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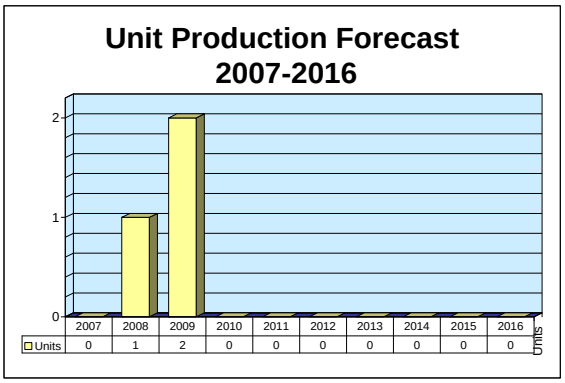
K-1 - Archived 9/2008

Outlook

- Rocketplane Kistler joins forces with Alliant Techsystems for K-1 development
- RpK on track to complete Critical Design Review in 2007
- First K-1 demonstration flight expected in 2008-09
- NASA expects RpK to conduct two K-1 flights to International Space Station by 2010



Orientation

Description. The K-1 is a fully reusable launch vehicle.

Sponsor. Rocketplane Kistler (RpK) Oklahoma City, Oklahoma, manages the overall K-1 program.

Status. Vehicle approximately 75 percent complete.

Total Produced. None

Application. K-1 vehicles will be fully reusable vehicles that carry payloads to space and automatically return to Earth.

Price Range. Rocketplane Kistler will charge approximately $40-$50 million for a K-1 launch.

Contractors

Prime

Rocketplane Kistler	http://www.kistleraerospace.com/, 4300 Amelia Earhart Ln, Oklahoma City, OK 73159 United States, Tel: + 1 (405) 488-1200, Fax: + 1 (405) 488-1204, Email: abrock@rocketplane.com, Prime
Alliant Techsystems - Launch Systems Group	http://www.atk.com, PO Box 707, Brigham City, UT 84302 United States, Tel: + 1 (453) 863-3511, Email: businessdevelopment@atk.com, Lead Contractor (K-1 Development)

Subcontractor

Aerojet	http://www.aerojet.com, PO Box 13222, Sacramento, CA 95813-6000 United States, Tel: + 1 (916) 355-4000, Fax: + 1 (916) 351-8667, Email: comment@aerojet.com (Modified NK-33 and NK-34 Liquid Rocket Engines)
Charles Stark Draper Laboratory Inc	555 Technology Sq, Cambridge, MA 02139-3563 United States, Tel: + 1 (617) 258-1000, Fax: + 1 (617) 258-1131 (Guidance, Navigation and Mission Control System)

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Honeywell Aerospace, Engine Control Systems	http://www.honeywell.com/sites/aero/Engine_Controls.htm, 2525 W 190th St, Torrance, CA 90504-6099 United States, Tel: + 1 (310) 323-9500, Fax: + 1 (310) 512-2221 (Vehicle Management System)
Irvin Aerospace	http://www.airbornesystems-na.com, 3701 West Warner Ave, Santa Ana, CA 92704 United States, Tel: + 1 (714) 662-1400, Fax: + 1 (714) 662-1586 (Parachute Recovery System)
Lockheed Martin Space Systems - Michoud Operations	http://www.lockheedmartin.com/michoud, 13800 Old Gentilly Rd, PO Box 29304, New Orleans, LA 70189 United States, Tel: + 1 (504) 257-3311, Fax: + 1 (504) 257-2109 (Liquid Oxygen Tanks & Vehicle Assembly)
Northrop Grumman Corp	http://www.northropgrumman.com, 1840 Century Park E, Los Angeles, CA 90067-2199 United States, Tel: + 1 (310) 553-6262, Fax: + 1 (310) 201-3023, Email: onewebmaster@ngc.com (Vehicle Structure)
Oceaneering Space Systems	http://www.oceaneering.com/adtech/space/adtech_space.htm, 16665 Space Center Blvd, Houston, TX 77058-2268 United States, Tel: + 1 (713) 488-6485, Fax: + 1 (713) 488-9080 (Thermal Protection System)

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Technical Data

Design Features. The Rocketplane Kistler K-1 reusable booster looks very much like a stubby expendble launch vehicle (ELV). The rocket consists of a first stage called the Launch Assist Platform (LAP) and a second stage dubbed the Orbital Vehicle (OV). Unlike a typical ELV, in which the spent stages are discarded, the K-1's first and second stages return to Earth to be used again.

