

## ATLAS V

Since 1957, the Atlas rocket has been an integral part of America's space program, supporting national defense, launching Mercury astronauts to orbit and sending spacecraft to the farthest reaches of the solar system. Over the years, the Atlas booster has undergone a series of continuous improvements, culminating in the Atlas V with its modular design approach to meet specific customer requirements. The Atlas V consists of a common core booster powered by an RD-180 engine, the high-energy Centaur upper stage powered by an RL10 engine and either a 4-meter (400 series) or a 5-meter-diameter (500 series) payload fairing. For additional power at liftoff, up to three solid rocket boosters (SRBs) can be added to the Atlas V 400 series while the 500 series can support up to five SRBs. Flexibility and reliability are the hallmarks of the Atlas V system, making it the launch vehicle of choice for the full range of customer requirements.

## DELTA IV HEAVY

For 60 years, the Delta family of launch vehicles has achieved unparalleled success in providing access to space for our Department of Defense, NASA and commercial customers. From the earliest Delta rockets to the industry workhorse Delta II, continual upgrades and improvements have led to the Delta IV Heavy, the world's proven heavy lifter. The Delta IV Heavy consists of three common booster cores, each powered by an RS-68A engine, and the Delta Cryogenic Second Stage powered by an RL10 engine. A 5.4-meter-diameter payload fairing completes the stack. With a commitment to mission success, the Delta IV Heavy continues its legacy of launching our nation's mission-critical national security payloads.

## VULCAN CENTAUR

Leveraging the proven processes, technology and expertise of Atlas and Delta, the Vulcan Centaur rocket introduces new technologies and innovative features to create the highest value launch service with optimal performance to meet the full range of mission requirements. Vulcan Centaur consists of a single booster stage powered by a pair of BE-4 engines, the high-energy Centaur upper stage powered by two RL10 engines and a 5.4-meter-diameter payload fairing. For additional power at liftoff, up to six solid rocket boosters can be added to the Vulcan Centaur rocket. By making launch more affordable, Vulcan Centaur opens up new opportunities for space capabilities, offering unprecedented flexibility in a single system. From low-Earth orbit to Pluto, the single-core Vulcan Centaur does it all.

