Gas Evasive (4,330.0)
7 = End Cold Gas Evasive (4,380.0)

T/M Tracking Stations
HBK = Hartebeesthoek
MAD = Madrid
MAL = Malindi
TCS = Oakhanger
TDZ = TDRS-Z (275 deg W)
TDE = TDRS-E (41 deg W)

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Total Vehicle Integration & Checkout at the Launch Site

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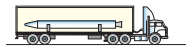
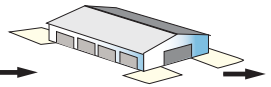
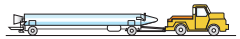


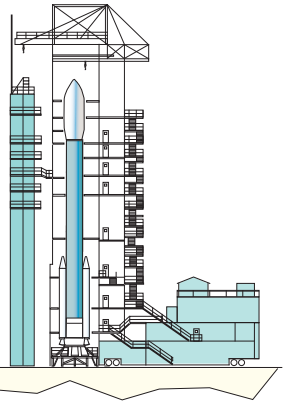
• Solid motors

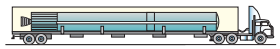


Solid Motor Building 1670
- Receive and inspect
- Leak-check motor
- Inspect grain
- Solid motor buildup
- Install nose cone



Solid Motors
- Transport to SLC-2



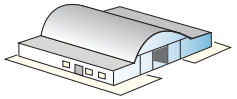


• First stage

• Second stage

• Interstage

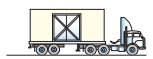
• Fairing



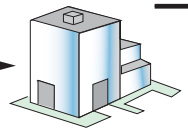
Building 836 South VAFB
- Offload stages and dispenser
- Receive inspection/storage
- Transport first stage and second stage to HPF
- Transport interstages to SLC-2
- Offload fairing, install LEA, and transport to SLC-2
- Transport dispenser to SV processing facility

Hazardous Processing Facility (HPF)
First-Stage Processing
- Receive inspection
- Destruct installation
- Transport to SLC-2

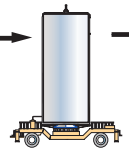
Second Stage Processing
- Receiving inspection
- Nozzle installation
- Destruct installation
- Transport to SLC-2



• Space vehicle (SV)



Astrotech
SV Processing Facility
- SV receiving inspection
- DPAF receives inspection
- Checkout and install ordnance
- Pressurize
- Load hydrazine
- Mate SVs to DPAF
- Weigh Spacecraft
- Encapsulate SV/DPAF assembly



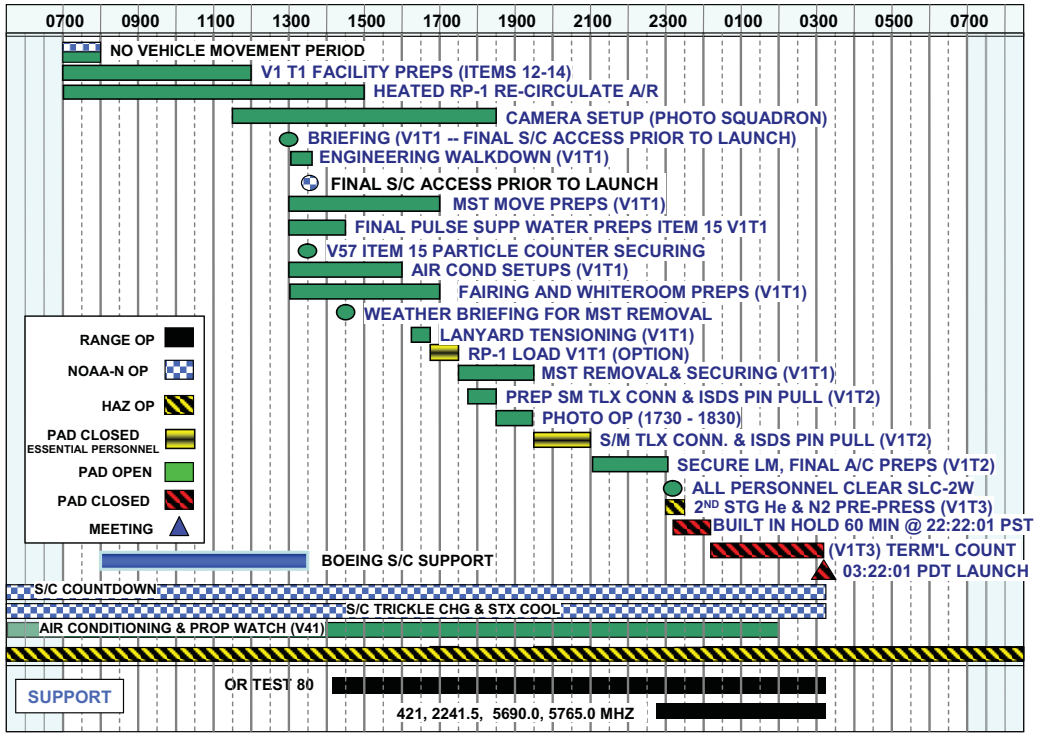
• Transport SV assembly to SLC-2

Vehicle Processing
- Erect and mate
  - First stage
  - Interstage
  - Solid motors
  - Second stage
- Erect and store fairing
- Align solid motors
- Interface checkout
- Simulate flight test
- Countdown preparation

SV Mate and Integrated Testing
- Flight program verification
- Ordnance installations
- Mate fairing
- Second-stage propellant load
- RIFCA, beacon, and RS check

Terminal Countdown and Launch

Delta II Countdown (T-0 Day)



Delta II Terminal Count (T-0 Day)