Technologies at height!

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ЦСКБ ПРОГРЕСС

Launch Vehicles

SAMARA SPACE CENTRE

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The head of Samara Space Centre is
Dr. Alexander N. Kirilin,
Director-General

State Research & Production Space Rocket Centre "TsSKB-Progress" (Samara Space Centre) is the leading Russian enterprise and one of the world leaders in building and operation of middle-class launch vehicles, unmanned spacecraft for Earth remote sensing and applied purposes.

SAMARA SPACE CENTRE has wide experience in the realization of various Russian space-rocket programs and is involved in the largest international projects. Since 1959 it has made and put into service 9 launch vehicle modifications. They were used in 1 730 spacecraft launches with over 970 spacecraft developed by this company. This is almost ⅔ of the total number of launches in the USSR and Russia. The enterprise made 27 types of spacecraft for research and applied purposes as well as for national security purposes.

SAMARA SPACE CENTRE combines production traditions of Samara "Progress" plant, which dates back to the 19-th century and the Central Specialized Design Bureau with its over 45 year experience in design of space-rocket technology. The Centre has subsidiaries in Baikonur launch site, in Moscow region, representations in Moscow and in Plesetsk launch site.

Samara Space Centre's Launch Vehicles

Launch vehicles "Soyuz-FG", "Soyuz-U", "Molniya-M" are operational now. New launch vehicle "Soyuz-2" is undergoing flight tests. "Soyuz-U" and "Soyuz-FG" launch vehicles deliver cosmonauts and cargo to International Space Station and launch unmanned spacecraft to low orbits. "Molniya-M" launch vehicle is used for launches to high elliptical orbits. Launches to middle, high and sun-synchronous orbits are provided by "Soyuz-FG" and "Soyuz-2" launch vehicles with "Fregat" kick-stage.

"Soyuz" launch vehicle is the unchallengeable leader in the number of launches and reliability among middle-class launch vehicles. 1730 launches of launch vehicles of R-7A family had been made by March 1, 2008.

"Soyuz-U" and "Soyuz-FG" Launch Vehicles

"Soyuz-U", "Soyuz-FG" launch vehicles are basic in the Russian launching systems. They launch the bulk of spacecraft within the Federal space program and international space cooperation program. Upgraded engines are used in the modules of the 1-st and 2-nd stages in "Soyuz-FG" launch vehicle to increase the lifting capacity. "Fregat" kick-stage is used to launch spacecraft into medium and highly elliptical orbits.

"Soyuz-U" launch vehicle has been in operation since 1973 and "Soyuz-FG" launch vehicle has been in operation since 2001. By March 1, 2008, 747 launches of Soyuz-U LV and 22 launches of Soyuz-FG LV had been made.

The proven operational reliability index of "Soyuz-U" and "Soyuz-FG" launch vehicles is 0.984.

Specifications of "Soyuz-U" and "Soyuz-FG" launch vehicles

Number of stages	3
Liftoff mass	310 tons
Maximal length	51 m
Nose fairing diameter	2.7 m; 3.0 m; 3.3 m; 3.715 m

Power capability of "Soyuz-U" and "Soyuz-FG" launch vehicles with nose fairing of 3.715 m diameter

Launch site	Inclination	Mean altitude of circular orbit	Payload mass	
			Soyuz-U LV	Soyuz-FG LV
Plesetsk	62.8° 67.1° 81.4°	220 km 190 km 200 km	6150 kg 6090 kg 5800 kg	- - -
Baikonur	51.8° 64.9°	200 km 190 km	6650 kg 6450 kg	6900 kg 6700 kg

"Soyuz-2" Launch Vehicle

Soyuz-2 LV is a new launch vehicle. It will enable to replace in the future "Soyuz-U", "Soyuz-FG" and "Molniya-M" launch vehicles with one launch vehicle.