# ROCKET RUNDOWN

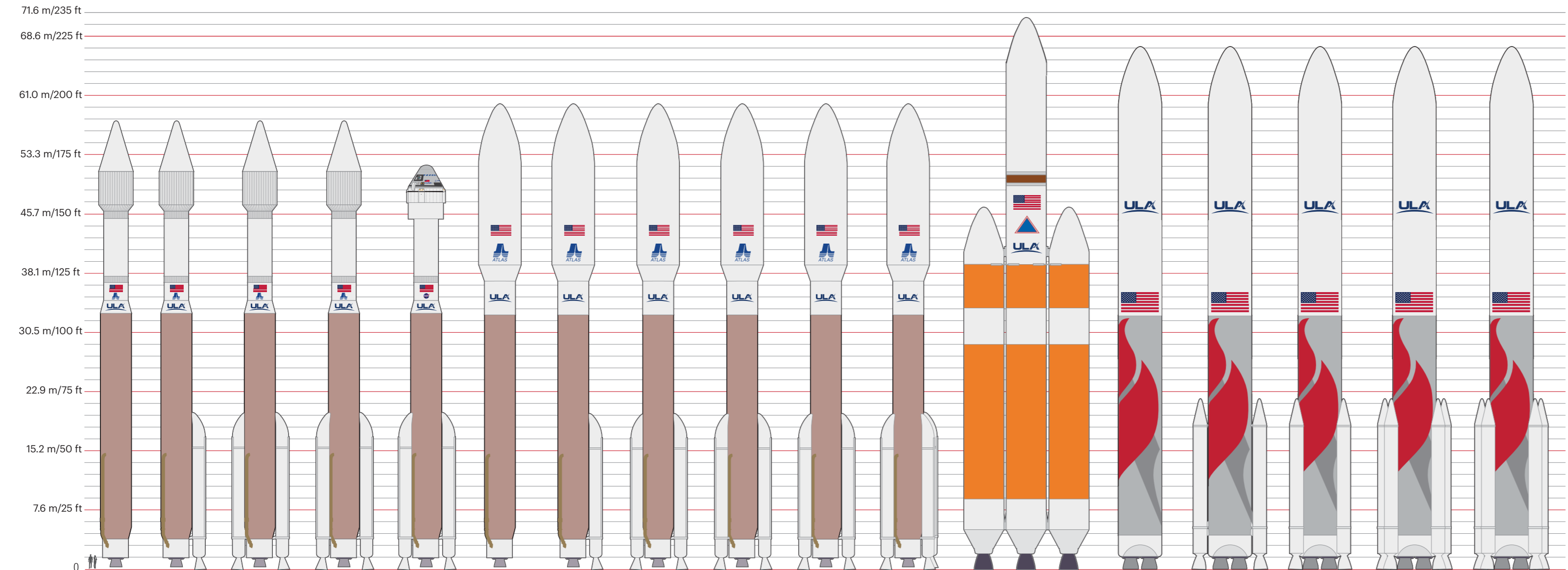
## A Fleet Overview

[ulalaunch.com](http://ulalaunch.com)



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Product information as of 11/19.





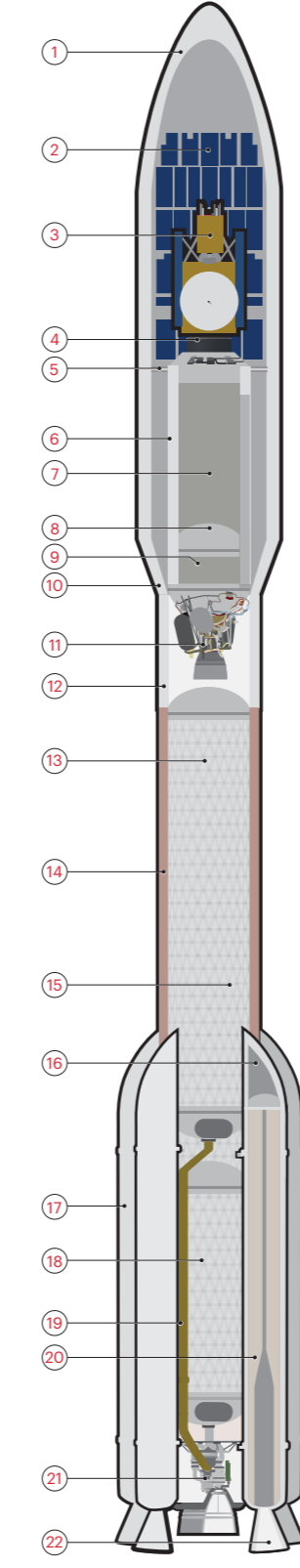
Atlas V 401, Atlas V 411, Atlas V 421, Atlas V 431, Atlas V Starliner, Atlas V 501, Atlas V 511, Atlas V 521, Atlas V 531, Atlas V 541, Atlas V 551, Delta IV Heavy, Vulcan Centaur (0 Solids), Vulcan Centaur (2 Solids), Vulcan Centaur (4 Solids), Vulcan Centaur (6 Solids), Vulcan Centaur Heavy

PERFORMANCE (kg/lb)	
<b>GEO</b>	N/A, 1,935/4,270, 2,480/5,460, 2,820/6,210, N/A, N/A, N/A, 2,540/5,610, 3,080/6,800, 3,530/7,800, 3,850/8,500, 6,580/14,500, N/A, 2,600/5,700, 4,800/10,600, 6,500/14,300, 7,200/15,900
<b>GTO</b>	4,750/10,470, 5,950/13,110, 6,890/15,180, 7,700/16,970, N/A, 3,780/8,330, 5,250/11,570, 6,480/14,280, 7,450/16,420, 8,290/18,270, 8,900/19,620, 14,210/31,330, 2,900/6,400, 7,600/16,800, 10,800/23,800, 13,600/30,000, 14,400/31,700
<b>LEO-REF</b>	9,800/21,600, 12,030/26,530, 13,600/29,980, 15,260/33,660, N/A, 8,210/18,100, 11,000/24,250, 13,500/29,760, 15,530/34,250, 17,410/38,400, 18,850/41,570, 28,370/62,540, 10,600/23,400, 18,500/40,800, 23,900/52,700, 27,200/60,000, 27,200/60,000
<b>LEO-ISS</b>	8,910/19,640, 10,670/23,530, 12,060/26,600, 13,250/29,220, 13,250/29,220, 7,540/16,630, 10,160/22,410, 12,510/27,590, 14,480/31,920, 16,290/35,920, 17,720/39,080, 25,980/57,280, 9,000/19,800, 16,100/35,500, 21,000/46,300, 25,300/55,800, 26,200/57,800
<b>LEO-POLAR</b>	8,080/17,820, 9,980/22,020, 11,140/24,560, 12,130/26,750, N/A, 6,770/14,930, 9,060/19,990, 11,160/24,610, 12,880/28,410, 14,480/31,940, 15,760/34,750, 23,560/51,950, 8,300/18,300, 15,000/33,100, 19,500/43,000, 23,200/51,100, 24,000/52,900
<b>MEO</b>	2,470/5,440, 3,050/6,730, 3,640/8,020, 4,220/9,300, N/A, 1,770/3,910, 2,590/5,700, 3,580/7,890, 4,030/8,880, 4,470/9,860, 4,920/10,850, 8,450/18,630, 600/1,300, 3,900/8,600, 6,000/13,200, 8,000/17,600, 8,900/19,600
<b>TLI</b>	3,160/6,970, 4,090/9,020, 4,830/10,660, 5,430/11,990, N/A, 2,210/4,870, 3,400/7,510, 4,360/9,610, 5,120/11,300, 5,800/12,790, 6,330/13,960, 11,290/24,890, 2,300/5,100, 6,300/13,900, 9,000/19,800, 11,300/24,900, 12,100/26,700