The K-1 is powered by a total of four engines: two AJ26-58s and one AJ26-59 in the LAP, and one AJ26-60 in the OV. Originally produced by Kuznetsov and designated NK-33 (for the -58 and -59) and NK-43 (for the -60), the engines were designed in the late 1950s to power the Soviet Union's N1 lunar launch vehicle (in which 30 engines were clustered on the first stage). The NK-33 engines burn kerosene and liquid oxygen and, after modifications by Aerojet, were designated AJ26-58/59/60.

Aerojet installed a gimbal block for thrust vectoring, changed wiring harnesses, and installed electro-mechanical valve actuators. The modifications added about 135 kilograms to the engines and reduced the motor's thrust-to-weight ratio from about 124:1 to 111:1.

The NK-33 is a rugged and dependable motor. Kuznetsov once static-tested a unit for four hours to destruction, far more than the 140-second burn time normally required for the first stage. Designed to be used for 15 firings, the AJ26 powerplants will be used for 10 K-1 flights, overhauled, and then used 10 more times before being retired. Rocketplane Kistler has reserved rights for 58 of the 70 NK-33 engines in the Russian inventory and for all of the 18 NK-43 engines built.

In a typical K-1 launch, the first stage's three engines ignite and burn for 139 seconds before the stage separates. The second-stage engine then ignites, operating until the booster reaches its final low-Earth orbit. Second-stage attitude adjustment and de-orbit is provided by two new liquid oxygen and ethanol-fed orbital maneuvering subsystem engines.

Once separated, the first stage deploys a stabilizing drogue chute just before turnaround. Ignition places it on a ballistic trajectory back to the launch site. Six parachutes – the largest parachute cluster in the world, according to Rocketplane Kistler – are deployed at altitude, with airbags inflating just before a soft touchdown. The stage is then prepared for another flight.

Meanwhile, the second stage's hinged payload fairing opens, the payload is deployed, and the fairing is then closed. After deploying the payload, the orbital vehicle does a pitchover and fires its rocket engine to break out of orbit. Using the blunt-nose cone as a heat shield, the stage re-enters the atmosphere for a landing at the launch site. Three parachutes are deployed at altitude and airbags are inflated just before a soft touchdown. This vehicle is then prepared for another flight, within days after landing.