"Soyuz-2" launch vehicle with "Fregat" kick-stage will enable to launch spacecraft to various orbits: low, medium, high elliptical, sun-synchronous, GTO and GSO.

"Soyuz-2" launch vehicle was developed on the basis of "Soyuz" launch vehicle in two phases (phases 1A and 1B).

Modification phase of "Soyuz-2-1A" launch vehicle:

- injectors with improved mixing characteristics are used in engines of the I-II stages;
- a new control system, unified for three stages, was developed on the basis of highly efficient digital computer;
- a new digital radio-telemetry system is used;
- the III stage unit structure is maximally unified both for modification phase 1A and modification phase 1B.

Modification phase of "Soyuz-2-1B" launch vehicle:

- in addition to improvements of modification phase 1A new engine with greater power capabilities is used in the III stage unit.

It enabled to increase orbiting accuracy, stability and controllability of launch vehicle and to use assembly-and-protection module with nose fairing of 4.11 m diameter and 11.43 m length.

"Soyuz-2" launch vehicle specifications

Number of stages	3
Liftoff mass	307 tons
Maximal length	46 m
Nose fairing diameter	2.7 m; 3.0 m; 3.3 m; 4.11 m

"Soyuz-2" launch vehicle power capability with nose fairing of 3.715 m diameter

Launch site	Inclination	Mean altitude of circular orbit	Payload mass	
			Soyuz-2-1a LV	Soyuz-2-1b LV
Plesetsk	62.8° 67.1° 81.4° 98.3°	220 km 190 km 200 km 200 km	6830 kg 6690 kg 6360 kg 5900 kg	7850 kg 7880 kg 7470 kg 6900 kg
Baikonur	51.8° 64.9° 95.4°	200 km 200 km 200 km	7020 kg 6400 kg 5500 kg	8200 kg 7400 kg 6300 kg

Flight tests of "Soyuz-2-1A" launch vehicle successfully started on November 8, 2004 with the launch from Plesetsk launch site. On October 19, 2006 the first commercial "Soyuz-2" launch vehicle with European meteorological satellite "Metop" was launched. On December 24, 2006 "Soyuz-2-1A" launch vehicle was launched with spacecraft for national security purposes.

Flight tests of "Soyuz-2-1B" launch vehicle started on December 27, 2006 with the launch of French research spacecraft "Corot" from Baikonur launch site.

By March 1, 2008, 4 launches of "Soyuz-2" launch vehicle had been made in all. The proven operational reliability index of "Soyuz-2" launch vehicle is 0.981.

"Soyuz-ST" Launch Vehicle

"Soyuz-ST" launch vehicle is developed on the basis of "Soyuz-2" launch vehicle and designed for commercial spacecraft launches from Kourou launch site (French Guiana).

"Soyuz-ST" launch vehicle is adapted in compliance with the requirements of Kourou space centre in terms of safety (uplink commands to stop flight), telemetry system (UHF transmitters with European IRIG format for telemetry frame) and operational environment (high humidity, sea transportation and others).

"Soyuz-ST" launch vehicle is equipped with ST-type nose fairing, meeting international demands. When used with "Fregat" kick-stage it will enable to orbit a wide range of payloads.

Power capability of "Soyuz-ST" launch vehicle

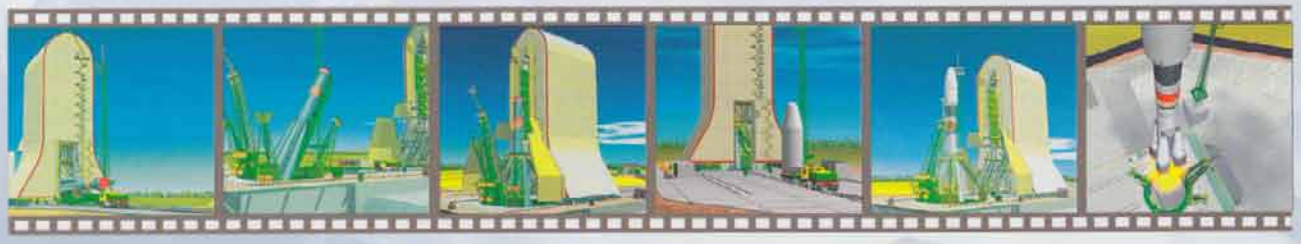
Launch vehicle	GTO (ΔV=1500 m/s)	Sun-synchronous orbit ($H_{circular}$=820 km)
Soyuz-ST-A LV	2850 kg	4230 kg
Soyuz-ST-B LV	3240 kg	4900 kg

