

Heavy Lift Launch Vehicles

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What is “Heavy Lift”?

- Anything rated to carry 20+ tons into Low Earth Orbit (LEO)
- Used for manned missions, large ISS resupply missions, and orbital insertions
- History:
 - First developed by Werner von Braun at NASA Marshall
 - One aspect of the Cold War’s Space Race

Saturn V



- Used from 1967-1973 for Apollo lunar missions
- 155 tons to LEO
- Five F-1 and six J-2 engines
- Nearly 8 million lbf of thrust

Delta IV and Space Shuttle



- Used for travel to ISS, launch of satellites/defense payloads
- Only about 30 tons to LEO
- Space Shuttle was developed without much initial purpose
- Delta IV is second most powerful vehicle today

Falcon Heavy



- First commercial heavy lift vehicle – SpaceX
- 70 tons to LEO
- 27 Merlin engines; 5 ½ million lbf of thrust
- Uses recoverable Falcon 9 boosters

New Glenn



- Under development by Blue Origin
- First flight expected in 2021
- 45 tons to LEO
- Seven BE-4 engines; 4 million lbf of thrust
- Industry-leading 7 meter fairing

Starship



- Meant to replace SpaceX Falcon 9 and Falcon Heavy
- First flight expected in 2021
- 150 tons to LEO
- Two stages – “Super Heavy” booster and “Starship” capsule
- Can serve LEO, Moon, and Mars missions

Space Launch System



- NASA's heavy lift vehicle project
- Exploration Mission 1 – June 2020
- Multiple configurations: 130 tons to LEO and 45 tons to deep space
- Solid rocket booster and RS-25 engines; up to 11.9 million lbf thrust
- Facing cost and schedule issues