Atlas V AEHF-1

Mission Overview
Cape Canaveral Air Force Station, FL

ULA®
United Launch Alliance

ATLAS®

The ULA team is proud to be the launch provider for the Advanced Extremely High Frequency-1 (AEHF-1) satellite. The AEHF satellites are the next generation of global, high-security, survivable communications satellites that will be used by all branches of the United States military.

AEHF satellites are the follow-on to the Department of Defense's current five-satellite Milstar communications constellation. When fully operational, the Advanced EHF constellation will consist of four crosslinked satellites for the user.

The Air Force's Military Satellite Communications Systems Wing (MCSW) is the lead agency responsible for managing the AEHF contract. MCSW ensures that the secure communications capabilities of this system are made available to military personnel around the globe. AEHF-1 was designed and built for the U.S. Air Force by the Lockheed Martin Corporation.

My thanks to the entire team for its dedication in bringing AEHF-1 to launch and to the Air Force for selecting the ULA team to launch this important national security mission.

Go Atlas, Go Centaur, Go AEHF-1!

Jim Sponnick
Vice President,
Mission Operations

Atlas V AEHF-1

AEHF-1 SATELLITE | Overview

The AEHF System is a joint service satellite communications system that will provide survivable, global, secure, protected, and jam-resistant communications for high-priority military ground, sea and air assets. Advanced EHF will allow the National Security Council and Unified Combatant Commanders to control their tactical and strategic forces at all levels of conflict through general nuclear war and supports the attainment of information superiority.

The AEHF System is the follow-on to the Milstar system, augmenting and improving on the capabilities of Milstar, and expanding the MCSW architecture. It will provide connectivity across the spectrum of mission areas, including land, air and naval warfare; special operations; strategic nuclear operations; strategic defense; theater missile defense; and space operations and intelligence.

The AEHF system will consist of four satellites in geosynchronous earth orbit (GEO) that provide 10 times the throughput of the Milstar satellites with a substantial increase in coverage for users. The AEHF system is composed of three segments: space (the satellites), ground (mission control and associated communications links), and terminals (the users). The segments will provide communications in a specified set of data rates from 75 bps to approximately 8 Mbps. The space segment consists of a cross-linked constellation of four satellites. The mission control segment controls satellites on orbit, monitors satellite health, and provides communications system planning and monitoring. This segment is highly survivable, with both fixed and mobile control stations. System uplinks and crosslinks operate in the extremely high frequency (EHF) range and downlinks in the super high frequency (SHF) range. The terminal segment includes fixed and ground mobile terminals, ship and submarine terminals, and airborne terminals used by all of the services and international partners (Canada, Netherlands, and UK).

The fully fueled, approximately 13,600-lb spacecraft is based on the Lockheed Martin A2100 commercial satellite that includes hall current thruster electric propulsion, which is 10 times more efficient than conventional bipropellant systems. The thrusters remove orbit eccentricity during transfer orbit operations, orbit maintenance, and satellite repositioning. The payload features onboard signal processing and crossbanded EHF/SHF communications. Increased coverage is provided by antennas consisting of two SHF Downlink Phased Arrays, two Crosslinks, two Uplink/Downlink theater anti-jam nulling antennas, one Uplink EHF Phased Array, six Uplink/Downlink Gimbaled Dish Antenna, one each Uplink/Downlink earth coverage horns.

Photo Courtesy of Lockheed Martin Corporation

ATLAS V 531 LAUNCH VEHICLE | Overview

The Atlas V 531 consists of a single Atlas V booster stage, the Centaur upper stage, three solid rocket boosters (SRBs), and a 5-meter payload fairing (PLF).