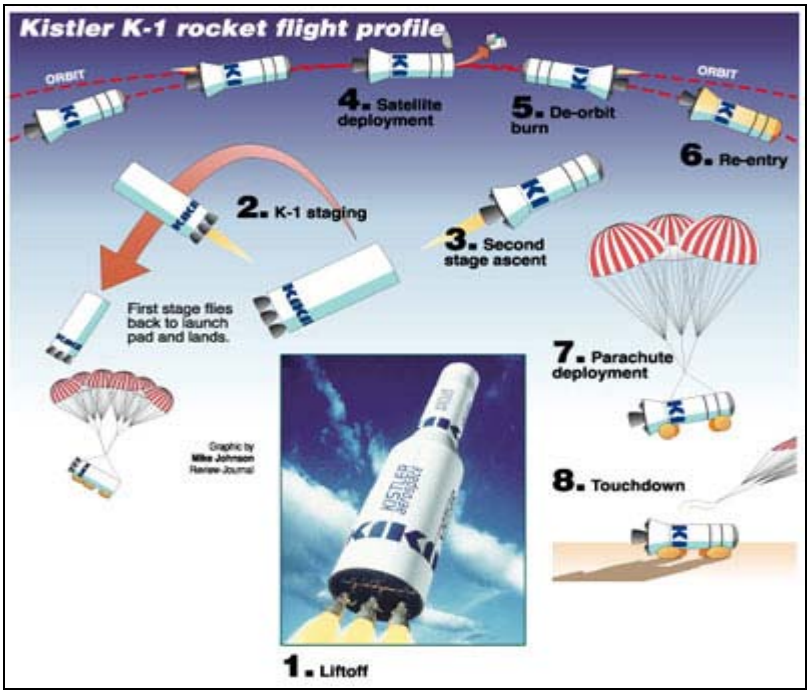
K-1

Rocketplane Kistler plans to launch the K-1 from two facilities. Initial launches will take place at the Woomera Spaceport in South Australia. For later missions, the Spaceport Nevada at the Nevada Nuclear Test Site will also be tapped.

	Metric	U.S.
Dimensions		
Overall length	36.9 m	121.2 ft
LAP length	18.3 m	60.2 ft
OV length (including extended payload module)	18.6 m	61.0 ft
Weight		
K-1 gross weight	382,300 kg	841,000 lb
Stage 1 gross weight	250,500 kg	552,252 lb
Stage 2 gross weight	131,800 kg	290,000 lb
Performance		
Payload to 200 km, 45° inclination	4,600 kg	10,150 lb
Payload to 200 km, 90° inclination	3,000 kg	6,600 lb
Payload to 800 km, 98.6° inclination	1,250 kg	2,750 lb

Propulsion

Stage 1	(2)	AJ26-58 liquid propulsion (kerosene and liquid oxygen) rocket engines, 1,512 kN (340,000 lb) thrust each at liftoff. Specific impulse 297 sec. (sea level), 331 sec. (vacuum). Burn time approximately 140 sec.
	(1)	AJ26-59 liquid propulsion (kerosene and liquid oxygen) rocket engine, 1,512 kN (340,000 lb) thrust at liftoff. Specific impulse 297 sec. (sea level), 331 sec. (vacuum). Burn time approximately 140 sec.
Stage 2	(1)	AJ26-60 liquid propulsion (kerosene and liquid oxygen) rocket engine, 1,769 kN (397,671 lb) thrust. Specific impulse 348 sec. (vacuum).
	(1)	AJ/OMS liquid propulsion (ethanol and liquid oxygen) Orbital Maneuvering System engine, 3.9 kN (870 lb) thrust.



K-1 Flight Stages

Source: Rocketplane Kistler

K-1

Program Review

Background. Rocketplane Kistler is developing a two-stage vehicle that can be reliably and inexpensively reused and act as a delivery service to low-Earth orbit. Indeed, Rocketplane Kistler anticipates that the K-1 will be operated with air freight efficiency.

Second-Stage Parachute System Tested. Kistler successfully completed a parachute drop test involving a three-parachute cluster in 1998. An instrumented payload weighing 4,130 kilograms, the estimated weight of the K-1's empty second stage, was dropped from an aircraft flying at an altitude of 3,050 meters. Twelve seconds into the flight, the cluster of parachutes was deployed, allowing the object to touch down safely.

First Stage Parachute Drop Test. Kistler successfully completed a six-parachute cluster drop test in 1998, which simulated the safe return of the K-1's first-stage vehicle following separation and return to the launch site.

As with the earlier test of the second stage's parachute assembly, an instrumented payload weighing 18,145 kilograms was dropped from an aircraft flying at an altitude of 3,000 meters. The cluster of six parachutes opened 12 seconds later and safely returned the object to the ground.

Kistler Signs Nevada Launch Site Agreement

In a major step toward its first U.S.-based launch, Kistler Aerospace signed a final agreement in 1998 with the NTS Development Corp. The agreement grants Kistler the right to occupy and operate from Area 18 at the Nevada Test Site, 95 kilometers northwest of Las Vegas.

Northrop Grumman Agrees to Invest in Kistler. Northrop Grumman announced in 1999 that it would invest $30 million in Kistler Aerospace's K-1 program, and that it expected to double the amount to $60 million before the vehicle's first flight.

