

## U.S. Space Launch Vehicles

Vehicle	Stages: Engine/Motor	Propellant <sup>a</sup>	Thrust (kilonewtons) <sup>b,c</sup>	Max. Dia x Height (m)	Max. Payload (kg) <sup>d</sup>			First Launch <sup>f</sup>
					185-km Orbit	Geosynch. Transfer Orbit	Sun- Synch. Orbit <sup>e</sup>	
Pegasus				6.71x15.5 <sup>h</sup>	380 280 <sup>f</sup>	—	210	1990
	1. Orion 50S	Solid	484.9	1.28x8.88				
	2. Orion 50	Solid	118.2	1.28x2.66				
	3. Orion 38	Solid	31.9	0.97x1.34				
Pegasus XL				6.71x16.93	460 350 <sup>f</sup>	—	335	1994 <sup>g</sup>
	1. Orion 50S-XL	Solid	743.3	1.28x10.29				
	2. Orion 50-XL	Solid	201.5	1.28x3.58				
	3. Orion 38	Solid	31.9	0.97x1.34				
Taurus				2.34x28.3	1,400 1,080 <sup>f</sup>	255	1,020	Not scheduled
	0. Castor 120	Solid	1,687.7	2.34x11.86				
	1. Orion 50S	Solid	580.5	1.28x8.88				
	2. Orion 50	Solid	138.6	1.28x2.66				
	3. Orion 38	Solid	31.9	0.97x1.34				
Delta II (7920, 7925)				2.44x29.70	5,089 3,890 <sup>f</sup>	1,842 <sup>i</sup>	3,175	1990, Delta-7925 [1960, Delta]
	1. RS-270/A	LOX/RP-1	1,043.0 (SL)	3.05x38.1				
	Hercules GEM (9)	Solid	487.6 (SL)	1.01x12.95				
	2. AJ10-118K	N204/A-50	42.4	2.44x5.97				
	3. Star 48B <sup>j</sup>	Solid	66.4	1.25x2.04				
Atlas E				3.05x28.1	820 <sup>f</sup> 1,860 <sup>e,k</sup>	—	910 <sup>k</sup>	1968, Atlas F [1958, Atlas LV-3A]
	1. Atlas MA-3	LOX/RP-1	1,739.5 (SL)	3.05x21.3				
Atlas I				4.2x43.9	—	2,255	—	1990, I [1966, Atlas Centaur]
	1. Atlas MA-5	LOX/RP-1	1,952.0 (SL)	3.05x22.16				
	2. Centaur I: RL10A-3-3A (2)	LOX/LH <sub>2</sub>	73.4/ engine	3.05x9.14				
Atlas II				4.2x47.5	6,580 5,510 <sup>f</sup>	2,810	4,300	1991, II [1966, Atlas Centaur]
	1. Atlas MA-5A	LOX/RP-1	2,110.0 (SL)	3.05x24.9				
	2. Centaur II: RL10A-3-3A (2)	LOX/LH <sub>2</sub>	73.4/engine	3.05x10.05				
Atlas IIA				4.2x47.5	6,828 6,170 <sup>f</sup>	3,062	4,750	1992, Atlas IIA [1966, Atlas Centaur]
	1. Atlas MA-5A	LOX/RP-1	2,110.0 (SL)	3.05x24.9				
	2. Centaur II: RL10A-4 (2)	LOX/LH <sub>2</sub>	92.53/engine	3.05x10.05				
Atlas IIAS				4.2x47.5	8,640 7,300 <sup>f</sup>	3,606	5,800	1993, IIAS [1966, Atlas Centaur]
	1. Atlas MA-5A Castor IVA (4) <sup>j</sup>	LOX/RP-1 Solid	2,110.0 (SL) 433.6 (SL)	3.05x24.9 1.01x11.16				
	2. Centaur II: RL10A-4 (2)	LOX/LH <sub>2</sub>	92.53/engine	3.05x10.05				

## APPENDIX D

(Continued)