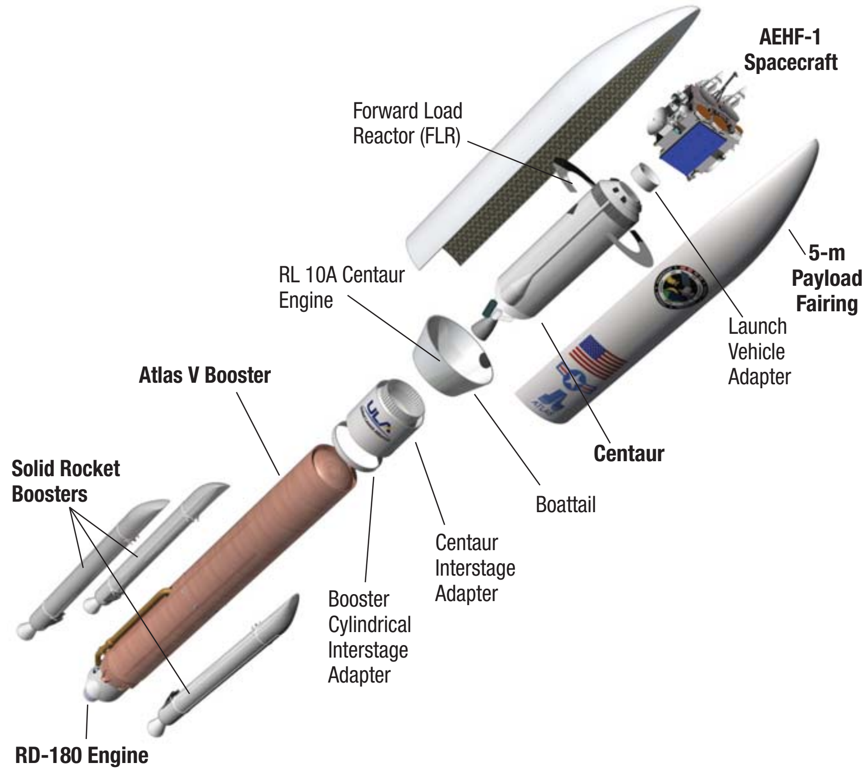
The Atlas V booster is 12.5 ft in diameter and 106.5 ft in length. The booster's tanks are structurally rigid and constructed of isogrid aluminum barrels, spun-formed aluminum domes, and intertank skirts. Atlas booster propulsion is provided by the RD-180 engine system (a single engine with two thrust 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.

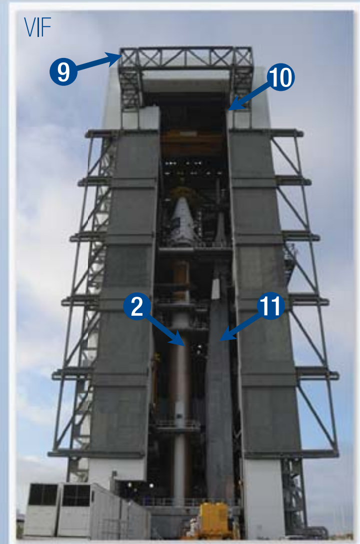
The AEHF-1 satellite is encapsulated in the Atlas V 5-meter diameter short PLF. The 5-meter PLF is a sandwich composite structure made with a vented aluminum-honeycomb core and graphite-epoxy face sheets. The bisector (two-piece shell) PLF encapsulates both the Centaur and the spacecraft, which separates 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 531 LAUNCH VEHICLE | Expanded View



SLC-41 | Overview

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



ATLAS V AEHF-1 | Mission Overview

The first AEHF mission will be flown on an easterly trajectory from Space Launch Complex 41 (SLC-41) at Cape Canaveral Air Force Station (CCAFS), Florida. The spacecraft will be released into a supersynchronous transfer orbit. Following separation, the satellite will tailor its orbit using an on-board propulsion system and begin its mission.

