

## VEHICLE COMPARISON

BLUE ORIGIN NEW SHEPARD  
 SPACE X FALCON 9

Blue Origin's New Shepard suborbital booster and SpaceX's Falcon 9 suborbital booster may look alike at first glance. However, the Falcon 9 carries a staggering 130 tons at launch while New Shepard carries only 5.

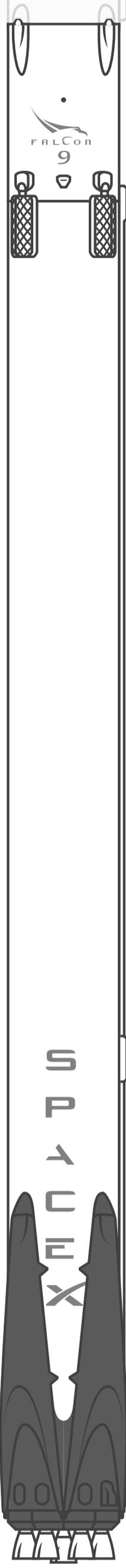
The two vehicles are, in fact, completely different designs for two completely different purposes. Blue Origin's booster is designed to carry a single crew capsule to space (100 kilometers up), while SpaceX's Falcon 9 booster (and the Falcon 9 upper stage) bring payload to orbit. This requires about four times as much total energy as New Shepard's 100.5km hop into space.

New Shepard's trajectory brings it up and back down with only two burns: a launch burn and a landing burn. The Falcon 9, on the other hand, has to deliver (with the upper stage) a payload to orbit. This means that the Falcon 9 has to angle itself towards the horizon during launch; at stage separation (when the upper stage detaches to complete the mission), the Falcon 9 booster is travelling faster horizontally than vertically. This velocity is reversed with three more engine restarts (four including the launch).

The boostback burn brings the vehicle's trajectory back towards land. However, the booster will reenter the atmosphere at a speed far too fast to survive. So at an altitude of about 70km, three of the engines are restarted to slow the vehicle down before it hits the thicker, lower parts of the atmosphere. When the entry burn ends, the Falcon 9 booster is only 40km above the ocean, on a trajectory that will drop it harmlessly into the ocean in case of a failed landing burn.

The third, critical, burn the Falcon 9 performs is the landing burn. This is a single-engine burn, starting about 30 seconds before touchdown. The single center engine reignites a final time as the vehicle plummets towards the ground; the grid fins reorient the vehicle and push it towards the landing pad, and about 5 seconds from touchdown, the landing legs unfold and the booster touches down on the landing pad.

In closing, it's unfair to compare the two vehicles. New Shepard is designed for several minutes of microgravity, while Falcon 9 is designed to carry satellites into orbit. The vehicles perform their respective tasks admirably.



BLUE ORIGIN **NEW SHEPARD**

SPACE X **FALCON 9**

~40	<b>WET MASS</b> tons	~ 450
~12	<b>HEIGHT</b> meters	~ 48
~3	<b>DIAMETER</b> meters	3.7
1.2	<b>VELOCITY</b> km/s at sep	~ 1.6
~3.5	<b>dV</b> km/s of booster	~ 8.5
~5	<b>PAYLOAD</b> tons at sep	~ 130
110,000	<b>THRUST</b> sea level, pounds	1,530,000