## U.S. Space Launch Vehicles

Vehicle	Stages: Engine/Motor	Propellant <sup>a</sup>	Thrust (kilonewtons) <sup>b, c</sup>	Max. Dia x Height (m)	Max. Payload (kg) <sup>d</sup>			First Launch <sup>f</sup>
					185-km Orbit	Geosynch. Transfer Orbit	Sun- Synch. Orbit <sup>e</sup>	
Titan II					1,905 <sup>c</sup>	—	—	1988, Titan II SLV [1964, Titan II Gemini]
1.	LR-87-AJ-5 (2)	N204/A-50	1,045.0	3.05x42.9				
2.	LR-91-AJ-5	N204/A-50	440.0	3.05x21.5				
Titan III					14,515	5,000 <sup>l</sup>	—	1989, Titan III [1964, Titan IIIA]
0.	Titan III SRM (2) (5-1/2 segments)	Solid	6,210.0	3.05x47.3				
1.	LR87-AJ-11 (2)	N204/A-50	1,214.5	3.11x27.6				
2.	LR91-AJ-11	N204/A-50	462.8	3.05x24.0				
Titan IV					17,700	6,350 <sup>m</sup>	—	1989, Titan IV
0.	Titan IV SRM (2) (7 segments)	Solid	7,000.0	3.05x62.2	14,110 <sup>f</sup>			
1.	LR87-AJ-11 (2)	N204/A-50	1,214.5	3.11x34.1				
2.	LR91-AJ-11	N204/A-50	462.8	3.05x26.4				
Titan IV/ Centaur					—	5,760 <sup>a</sup>	—	1994, Titan IV Centaur
0.	Titan IV SRM (2) (7 segments)	Solid	7,000.0	4.3x62.2				
1.	LR87-AJ-11 (2)	N204/A-50	1,214.5/engine	3.11x34.1				
2.	LR91-AJ-11(1)	N204/A-50	462.5	3.05x26.4				
3.	Centaur: RL-10A-3-3A	LOX/LH <sub>2</sub>	73.4	3.05x10.0				
4.	SRMU (3 segments)		7690	4.3x9.0				
Space Shuttle <sup>n</sup>					24,900 <sup>o</sup>	5,900 <sup>p</sup>	—	1981, Columbia
1.	SRB: Shuttle SRB (2)	Solid	11,790.0 (SL)	23.79x56.14 <sup>h</sup> 3.70x45.46				
2.	Orbiter/ET: SSME (3)	LOX/LH <sub>2</sub>	1,668.7 (SL)	8.41x47.00 (ET) 23.79x37.24 <sup>h</sup> (orbiter)				
3.	Orbiter/OMS: OMS engines (2)	N <sub>2</sub> O <sub>4</sub> /MMH	26.7	23.79x37.24 <sup>h</sup>				
Delta III					8,292	3,810	6,768	1998 <sup>g</sup>
1.	RS-27A Alliant GEM (9)	LOX/RP-1 Solid	1,043.0 (SL) 608.8	4x39.1 1.16x14.7				
2.	RL-10B-2	LOX/LH <sub>2</sub>	110	4x8.8				
3.	Star 48B	Solid	66.4	1.25x2.04				

APPENDIX D  
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## NOTES:

- a. Propellant abbreviations used are as follows:
  - A-50 = Aerozine 50 (50% Monomethyl Hydrazine, 50% Unsymmetrical Dimethyl Hydrazine)
  - RP-1 = Rocket Propellant 1 (kerosene)
  - Solid = Solid Propellant (any type)
  - LH<sub>2</sub> = Liquid Hydrogen
  - LOX = Liquid Oxygen
  - MMH = Monomethyl Hydrazine
  - N<sub>2</sub>O<sub>4</sub> = Nitrogen Tetroxide
- b. Thrust at vacuum except where indicated at sea level (SL).
- c. Thrust per engine. Multiply by number of engines for thrust per stage.
- d. Inclination of 28.5° except where indicated.
- e. Polar launch from Vandenberg AFB, CA.
- f. First successful orbital launch [ditto of initial version].
- g. First launch was a failure
- h. Diameter dimension represents vehicle wing span.

**NOTE: Data should not be used for detailed NASA mission planning without concurrence of the Director of Space Transportation System Support Programs.**