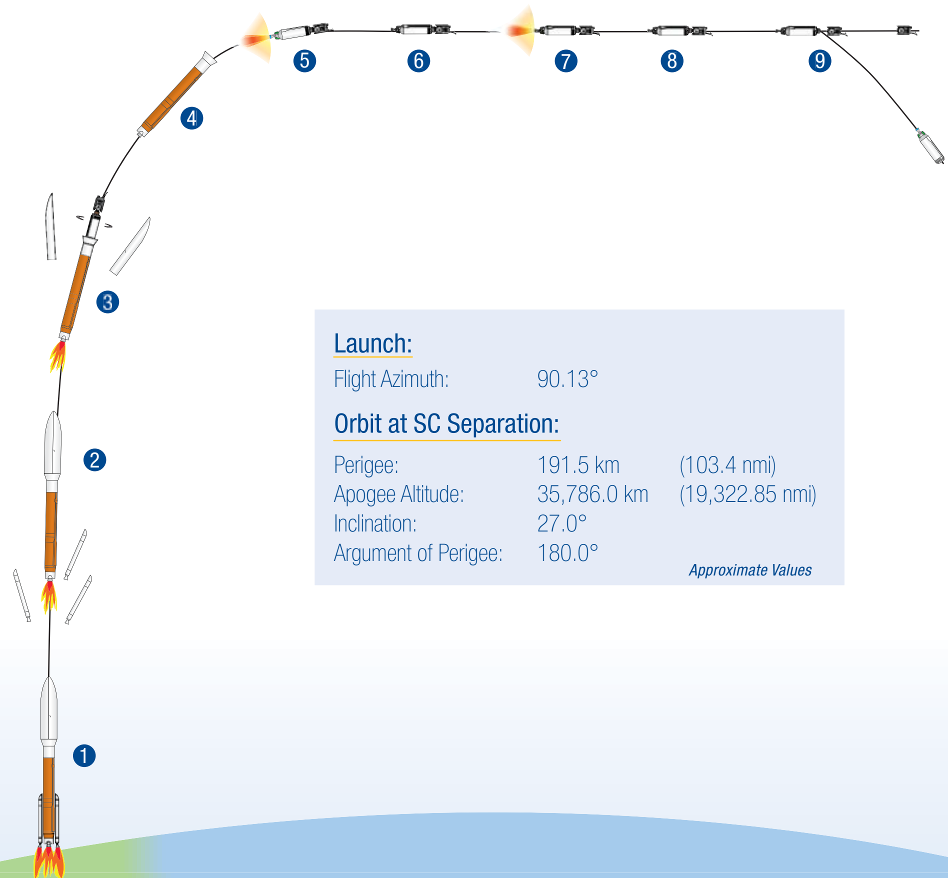
Mission telemetry data will be gathered by TEL-4 (Merritt Island); Jonathan Dickinson Missile Tracking Annex (JDMTA), Antigua; Diego Garcia; and Guam Tracking Stations. The orbiting Tracking and Data Relay Satellite (TDRS) constellation will also participate in gathering telemetry during the AEHF-1 mission.

The mission begins with RD-180 engine ignition approximately 2.7 seconds before liftoff (T-2.7 seconds). SRB ignition takes place at T-0.8 seconds after telemetry indication of healthy RD-180 startup. Liftoff occurs at T+1.1 seconds. Shortly after the vehicle clears the pad, it performs its pitch/yaw/roll maneuver. There are two dynamic pressure peaks during the flight: the first occurs at approximately 48 seconds and the second at approximately 58 seconds. The SRBs burn out at approximately 92 seconds. The first two SRBs are jettisoned 115 seconds into the flight; the third is jettisoned at approximately 117 seconds. The PLF and FLR jettison events take place at 215 and 220 seconds, respectively, during the boost phase of flight. Booster engine cutoff (BECO) occurs at approximately 260 seconds.

Centaur separation occurs 6 seconds after BECO; Centaur main engine start (MES-1) occurs 10 seconds after BECO. A little more than 14 minutes into the mission, the first Centaur main engine cutoff (MECO-1) occurs.

At 22.5 minutes into the mission, Centaur reorients itself for its second main engine start (MES-2). The second Centaur engine burn lasts a little more than 5 minutes, followed by the second Centaur main engine cutoff (MECO-2). After MECO-2, Centaur reorients its attitude for spacecraft separation and begins a passive thermal control roll (PTC). AEHF-1 separates about 23 minutes after MECO-2.

