Start/Start-1 Launch Vehicles

Outlook

- No Start launch vehicle has lifted off since 2006, and no Start-1s are scheduled to lift off
- Start/Start-1 faces growing competition from increasing lightweight launch vehicle market
- Older ICBMs that Start vehicles are based on would be too expensive to refurbish for launch to compete with newer light launch vehicles, like PSLV, Vega, and Epsilon
- This report will be archived in 2016

Orientation

Description. Start and Start-1 are small, mobile, expendable launch vehicles developed from the former SS-25 (Topol) intercontinental ballistic missile (ICBM).

Sponsor. Puskovie Uslugi (Launch Services), Moscow, a joint venture between the Russian space agency and NTTS Kompleks (STC Complex), provides launch services using the Start and Start-1 vehicles. STC Complex is a joint venture between the Moscow Institute of Heat Technology and GPO Votkinsky Zavod (GPO-VZ), Votkinsk, Udmurtia. The United Start Corporation, located in California, markets the Start and Start-1 vehicles in the West. United Start is majority U.S.-owned, with minority Russian ownership by Puskovie Uslugi.

Status. With no active launch manifest, production has apparently ended; the first Start-1 launch took place in 1993.

Total Produced. An estimated seven vehicles.

Application. Start and Start-1 mobile launch vehicles can launch small commercial or scientific research satellites weighing up to 750 kilograms into low-Earth orbit. One of the launcher's primary selling points is its ability to be transported to launch facilities practically anywhere in the world or to locations not previously used for launches.

Price Range. A Start-1 launch costs only $8 million to $9 million, with Start boosters selling for $10 million to $11 million.

Contractors

Prime

NPO Votkinsky Zavod	Ulitsa Kirova, 2, Votkinsk, 427410 Russian Federation, Tel: + 7 341 45 652 08, Prime
Puskovie Uslugi	Beryozovaya Alleya 10/1, Moscow, 127276 Russian Federation, Tel: + 7 095 402 6184, Fax: + 7 095 402 8229, Email: office@pu-lsp.ru, Program Participant (Launch Services)
United Start Corp	2995 Airway Ave, Costa Mesa, CA 92626 United States, Tel: + 1 (714) 755-7427, Fax: + 1 (714) 545-7676, Email: info@unitedstart.com, Program Participant (Western Marketing)

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Subcontractor

NPO Avto Pribor, Avto Pribor Plant Ltd	http://www.npo-pribor.ru, 79 Franze St, Vladimir, 117342 Russian Federation, Tel: + 7 095 330 65 70, Fax: + 7 095 334 83 80 (Avionics)
TsSKB Titan, Titan Central Design Bureau FSUE	2 Aviamotornaya St, Moscow, 111250 Russian Federation, Tel: + 7 8442 711910, Fax: + 7 8442 715736, Email: cdbtitan@avtlg.ru (Mobile Launcher System)

Comprehensive information on Contractors can be found in Forecast International's "International Contractors" series. For a detailed description, go to www.forecastinternational.com (see Products & Services/Governments & Industries) or call + 1 (203) 426-0800.

Contractors are invited to submit updated information to Editor, International Contractors, Forecast International, 22 Commerce Road, Newtown, CT 06470, USA; rich.pettibone@forecast1.com

Technical Data

Design Features. Like the SS-25 ICBM, the Start and Start-1 boosters feature their own mobile launch platform, which includes a launch container, transporter, and launch operations equipment. The transporter is equipped with a hydraulic erector for lifting the space booster from its horizontal traveling position to a vertical posture before launch.

The rocket is cold-launched – that is, ejected from the container by the pressure of a solid-propellant gas generator. The first-stage solid-propellant motor ignites as soon as the rocket clears the container.

Start-1 is a four-stage vehicle, and the larger Start features an additional fifth stage. Both use solid-propellant motors in all stages. Start-1 features yaw steering control and is able to reach multiple inclinations: 52°, 76°, and 90°.

Although the Start booster is mobile and can be launched from just about anywhere, missions most often took place from the former missile launch base at Svobodny, located in the Amur region in Russia's Far East (the first launch took place there in 1997). An alternative launch site was the Plesetsk Cosmodrome in northern Russia.

Start-1/Start

	Metric	U.S.
Dimensions		
Length	22/29 m	72/95 ft
Diameter	1.8 m	5.9 ft
Payload volume	1.3/7.8³ m	14/84³ ft
Weight		
Launch mass	47,000/60,000 kg	103,616/132,246 lb
Performance		
Maximum altitude, polar orbit	700/700 km	435/435 mi
Maximum payload	550/700 kg	1,212/1,543 lb

Propulsion (Start)

Stage 1	(1)	Solid propellant rocket motor, 908.6 kN (220,460 lbst), 60-second burn time
Stage 2	(1)	Solid propellant rocket motor, 490.3 kN (110,230 lbst), 64-second burn time
Stage 3	(1)	Solid propellant rocket motor, 490.3 kN (110,230 lbst), 64-second burn time
Stage 4	(1)	Solid propellant rocket motor, 245.1 kN (55,155 lbst), 56-second burn time
Stage 5	(1)	Solid propellant rocket motor, 9.8 kN (2,205 lbst), 207-second burn time

Propulsion (Start-1)

Stage 1	(1)	Solid propellant rocket motor, 908.6 kN (220,460 lbst), 60-second burn time
Stage 2	(1)	Solid propellant rocket motor, 490.3 kN (110,230 lbst), 64-second burn time
Stage 3	(1)	Solid propellant rocket motor, 245.1 kN (55,155 lbst), 56-second burn time
Stage 4	(1)	Solid propellant rocket motor, 9.8 kN (2,205 lbst), 207-second burn time

Variants/Upgrades

Start-1. Four-stage, all-solid-propellant booster.