The investment by Northrop Grumman is tiered, and includes the current $30 million with an additional $30 million to be invested as part of the last round of financing. This would complete the funding required to begin test flights of the K-1 vehicle. Additionally, Northrop Grumman holds the option, in the form of warrants, to invest up to an additional $120 million over an agreed-upon timeframe.

Taiwan Investors Support K-1

In 1999, the Taiwanese Ministry of Finance approved a plan that would allow seven local banks to invest $50 million in the K-1 project. In return, Kistler Aerospace transferred technology and offered parts supply contracts to companies in Taiwan.

NASA Awards Contract to Kistler. In 2001, NASA awarded Kistler a $10 million contract under the Space Launch Initiative (SLI) program. The contract had a potential value of $135 million if NASA opted to fly SLI technologies on the K-1. The arrangement allowed NASA to access data regarding K-1 flight tests. NASA also held an option to terminate the contract if the K-1 remained undeveloped by certain milestone dates.

This contract was withdrawn in 2004 by NASA following formal protests initiated by Space Exploration Technologies' Elon Musk.

Kistler Files for Chapter 11

In July 2003, Kistler Aerospace voluntarily filed for Chapter 11 in an effort to reorganize and to revitalize its capital and debt structure. Court documents filed at the time by Kistler indicate that the company owed $558 million, while its assets were $6.2 million. Kistler closed its Los Angeles office that same month and employed just 21 people out of its Kirkland (Washington) headquarters. Financial backers have so far put $700-$900 million into Kistler, depending on source. The company's lawyer, Youssef Sneider of Davis Wright Tremaine LLP in Seattle, estimated that Kistler would need another $650 million for its business plan. Sneider is quoted as saying at the time that the chances for the company's survival were "50/50."

Kistler Exits Bankruptcy

Kistler successfully emerged from bankruptcy on April 29, 2005, by handing over 20 percent ownership of the company to unpaid contractors. Kistler also hired the accounting firm Ernst & Young LLP to evaluate its post-bankruptcy value. Ernst & Young came to the conclusion that if Kistler secured the financing needed to complete its K-1 rocket and won the COTS contract to resupply the international space station, *and* its first launches were successful, the company could be worth as much as $175 million. Rocketplane Limited Inc bought Kistler in 2006.

Old Face Brings a New Name

The majority owner of Rocketplane Limited Inc added Kistler Aerospace to his portfolio. Rocketplane CEO and President George French purchased Kistler for an undisclosed amount and is now the majority owner of Rocketplane Kistler. French was an early investor in Kistler when it was started more than a decade ago.

COTS Award Goes to RpK, OSC Backs Out

In the summer of 2006, Orbital Sciences (OSC) and RpK entered into a conditional strategic relationship that established Orbital as RpK's primary industrial partner in the event the K-1 program was selected by NASA for a Commercial Orbital Transportation Services (COTS) award from of field of six contending companies. RpK was officially selected for a $207 million COTS award in August 2006, and the company announced that OSC was indeed signing on as an industrial partner. As part of the arrangement, OSC would contribute $10 million toward RpK's financing efforts. In late September, one month after the good news of the COTS award, the K-1 development effort was dealt a significant setback. Citing a difference of opinion regarding the K-1 business plan, OSC no longer wished to contribute $10 million and was backing out as RpK's industrial partner.