AEHF-1 FLIGHT PROFILE | Liftoff to Spacecraft Separation



Launch:

Flight Azimuth:	90.13°	

Orbit at SC Separation:

Perigee:	191.5 km	(103.4 nmi)
Apogee Altitude:	35,786.0 km	(19,322.85 nmi)
Inclination:	27.0°	
Argument of Perigee:	180.0°	

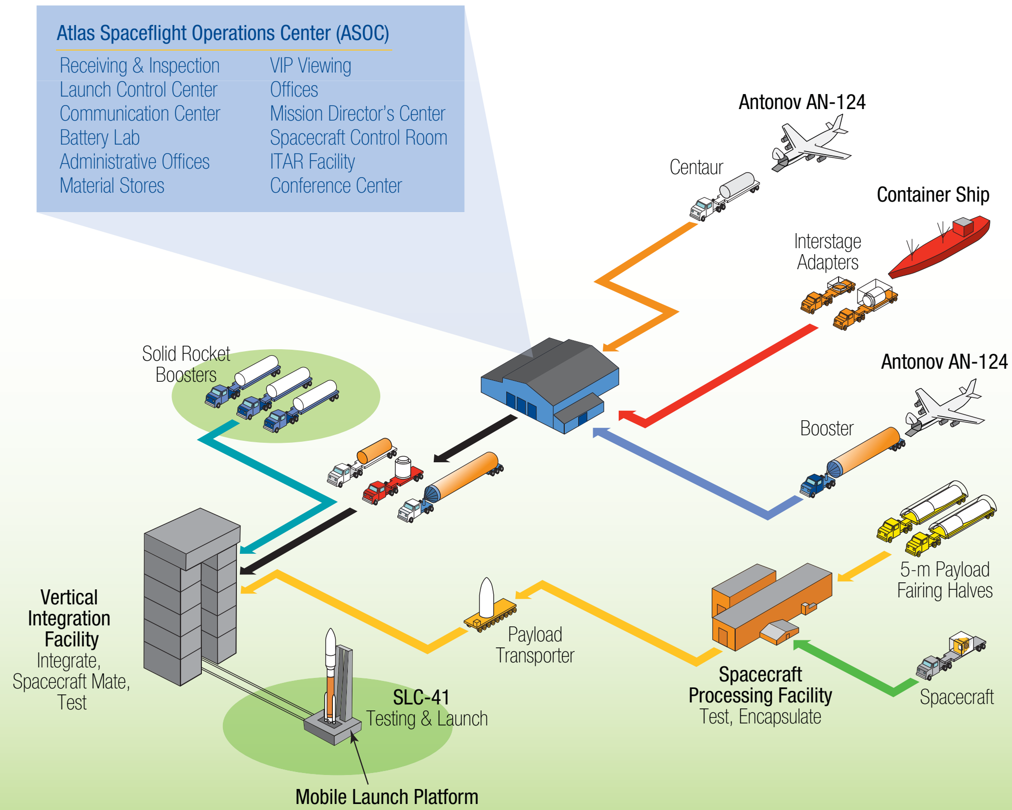
Approximate Values

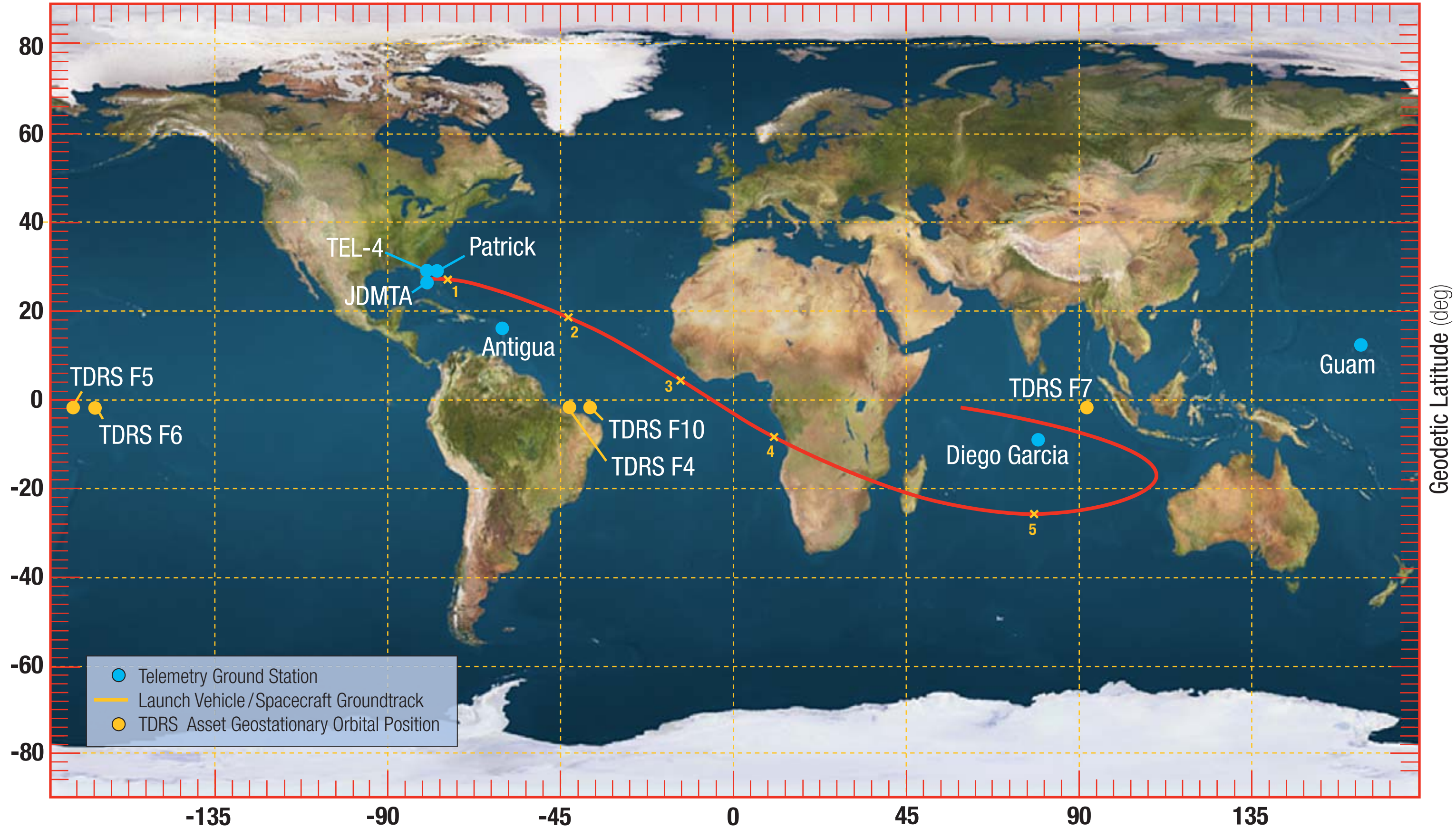
SEQUENCE OF EVENTS | Liftoff to Spacecraft Separation

	Event	Time (seconds)	Time (hr:min:sec)
1	RD-180 Engine Ignition	-2.7	-.00:00:02.7
	T=0 (Engine Ready)	-0.8	-.00:00:00.8
	SRB Ignition	-0.8	-.00:00:00.8
	Liftoff (Thrust to Weight >1)	1.1	00:00:01.1
	Full Thrust	2	00:00:02
	Begin Pitch/Yaw/Roll Maneuver	5	00:00:05
	End Pitch/Yaw Maneuver	20	00:00:20
	End Roll Maneuver	32	00:00:32
	Throttle Down (76%)	34	00:00:34
	First Dynamic Pressure Peak	48	00:00:48
	Throttle Up (100%)	57	00:00:57
	Second Dynamic Pressure Peak	58	00:00:58
2	SRB Burnout	91	00:01:31
	SRB 1 & 2 Jettison	114	00:01:54
	SRB 3 Jettison	116	00:01:56
3	Payload Fairing Jettison	207	00:03:27
	Forward Load Reactor Jettison	213	00:03:33
4	Atlas Booster Engine Cutoff (BECO)	257	00:04:17
	Atlas Booster/Centaur Separation	263	00:04:23
5	Centaur First Main Engine Start (MES1)	273	00:04:33
6	Centaur First Main Engine Cutoff (MECO1)	848	00:14:08
7	Centaur Second Main Engine Start (MES2)	1337	00:22:17
8	Centaur Second Main Engine Cutoff (MECO2)	1657	00:27:37
9	AEHF-1 Spacecraft Separation	3060	00:51:00

