



MINOTAUR SPACE LAUNCH VEHICLES

**Reliable, Cost Effective
Launch Services of
Government Payloads**

Minotaur Space Launch Vehicles provide a complete responsive, reliable, and cost-effective launch capability for small and medium U.S. Government-sponsored spacecraft. Minotaur vehicles combine residual government-supplied ICBM rocket motors with commercially-procured motors and state-of-the-art avionics and other hardware. Integrating, testing and launching vehicles utilizing residual government assets and commercially procured components is one of Northrop Grumman's unique strengths gained from experience spanning several decades.

Minotaur rockets are designed to be launched from multiple spaceports including in Virginia, Florida, California and Alaska, utilizing por-

table ground support equipment. The Minotaur family of launch vehicles are provided via the Orbital/Suborbital Program (OSP) and managed by the U.S. Space Force Space and Missile Systems Center (SMC), Launch Enterprise, Experimental Launch and Test Division (LE/LEX), Rocket Systems Launch Program (RSLP) located at Kirtland Air Force Base, New Mexico.



Northrop Grumman's Dulles, Virginia campus



Northrop Grumman's Chandler, Arizona campus

KEY FEATURES

- 17 space launch missions to date with 100% success rate
 - 11 Minotaur I
 - 5 Minotaur IV
 - 1 Minotaur V
- 83 satellites boosted into orbit
- Flexible design enables a variety of mission capabilities
- Cost effective and reliable space launch
- Mission success is ensured by mature systems and processes
 - Northrop Grumman's rigorous mission assurance program
 - Full government insight and independent assessment
- Multiple spaceport launch capability (California, Florida, Alaska, Mid-Atlantic) using portable ground support equipment



MINOTAUR I

Minotaur I uses residual Minuteman II first and second stage rocket motors with upper two stages shared with other Northrop Grumman launch vehicles. Minotaur I is capable of launching spacecraft of up to 580 kg to Low-Earth Orbit. To date, Minotaur I has conducted 11 missions since 2000, launching 62 satellites into orbit with a 100% success rate.

MINOTAUR IV

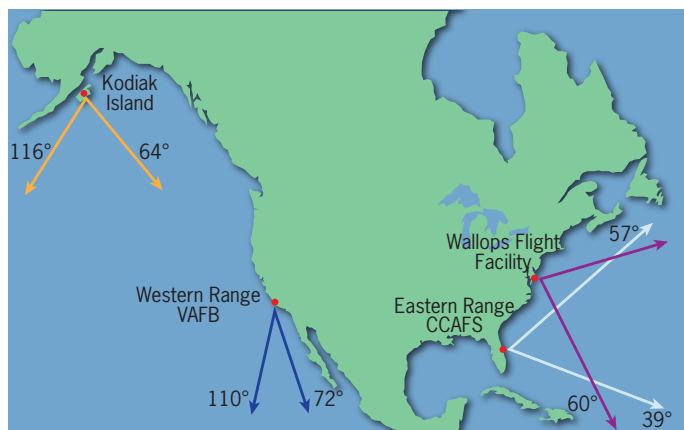
Minotaur IV uses residual Peacekeeper first, second and third stage rocket motors and a commercial solid rocket upper stage. Minotaur IV is capable of launching spacecraft of up to 1,600 kg to Low-Earth Orbit. To date, Minotaur IV has conducted five space launch missions since 2010 launching 20 satellites into orbit, and two missions launching payloads into suborbital trajectories with a 100% success rate.

MINOTAUR V

Minotaur V is a five stage evolutionary version of Minotaur IV that adds a commercial fifth stage motor to provide a cost effective means to launch U.S. Government-sponsored small spacecraft into high energy trajectories, including Geosynchronous Transfer Orbits (GTO), trans-lunar and deep space trajectories. The inaugural launch of a Minotaur V rocket occurred on September 6, 2013 from Wallops Island, Virginia boosting NASA's LADEE spacecraft on a lunar science mission.

MINOTAUR VI

Minotaur VI, the newest member of the Minotaur family, adds a government-supplied lower stage to the Minotaur IV design to significantly increase performance with only a modest increase in cost. Minotaur VI is capable of boosting up to 2,600 kg to Low-Earth Orbit and offers a significant increase in capability to boost payloads into higher Earth orbits and trajectories that require the additional energy.



