VULCAN CENTAUR SYSTEM BRIEFING





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MISSION SUCCESS...128 AND COUNTING!





DEVELOPING A NEXT GENERATION ROCKET VULCAN CENTAUR

PRODUCT ROAD MAP



BE-4/AR1 Replaces the RD-180, Retires Delta-Heavy

VULCAN CENTAUR OVERVIEW



MASSIVE CAPITAL **IMPROVEMENTS** COMPLETE **UP TO 20 VULCAN CENTAUR VEHICLES** PER YEAR



Circumferential Friction Stir Welding (CFSW)

LEVERAGING EXISTING INFRASTRUCTURE MEETING CUSTOMER REQUIREMENTS



SLC-41, CCAFS - East Coast



SLC-3, VAFB – West Coast

STRATEGIC PARTNERS FOCUS MORE CAPABLE AND COST EFFICIENT HARDWARE



GEM 63 Structural Test Article Case Wind



First Made-In-America Out of Autoclave Composite Payload Fairing

1.6 MILLION SQUARE FEET LARGEST ROCKET FACTORY IN NORTH AMERICA



PAD **MODIFICATIONS ALREADY UNDERWAY SUPPORTING** FIRST **VULCAN CENTAUR FLIGHT IN 2020**



Retrofitted Launch Facilities



Vertical Payload Integration; Both Coasts, All Vehicles

LAUNCH SITE OVERVIEW



Launch Capability From Both Coasts Supports Full Range of Orbits



VULCAN CENTAUR PERFORMANCE

Vehicle	Vulcan Centaur	Vulcan Centaur	Vulcan Centaur
Orbit *	(2-solid)	(6-solid)	Heavy (2023)
LEO ER	17800 kg	27400 kg	34900 kg
28.7° (Ref.) 200 km circular	[39200 lb]	[60300 lb]	[76900 lb]
LEO ER	15300 kg	24200 kg	31400 kg
51.6° (ISS) 407 km circular	[33800 lb]	[53400 lb]	[69300 lb]
LEO WR	14300 kg	22300 kg	27900 kg
90° (Polar) 200 km circular	[31500 lb]	[49200 lb]	[61500 lb]
GTO 1800 m/s 35,786 km x 185 km @ 27.0 deg	7400 kg [16400 lb]	13300 kg [29300 lb]	16300 kg [35900 lb]
GEO	2050 kg	6000 kg	7200 kg
35,786 km circular @ 0 deg	[4500 lb]	[13200 lb]	[15900 lb]

*Performance values should be considered for reference and are subject to change.

DEVELOPMENT HISTORY

- Atlas II, IIA, IIAS, IIIA, IIIB and V all 100% successful
- First Atlas V (AV-001) Launched:
 - First second of the launch window
 - First launch attempt
 - Within three months of an ILC set nearly 3 ¹/₂ years prior
- AV-001 flight performance exceeded contracted performance by 88 m/s ΔVgto



CONFIDENCE IN VULCAN CENTAUR DEVELOPMENT

Atlas and Delta experience mixed with new innovations to produce a modern, competitive launch system

Vulcan Centaur Builds Upon Atlas and Delta to continue strong record of Mission Success

- Mature system engineering processes
- Established manufacturing processes and Quality system
- Proven production capabilities and facilities
- Responsive launch capabilities and infrastructure



SUMMARY

The World's Best Value for Launch Services

ULA and Strategic Partners Combining Strengths

- Innovation Delivers Affordable Space Access
- Reliable Launch of Critical Customer Payloads

Leverage Our Atlas and Delta Experience

- Increase System Performance
- Maintain Unparalleled Mission Success Record



Vulcan Centaur is the Future of Affordable, Reliable Space Flight