GEO (Geosynchronous Earth Orbit) = 35,786 km circular at 0 deg | GTO (Geosynchronous Transfer Orbit) = 35,786 km x 185 km at 27.0 deg | LEO-Reference (Low Earth Orbit-Reference) = 200 km circular at 28.7 deg | LEO-ISS (Low Earth Orbit-International Space Station) = 407 km circular at 51.6 deg | LEO-Polar (Low Earth Orbit-Polar) = 200 km circular at 90 deg  
 MEO (Medium Earth Orbit) = 20,368 km circular at 55 deg | TLI (Trans-lunar Injection) = C3: -2 km<sup>2</sup>/sec<sup>2</sup>

### ATLAS V

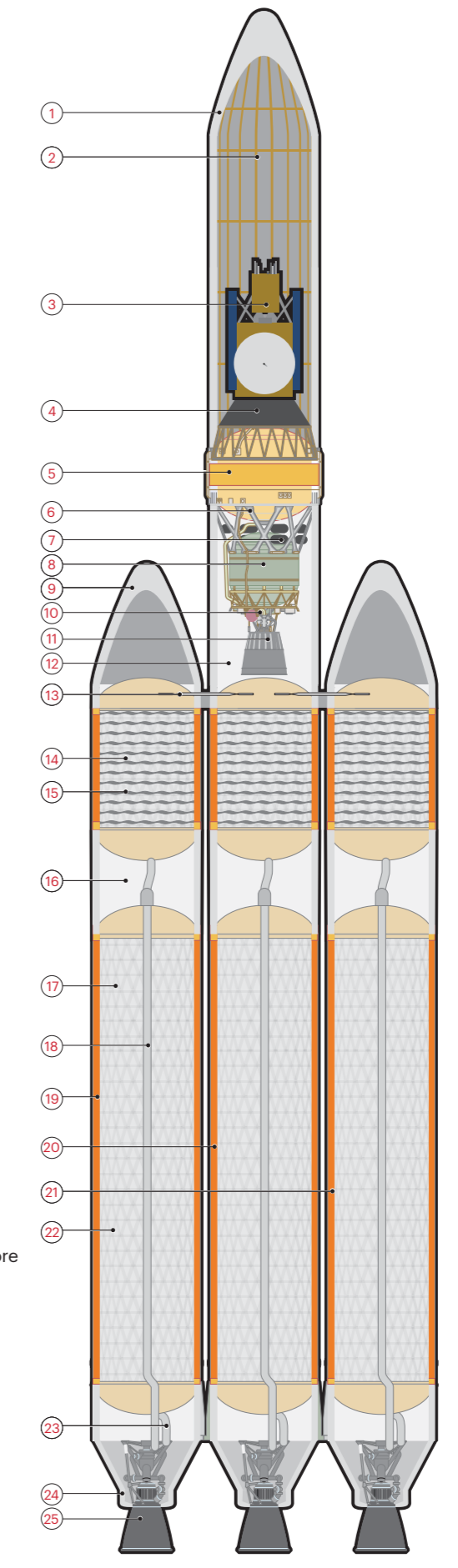
1. Payload Fairing
2. Acoustic Panels
3. Spacecraft
4. Payload Adapter
5. Centaur Forward Load Reactor
6. Centaur
7. Centaur Fuel (LH2) Tank
8. Common Bulkhead
9. Centaur Oxidizer (LO2) Tank
10. Fairing Boattail
11. Centaur Engine (RL10)
12. Interstage Adapter
13. Booster Oxidizer (LO2) Tank
14. Common Core Booster
15. Isogrid Structure
16. Nose Cone
17. Solid Rocket Booster
18. Booster Fuel (RP-1) Tank
19. Booster Oxidizer (LO2) Feedline
20. Solid Rocket Propellant
21. Booster Engine (RD-180)
22. Solid Rocket Booster Nozzle