Soyuz LV at Guiana Space Centre

Launching facilities for "Soyuz-ST" launch vehicle are being built in Guiana Space Centre for launches from Kourou. Equatorial position of the launch site in French Guiana ensures maximal power capability of launch vehicle when launching payloads to GTO and GSO.

In comparison with Baikonur launch site lifting capacity is increased twice while launching payloads to geostationary transfer orbits from launch site in Guiana Space Centre and three times - while launching payloads to geostationary orbits from launch site in Guiana Space Centre.

Implementation of the project will enable at least 50 launches of "Soyuz-ST" launch vehicle during 15 years.



"Soyuz-2-3" Launch Vehicle

Three-stage middle-class "Soyuz-2-3" launch vehicle is a further modification of "Soyuz-2" launch vehicle aimed at increasing power capability to expand the range of launched spacecraft.

An upgraded gimbaled sustainer engine NK-33-1 is used on the central module of "Soyuz-2-3" launch vehicle. The central module of "Soyuz-2-3" launch vehicle has the increased diameter of the lower part of the module: 2050-2660 mm.

"Soyuz-2-3" launch vehicle conceptual design was developed.

Technical data of "Soyuz-2-3" launch vehicle

Number of stages	3
Liftoff mass	335.5-340 tons
Maximal length	47 m
Nose fairing diameter	4.11 m

Power capability of "Soyuz-2-3" launch vehicle

Launch site	Circular orbit (mean altitude is 200 km)	GTO (with "Fregat" kick-stage)	Sun-synchronous orbit (with "Fregat" kick-stage)
Baikonur	10000 kg (inclination 51.8°)	2 480 kg	6 200 kg
Plesetsk	9700 kg (inclination 62.8°)	2 100 kg	6 700 kg
Kourou	10700 kg (inclination 5.3°)	3 900 kg	-

"Soyuz-1" Launch Vehicle

The development of advanced light-class "Soyuz-1" launch vehicle is performed to meet the increased demands of international market for small spacecraft launches.

"Soyuz-1" launch vehicle is developed on the basis of "Soyuz-2-1B" launch vehicle by means of strap-ons removal, by the use of sustainer engine NK-33-1 on the central module and use of serial nose fairing of "Soyuz" launch vehicle.

"Soyuz-1" launch vehicle conceptual design was developed.

Technical data of "Soyuz-1" launch vehicle

Number of stages	2
Liftoff mass	136 tons
Maximal length	44 m
Nose fairing diameter	3 m

Power capability of "Soyuz-1" launch vehicle

Launch site	Low circular orbit (mean altitude is 200 km)
Baikonur	2250 kg (inclination 51.8°)
Plesetsk	2400 kg (inclination 62.8°)

Payload Launch Services

In international space market Samara Space Centre renders payload launch services with "Soyuz" and "Soyuz-2" launch vehicles.

By now 32 US communication satellites "Globalstar", 4 European research satellites "Cluster-2", European satellites "Mars-Express" and "Venus-Express", US communication satellite "Galaxy-14", Israeli communication satellite "Amos-2", European navigational satellite "Galileo", European meteorological satellite "Metop", French research satellite "Corot", Canadian research satellite "Radarsat-2" have been launched successfully.