Significant News

ATK Fills Void Left by OSC – Alliant Techsystems (ATK) will become the lead contractor for RpK's K-1 launch vehicle. Under terms of the agreement, ATK will provide launch vehicle development, assembly, integration and test of the launch system, and will conduct launch and landing site development and launch vehicle preparation for the K-1. ATK will also develop and produce composite structures and subsystems for the pressurized and un-pressurized K-1 cargo modules, and conduct vehicle recovery and refurbishment. (RpK, 11/06)

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Timetable

Month	Year	Major Development
	1995	Preliminary design
Mar	1998	Drop test of three-parachute second-stage recovery system
Mar	1998	First test-firing of the modified NK-33 engine
Jun	1998	Drop test of six-parachute first-stage recovery system
Jul	1998	Kistler breaks ground on Spaceport Woomera in South Australia
Jul	2003	Kistler files for Chapter 11
Feb	2006	Rocketplane Kistler formed
	2007/8	K-1 development expected to be complete
	2008/9	First launch of the K-1 scheduled
	2010	NASA deadline for completion of two demo flights to ISS

Forecast Rationale

Rocketplane Kistler (RpK) says it expects to wrap up $500 million in private financing before the end of summer 2007. RpK made the announcement shortly after NASA acknowledged that RpK missed a May 31 Commercial Orbital Transportation Services (COTS) deadline. The May 31 deadline was to show that RpK had secured the rest of the developmental money for the K-1 in order to ultimately demonstrate by 2010 that it is capable of making supply runs to the International Space Station.

Under the terms of the COTS Space Act Agreement that NASA awarded to RpK in August 2006, RpK must show that it is making programmatic, technical and financial progress in order to continue receiving financial assistance from NASA for the K-1. As of July 2007, NASA had given RpK approximately $32 million of the $207 million it is entitled to receive under COTS if it completes three K-1 demonstration flights, including two to the ISS by 2010.

RpK received the first installment of $7.3 million in September 2006 after the company passed a program implementation review. A second $7.3 million installment was made after RpK completed a $40 million financing round in October 2006 despite being one month later than anticipated. After RpK completed the systems requirement review in February, an additional $15.5 million was awarded by NASA.

RpK would have received an additional $7.5 million in February 2007 if it had adhered to its original schedule for raising $120 million in a second round of financing. However as the February deadline approached RpK

renegotiated the COTS milestones, convincing NASA to allow more time to raise not just the $120 million that was coming due but all of the $500 million of its requisite private financing. RpK representatives said the plans were changed at the request of investment banker Jeffries Quarterdeck, who wanted to take advantage of a favorable investment climate to complete a third and final $380 million round.

The revised Space Act Agreement signed February 28 gave RpK until the end of May to complete a single, final round of financing, after which NASA would pay Rocketplane Kistler $7.5 million. When the May deadline came and went without RpK closing the round, NASA said it was amenable to giving the company more time to complete it.

The two sides had not signed a revised agreement as of July 2007, but RpK was reportedly lining up heavy-hitter investors and expected to meet its financing obligations by mid-summer 2007. (If RpK succeeded, it would be about six months ahead of the original timeline laid out in 2006.) If RpK missed the deadline, it would mark the fourth time it had to return to NASA to plead its case for additional time.

While raising the money has been a chore, NASA confirmed to Forecast International that RpK has met all of its programmatic and technical milestones thus far. RpK is also on schedule for completing a Critical Design Review for the unpressurized cargo module in November 2007. NASA's confidence in RpK doesn't seem to have wavered, which is most likely due to the fact that the K-1's development is very nearly complete.

While the first application for the K-1 is carrying cargo, RpK expects the RLV could potentially launch satellites into space for around $40-$50 million, which compares favorably with the likes of Boeing and Lockheed Martin. The K-1 is being launched at a rocket range in Woomera, Australia.

Rocketplane Kistler hopes that, following a successful debut of the K-1, revenues will begin to roll in sufficiently to build three more vehicles for a fleet of five K-1s. Forecast International believes this is much too optimistic at this point and therefore has issued a conservative forecast consisting of two K-1 vehicles to meet the demands of the ISS and COTS contract.

Ten-Year Outlook

ESTIMATED CALENDAR YEAR UNIT PRODUCTION												
Designation or Program		**High Confidence**				**Good Confidence**			**Speculative**			
	Thru 2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**Total**
Rocketplane Kistler												
K-1 <> RpK K-1												
	0	0	1	2	0	0	0	0	0	0	0	3
Total	0	0	1	2	0	0	0	0	0	0	0	3