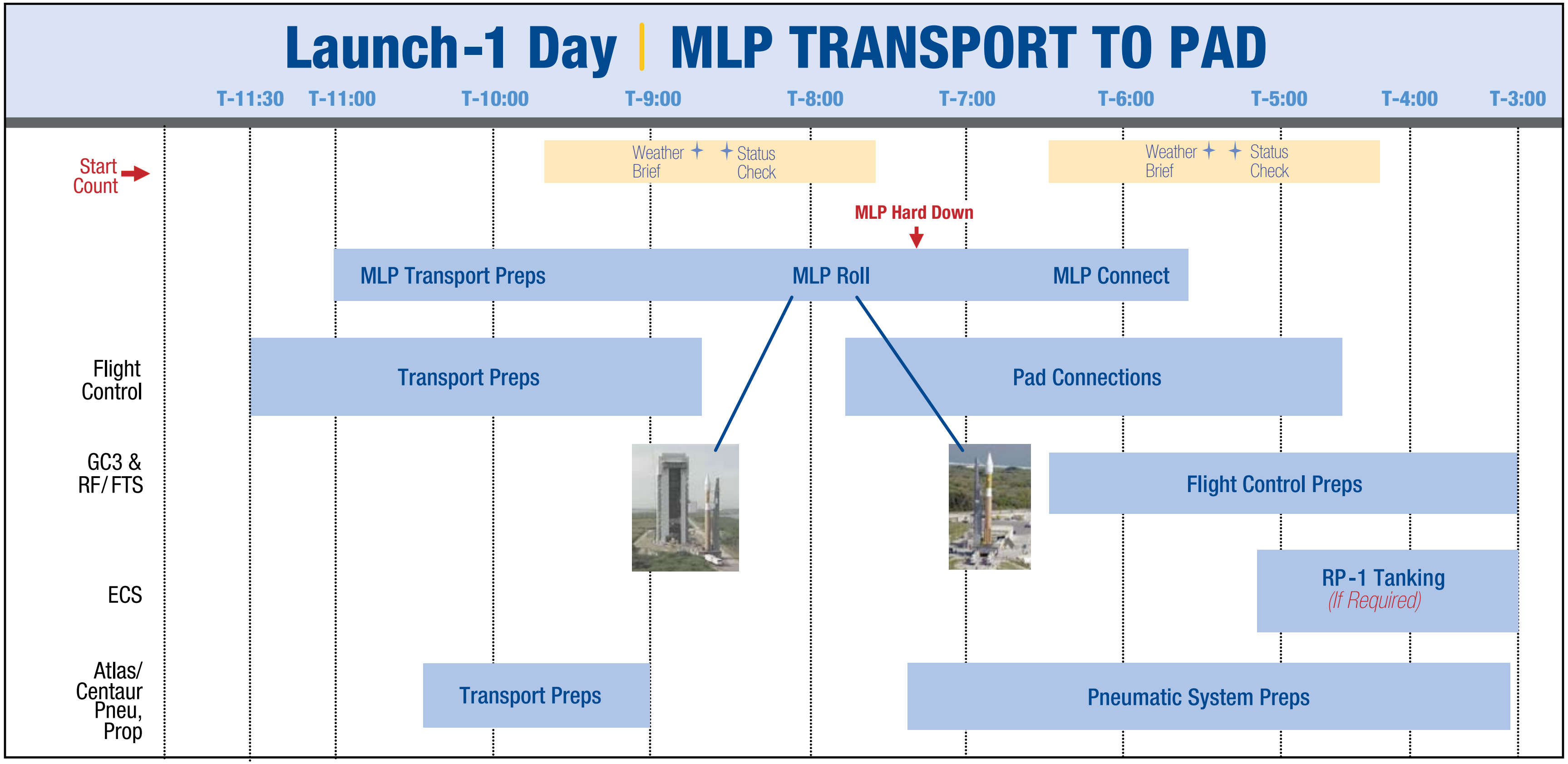
ATLAS V PRODUCTION | Overview

ATLAS V PROCESSING | Cape Canaveral

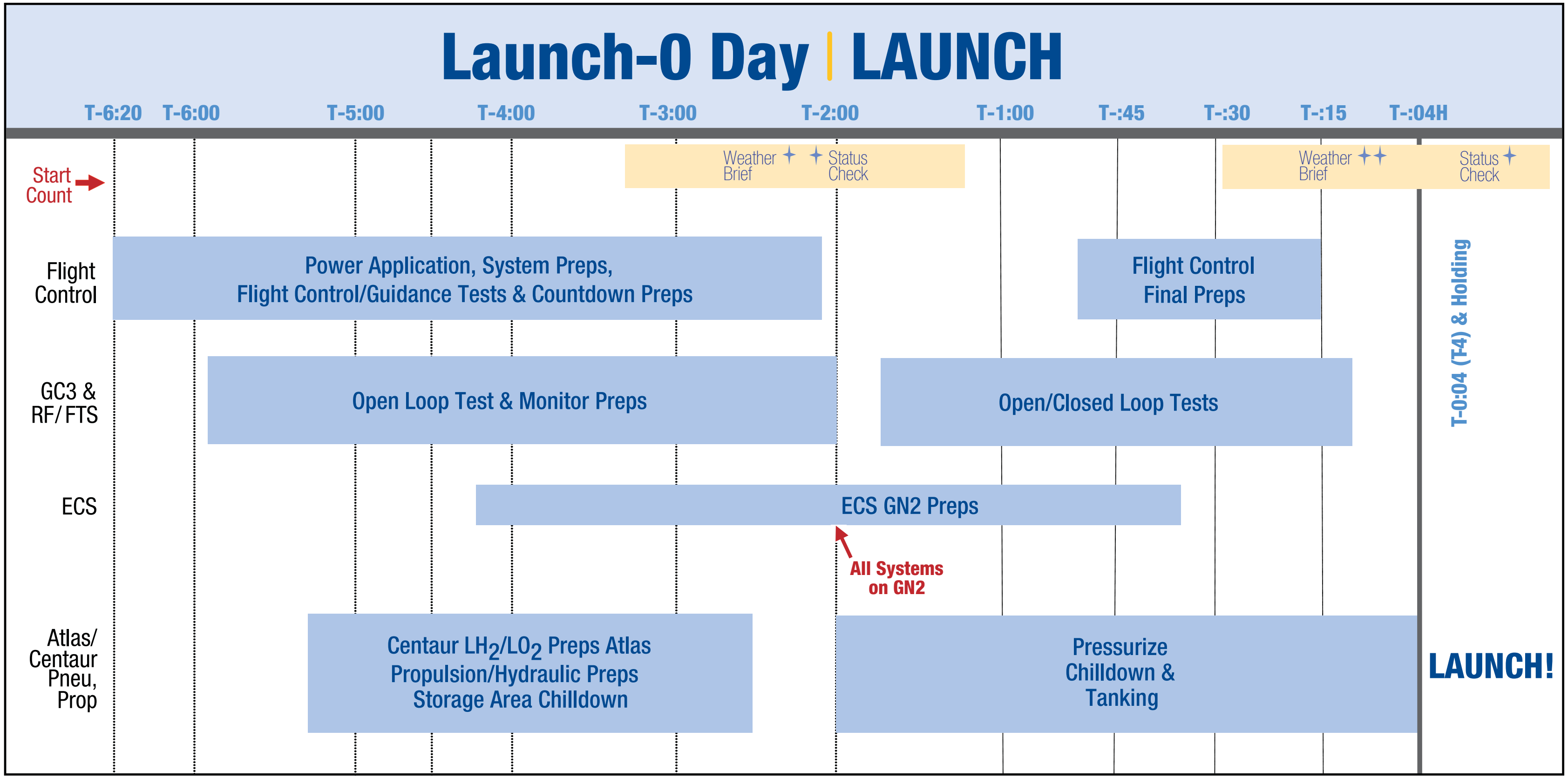




1 = MES1 (0:04:36) | **2 =** MECO1 (0:04:35) | **3 =** MES2 (0:22:19) | **4 =** MECO2 (0:27:41) | **5 =** AEHF-1 Separation (0:51:04)



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
(If Required)
Atlas/ Centaur Pneu, Prop
Transport Preps
Pneumatic System Preps


Launch-0 Day | LAUNCH
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
ECS
ECS GN2 Preps
All Systems on GN2
Atlas/ Centaur Pneu, Prop
Centaur LH2/LO2 Preps Atlas Propulsion/Hydraulic Preps Storage Area Chilldown
Pressurize Chilldown & Tanking
T-0:04 (T-4) & Holding
LAUNCH!

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