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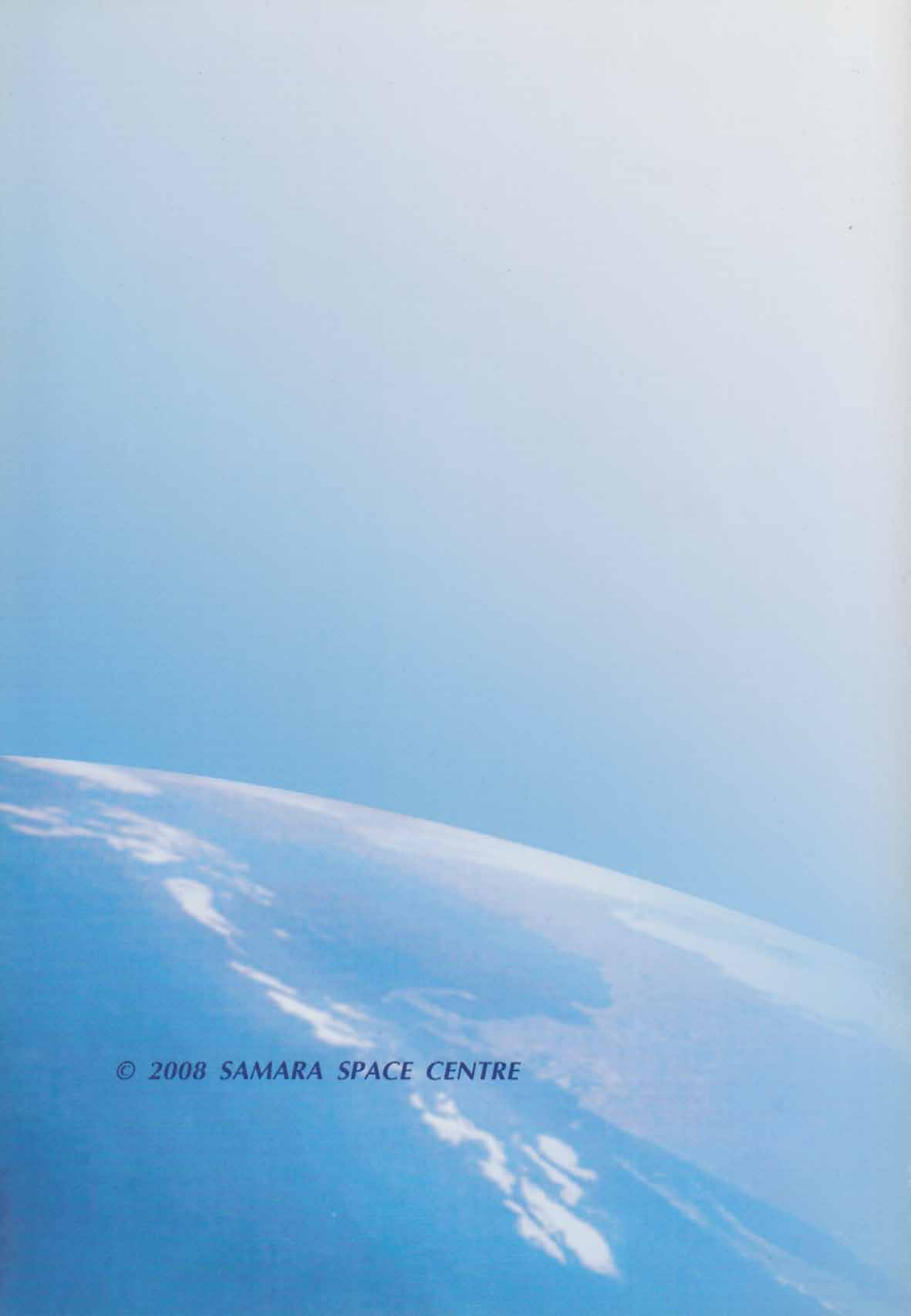

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