Atlas V 551

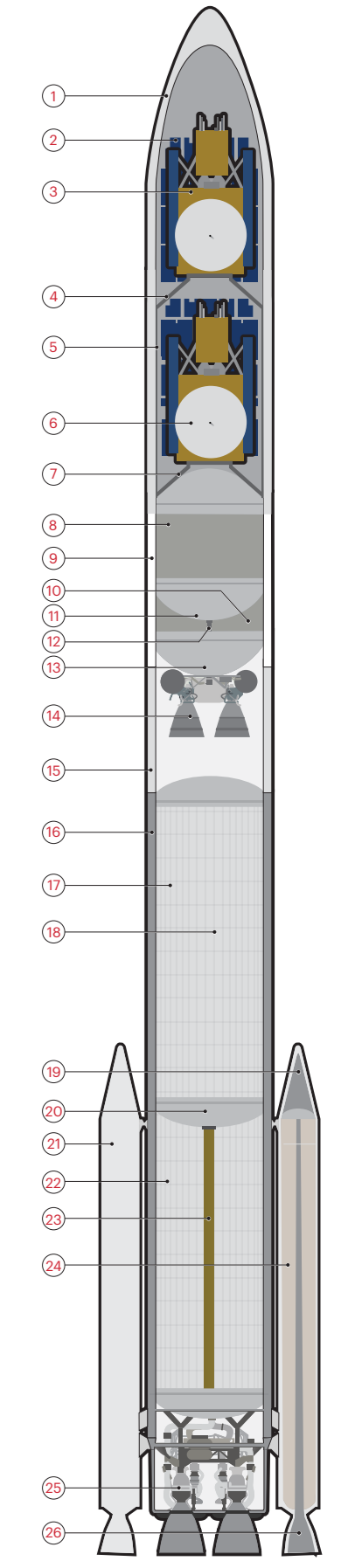
### DELTA IV HEAVY

1. Payload Fairing
2. Acoustic Blankets
3. Spacecraft
4. Payload Attach Fitting
5. DCSS Fuel (LH2) Tank
6. DCSS Intertank Truss Assembly
7. High Pressure Helium Bottle
8. DCSS Oxidizer (LO2) Tank
9. Nose Cone
10. DCSS Equipment Shelf
11. DCSS Engine (RL10)
12. Interstage Adapter
13. Strut Assembly
14. Booster Oxidizer (LO2) Tank
15. Anti-slosh Baffle
16. Centerbody
17. Booster Fuel (LH2) Tank
18. Booster Oxidizer (LO2) Feedline
19. Port Common Booster Core
20. Center Common Booster Core
21. Starboard Common Booster Core
22. Isogrid Structure
23. Booster Fuel (LH2) Feedline
24. Thermal Shield
25. Booster Engine (RS-68A)



### VULCAN CENTAUR

1. Payload Fairing
2. Fairing Acoustic Panels
3. Spacecraft
4. Forward Payload Attach Fitting
5. Multi-Launch Adapter
6. Spacecraft
7. Aft Payload Attach Fitting
8. Centaur Fuel (LH2) Tank
9. Centaur
10. Centaur Oxidizer (LO2) Tank
11. Common Bulkhead
12. Centaur Fuel (LH2) Feedline
13. Centaur Aft Bulkhead
14. Centaur Engine (RL10)
15. Interstage Adapter
16. Booster
17. Booster Oxidizer (LO2) Tank
18. Orthogrid Structure
19. Nose Cone
20. Common Bulkhead
21. Solid Rocket Booster
22. Booster Fuel (LNG) Tank
23. Booster Oxidizer (LO2) Feedline
24. Solid Rocket Propellant
25. Booster Engine (BE-4)
26. Solid Rocket Booster Nozzle



Shown in Multi-launch Configuration