Start. Five-stage, all-solid-propellant booster (uses second stage twice).

Program Review

Background. For many years now, Russia has converted former ICBMs into commercial, mobile, expendable launch vehicles based on the SS-25 (Topol RT-2PM) ICBM. The SS-25 mobile ICBM can launch a nuclear warhead to a distance of nearly 10,500 kilometers. The missile is not targeted for destruction under the terms of arms reduction treaties between the United States and Russia, and over 300 remain in the Russian inventory.

Enter Puskovie Uslugi

In 1998, Russia created Puskovie Uslugi to work with the U.S.-based United Start Corporation, which handles all licensing required by the U.S. State Department to ensure a smooth launch integration process. The plan was implemented to offer commercial satellite launch services using these small- to medium-class Russian booster rockets.

The Start program featured two phases. The Start-1 vehicle was developed under the first phase and declared ready for commercial service after its maiden launch in 1993. Phase 2 involved development of the larger but relatively useless Start rocket.

First Attempt a Failure

The first and only attempted launch of the larger Start booster ended in failure in 1995. It carried an Israeli Gurwin-1 TechSat spacecraft, a Mexican Unasat-1 communications satellite, and a Russian EKA 2 satellite. The failure, which sent the booster and its payload crashing into the sea in Russia's Far East, occurred sometime after the fourth-stage engine started.

Zeya Launched. Start-1 successfully launched the Zeya Russian military communications satellite from the Svobodny Cosmodrome in March 1997 – the first launch from the new complex. The 87-kilogram spacecraft was placed into a sun-synchronous polar orbit.

EarthWatch Launched. The State Department issued an export license to EarthWatch Inc (now called DigitalGlobe) in October 1995 authorizing the company to use the Start-1 launch vehicle to place its high-resolution commercial remote sensing satellite into orbit. The EarthWatch EarlyBird satellite was launched from the Svobodny Cosmodrome in December 1997, but EarthWatch engineers lost contact with the spacecraft four days later.

Start-1 Launches EROS. An Israeli remote sensing firm has launched two satellites on Start-1 launch vehicles. The satellites, dubbed Earth Resources Observation Satellites (EROS), transmit imagery to the Israeli Ministry of Defense as well as to commercial outlets. EROS A launched on board a Start-1 booster in December 2000, and EROS B launched on a Start-1 in April 2006.

Successful Launch of Swedish Science Satellite. The Swedish Space Corp's Odin spacecraft was launched on a Start-1 in February 2001. The 242-kilogram satellite was placed into a 626-kilometer orbit, from where it studies the Earth's ozone layer.

New Rocket in the Works?

In 2006, Russian scientists were reportedly working with Kazakhstan to develop a new aerial-launched rocket, which may resemble a scaled-down Start-1. Whether the new rocket resembles a Start-1 or not, this could spell the end of the Start-1 program.

No Start-1 launch vehicle has lifted off since 2006. With no launches since then, and no active launch manifest, it appears the Start-1 has been retired from active service.

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Start-1 lifts off from the Svobodny Cosmodrome.

Source: Swedish Space Corporation

Timetable

Month	Year	Major Development
Mar	1993	First Start-1 launch
Mar	1995	Five-stage Start vehicle lost in debut launch mishap
Mar	1997	Zeya military communications satellite launched on Start-1
Dec	1997	EarlyBird launched on Start-1
Dec	2000	EROS A launched on Start-1
Feb	2001	Odin launched on Start-1
Apr	2006	EROS B launched on Start-1

Forecast Rationale

The Start-1 is based on surplus parts from retired ICBMs, a factor that has kept its price attractive for many years. However, increasing competition has limited the market for Start launch vehicles. No Start has lifted off since 2006, and no launches are scheduled.

New boosters, such as the Indian PSLV, European Vega, and Japanese Epsilon, have entered the market in recent years. These boosters, which have been designed from the start as launch vehicles, are offering stiff competition to older ICBM-based launch vehicles. Other ICBM-based launch vehicles also continue to compete in the market, such as the Russian Dnepr and U.S. Minotaur.

Launch vehicles such as the PSLV and Vega also have strong connections to their national governments. Governments prefer to launch payloads on indigenous rockets, limiting Start sales abroad. For example, the ISRO typically uses its own PSLV to launch remote sensing satellites into orbit.

With no Start launch vehicles scheduled to lift off, it appears the program has ended. Even though the major components are recycled from ICBMs, and therefore already have been produced, they will need to be refurbished and modifications will need to be made to allow them to carry satellites rather than nuclear warheads. After years of neglect, it would be cost

prohibitive to restart those activities. Furthermore, rocket engines have a natural shelf life. Each year Start vehicles are not launched, they are closer to the end of their shelf life. Refurbishing them after their shelf life has passed would be too expensive. The launch vehicles would not be able to compete in the commercial market with other, newer light launch vehicles.

This report will be archived next year.

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