

ARCHIVED REPORT

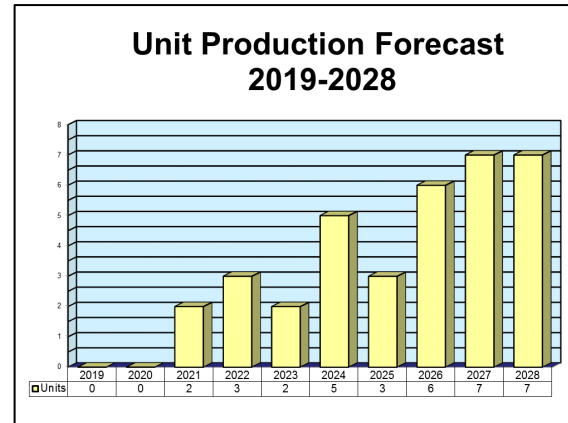
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Vector Launch Vehicles

Outlook

- Vector's outlook is currently in question, as funding from an unknown source has reportedly been withdrawn
- Vector suspended operations in August 2019
- According to some reports, a "core team" currently remains to finish the Vector-R rocket
- New funding might be acquired in the future to keep the company viable



Orientation

Description. Vector Space Systems is designing a family of small launch vehicles, the Vector-R and Vector-H, designed for rapid and frequent launch of payloads.

Sponsor. Vector Space Systems is a private company founded in 2016 and headquartered in Tucson, Arizona.

Status. In development.

Total Produced. Vector has produced one P-20 rocket, a subscale prototype for the Vector-R that flew to suborbital space in August 2016. Vector also

produced two prototype Vector-Rs that conducted test flights in 2017.

Application. The Vector-R will carry payloads with a launch mass up to 70 kilograms, while the Vector-H will carry payloads with a launch mass up to 160 kilograms.

Price Range. Prices for the Vector-H have not been announced yet. The Vector-R will cost between \$2 million and \$3 million per launch. However, that cost could be split between multiple passengers.

Contractors

Prime

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Vector Launch Vehicles

Technical Data

Design Features. The Vector family of launch vehicles features all-carbon-fiber structures along with pressurized propulsion feed systems. The family consists of the smaller Vector-R and larger Vector-H. Both vehicles use common avionics and engines, and are two-stage launch vehicles that offer optional third stages. Vector will conduct launches from the Pacific Spaceport Complex in Alaska, Cape Canaveral in Florida, and the new Camden County site in Georgia.

The launch vehicles are designed for rapid and frequent launches, and Vector would like to reuse the vehicles' first stages.

All Vector launch vehicles use the same motors and are differentiated by the number of motors installed in them (for more details, see the **Variants/Upgrades** section). The main engines use liquid oxygen and propylene propellant to produce 25,000 N (5,620 lbf) of thrust, while the second stage motors produce 3,700 N (8,320 lbf) of thrust.

Variants/Upgrades

Vector-R. The Vector-R is Vector's smaller launch vehicle. It is designed to carry nano and micro satellites into low-Earth orbit.

Specifications		<u>Metric</u>	<u>U.S.</u>
Dimensions			
Overall length		13 m	42.7 ft
Diameter		1.2 m	3.9 ft
Performance			
Payload (launch from Cape Canaveral to 250 km)		66 kg	145.5 lb
Payload (launch from Cape Canaveral to 500 km)		43 kg	94.8 lb
Payload (launch from Kodiak to 250-km sun-synchronous orbit)		42 kg	92.6 lb
Payload (launch from Kodiak to 500-km sun-synchronous orbit)		25 kg	55.1 lb

Propulsion		
<u>Stage</u>	<u>Engines</u>	<u>Peak Thrust</u>
First stage	3 LOX/Propylene	75 kN (16,861 lbf)
Second stage	1 LOX/Propylene	3.7 kN (831.8 lbf)

Vector-H. The Vector-H is Vector's larger launch vehicle. It is designed to carry nano and micro satellites into low-Earth orbit.