Existing Minotaur launch sites



Minotaur IV TacSat-4 launch



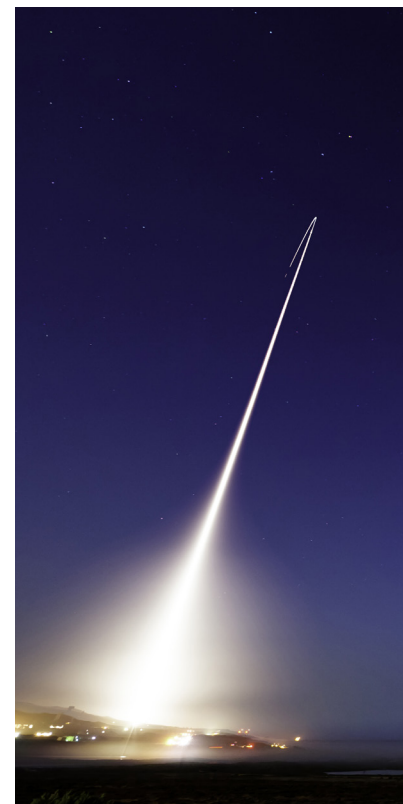
Minotaur IV SBSS launch



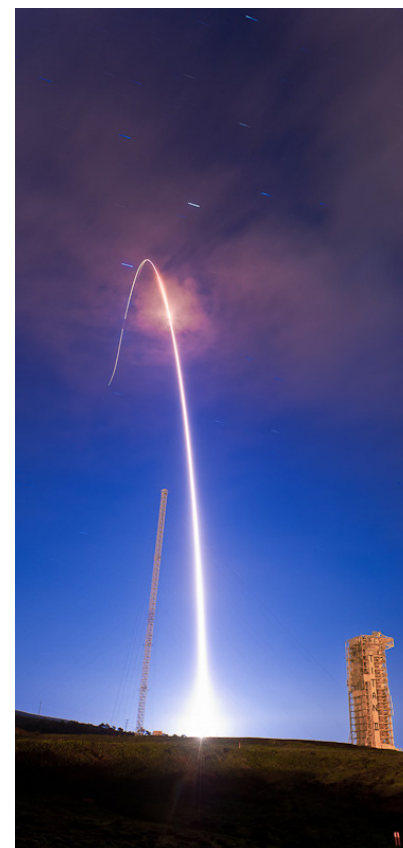
Minotaur IV Lite HTV-2 launch

MINOTAUR SPACE LAUNCH VEHICLES MISSION HISTORY

Flight #	Launch Date	Vehicle	Payload	Result
1	January 26, 2000	Minotaur I	AWAT	Success
3	July 19, 2000	Minotaur I	MightySat II.1	Success
8	April 11, 2005	Minotaur I	XSS-11	Success
9	September 22, 2005	Minotaur I	STP-R1	Success
10	April 14, 2006	Minotaur I	FORMOSAT-3/COSMIC	Success
11	December 16, 2006	Minotaur I	TacSat-2	Success
13	April 24, 2007	Minotaur I	NFIRE	Success
16	May 19, 2009	Minotaur I	TacSat-3	Success
18	September 25, 2010	Minotaur IV	SBSS	Success
19	November 29, 2010	Minotaur IV+	HAPS STP-S26	Success
20	February 6, 2011	Minotaur I	NRO	Success
21	June 29, 2011	Minotaur I	ORS-1	Success
23	September 27, 2011	Minotaur IV+	TacSat-4	Success
24	September 6, 2013	Minotaur V	LADEE	Success
25	November 16, 2013	Minotaur I	ORS-3	Success
26	August 25, 2017	Minotaur IV	ORS-5	Success
27	July 15, 2020	Minotaur IV	NROL-129	Success



Minotaur IV SBSS launch



Minotaur I NRO launch

Minotaur Space Launch Vehicle Configurations

LEO = Low-Earth Orbit

MTO = Medium-Transfer Orbit

GTO = Geosynchronous Transfer Orbit

TLI = Trans-Lunar Injection



	Minotaur I	Minotaur IV	Minotaur V	Minotaur VI
Performance	584 to LEO	1827 kg to LEO 532 kg to GTO 342 kg to TLI 560 kg to TLI	650 kg to MTO 1025 kg to MTO 866 kg to GTO	3144 kg to LEO
Height	21 m (69 ft.)	24 m (79 ft.)	24 m (79 ft.)	34 m (113 ft.)
Gross Liftoff Mass	36,000 kg (79,000 lbs.)	85,000 kg (187,000 lbs.)	88,000 kg (194,000 lbs.)	137,000 kg (302,000 lbs.)
Missions	11	5	1	
Spacecraft Launched	62	20	1	
Success Rate	100%	100%	100%	
Compatible Spaceports	California, Alaska, Florida, Mid-Atlantic	California, Alaska Florida, Mid-Atlantic	California, Alaska, Florida, Mid-Atlantic	Alaska, Florida

PERFORMANCE

Minotaur I

- Spacecraft mass-to-orbit of up to 580 kg to LEO (28.5°, 185 km)
- Typical orbit accuracy better than ± 5 km insertion apse, ± 45 km non insertion apse, and $\pm 0.1^\circ$ inclination
- Optional enhanced insertion accuracy better than 5 km in altitude and $\pm 0.05^\circ$ inclination
- Cold gas attitude control system readily accommodates a variety of spacecraft mission requirements, including precise separation pointing and post-boost maneuvers

Minotaur IV

- System performance assured from extensive booster motor flight history of more than 50 flights each
- Typical orbit accuracy better than ± 5 km insertion apse, ± 25 km non-insertion apse, and ± 0.1 deg inclination (3-sigma values)
- Optional enhanced insertion accuracy available
- Cold gas attitude control system readily accommodates a variety of spacecraft mission requirements, including precise separation pointing and post-boost maneuvers
- Minotaur IV with optional STAR™ 48BV Stage 4 provides up to 225 kg increased performance to LEO and support for HEO missions

Minotaur V

- Minotaur V has a GTO capability of 532 kg
 - 185 km x 35,786 km @ 28.5 degree inclination, 180 AoP
- Minotaur V has a MTO capability at 39 degrees of 650 kg from CCAFS
 - 185 km x 20,200 km at 39 Degree inclination, 180 AoP
- Minotaur V has a MTO capability at 55 degrees of 603 kg from WFF
 - 185 km x 20,200 km at 55 Degrees inclination, no AoP constraint
- Minotaur V has a TLI capability of 342 kg

Minotaur VI

- System performance assured from extensive booster motor flight history
- Cold gas attitude control system readily accommodates a variety of spacecraft mission requirements, including precise separation pointing and post-boost maneuvers
- Minotaur VI+ uses the optional STAR™ 37 upper stage to provide up to 200 kg increased performance to LEO and support for HEO missions with the following capability:
 - 980 kg to MTO
 - 860 kg to GTO
 - 560 kg to TLI

MORE INFORMATION

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