Specifications		<u>Metric</u>	<u>U.S.</u>
Dimensions			
Overall length		19.5 m	64 ft
Diameter		1.1 m	3.6 ft
Performance			
Payload (launch from Cape Canaveral to 200 km)		159.6 kg	352.5 lb
Payload (launch from Cape Canaveral to 500 km)		129 kg	284.3 lb
Payload (launch from Kodiak to 250-km sun-synchronous orbit)		115 kg	253.5 lb
Payload (launch from Kodiak to 500-km sun-synchronous orbit)		91 kg	200.6 lb

Propulsion		
<u>Stage</u>	<u>Engines</u>	<u>Peak Thrust</u>
First stage	6 LOX/Propylene	153 kN (34,396 lbf)
Second stage	1 LOX/Propylene	4.1 kN (922 lbf)

Vector Launch Vehicles



Vector Space P-20 Test Platform

Source: Vector Space Systems

Program Review

Background. Vector Space Systems entered the launch market in April 2016, when it announced that it had successfully raised \$1 million in funding. The company was founded by space industry veterans who had the goal of building lightweight launch vehicles that could rapidly launch small satellites into orbit. Three months later, Vector announced that it had acquired Garvey Spacecraft Corporation, a competing company that also had been working to develop lightweight launch vehicles. As part of the deal, Vector acquired all of Garvey's design work and Garvey founder John Garvey joined Vector as its chief technology officer (CTO).

Vector conducted its first launch in August 2016, which successfully tested the vehicle's upper stage engine. The company used a P-20 subscale test vehicle to conduct the suborbital test flight.

The company raised another \$1.25 million in November 2016 during a seed round that was led by the Space Angels Network.

Vector wrapped up a busy 2016 by conducting a successful ground test of one of its LOX/Propylene core engines in December.

In May 2017, Vector conducted a suborbital flight test of its Vector-R rocket's full-scale prototype, which successfully flew to 50,000 feet.

Vector quickly turned that achievement into another successful fundraising round, raising \$21 million from new investors in June 2017.

In August 2017, Vector conducted another successful suborbital flight of a prototype Vector-R. This flight was launched from the location where officials hope to build a new launch site in Camden County, Georgia. While the primary purpose of the flight was to demonstrate a new engine injector, the flight also marked the first time that Vector carried payloads from paying customers.

With the success of its second test launch, Vector began construction of its manufacturing facility in Tucson, Arizona, in December 2017. While Vector expected to conduct its first orbital launch in July 2018, the company was still conducting ground tests of its first stage engine that month. Then, in August 2019, Vector reportedly lost some crucial funding, causing the company to suspend operations.

Vector Launch Vehicles

Timetable

<u>Month</u>	<u>Year</u>	<u>Major Development</u>
Apr	2016	Vector Space Systems enters space market after raising \$1 million from investors
Jul	2016	Vector Space Systems acquires Garvey Spacecraft Corp
Aug	2016	Vector conducts suborbital test flight of its P-20 subscale test vehicle
Nov	2016	Vector raises additional \$1.25 million from new investors
Dec	2016	Vector conducts ground test of LOX/Propylene core engine
May	2017	Vector conducts suborbital test flight of a prototype Vector-R
Jun	2017	Vector closes \$21 million fundraising round
Aug	2017	Vector conducts suborbital test flight of a prototype Vector-R
Dec	2017	Vector begins construction of manufacturing facility
Jul	2018	Successful ground engine test
Aug	2019	Vector suspends operations

Forecast Rationale

Over the past year Vector Space Systems has run into financial difficulties, which has translated into a "pause" in operations. Little information is available, but it is probable that no progress is being made on the Vector launch vehicles. Some reports claim that a team is working to complete the Vector-R, but that is uncertain. Vector, in turn, has lost the contract to launch the USAF's ASLON-45 satellite.

Other startups such as Rocket Lab and LauncherOne predate Vector in their entry to the market. Vector made up for its recent arrival by moving aggressively. Vector raised an initial round of capital from investors in April 2016. By the end of the year, the company had successfully acquired Garvey Spacecraft Corporation and utilized that company's previous advances to

conduct a flight test of a subscale prototype and a ground test of one of its core-stage rocket motors.

Vector continued its rapid development pace in 2017, conducting two suborbital flights and raising additional funds. In 2018, Vector continued ground testing its rocket motor, and planned to conduct its first orbital launch. However, Vector suspended operations in 2019 after losing crucial funding.

Despite recent setbacks, Vector's previous tests were successful, so the only question is whether Vector can find funding to continue. Vector's launch vehicles would indeed fit into the current light launch vehicle market, and therefore a backer might appear. While this report forecasts that Vector will find funds in the near-term future, that remains a speculative prospect.

Ten-Year Outlook

ESTIMATED CALENDAR YEAR UNIT PRODUCTION												
Designation or Program	High Confidence					Good Confidence			Speculative			Total
	Thru 2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	
Vector Space Systems												
Vector -H <> Vector Space Systems												
	0	0	0	1	1	0	2	1	2	3	2	12
Vector -R <> Vector Space Systems												
	2	0	0	1	2	2	3	2	4	4	5	23
Subtotal	2	0	0	2	3	2	5	3	6	7	7	35
Total	2	0	0	2	3	2	5	3	6	7	7	35