ESTES DATA PACK SERIES
VOL. 1: SOYUZ
1/48 SCALE

INTRODUCTION

With a heritage that stretches back over six decades the Soyuz rocket is the most frequently flown orbital booster in history. Featuring a design that dates back to Sputnik and the dawn of the space race, the Soyuz rocket has been adapted to a wide range of roles, most notably as the booster for the eponymous Soyuz spacecraft. The 1/48 scale Soyuz kit from Estes faithfully represents this historic booster as a detailed flying model standing over a meter tall.

This data pack offers an overview of the history of the Soyuz rocket as well as an introduction to this landmark kit itself, including tips and tricks to help guide you as you build your own museum grade flying replica of one of the most significant vehicles in aerospace history.

Left: When the Soyuz rocket is in place on the launch pad, service arms close around the rocket, allowing access for service, fueling, and crew access. The arms retract in the final stage of the countdown. (NASA)

Ready for launch ice is visible on the surface of the Soyuz booster. The retracted access arm on the left can be moved back into place quickly should the crew need to evacuate. (NASA)

THE R-7 SEMYORKA FAMILY

Created in the chill of the Cold War between east and west, the R-7 was the world's first intercontinental ballistic missile (ICBM), with a mission to deliver nuclear warheads to the far side of the world. The R-7 was designed by OKB-1 (Experimental Design Bureau-1), the Soviet design group led by Chief Designer Sergei Korolev and tasked with developing ballistic missile technology in the years following World War II. Similar to postwar efforts in the west, the Bureau's initial work centered on understanding and exploiting captured German rocket technology, quickly resulting in homegrown Soviet versions of the V-2 ballistic missile. Strategic military demands quickly refocused the efforts of Korolev and his team onto larger missiles capable of longer range and greater payload.

The result of this effort was the R-7 intercontinental ballistic missile, first flown successfully at a remote site in Kazakhstan on August 21, 1957. Throughout the development of the R-7, the designers quietly recognized the potential of the new missile as a satellite booster. Plans for a simple orbital satellite were quickly drafted, and on October 4, 1957, Sputnik 1 was launched from the Kazakh test site (known today as the Baikonur Cosmodrome) becoming the first artificial object in history to orbit the Earth.

Chief Designer Sergei Korolev was the mastermind behind the R-7 missile, Sputnik, Vostok, and the early development of the Soyuz booster and spacecraft.

The social, political, and cultural impact of Sputnik 1 was both immense and immediate. The satellite was capable of transmitting no more than a monotonous beeping radio tone, but the success of the simple metal sphere brought to question the technological superiority of the United States. Perceptions of the Soviet Union as a science and engineering backwater were erased overnight, and a rapid succession of increasingly larger and more complex satellites were launched from the Cosmodrome over the next few years. The "space race" between the United States and the Soviet Union was underway, with the Soviets clearly in the lead.

Once the Soyuz booster and spacecraft have been fully integrated it is slowly moved from the assembly hall to the launch pad by rail. The special rail car on which the rocket is mounted is designed to provide power, cooling, and fluid support to the booster during the short journey. (NASA)

Despite the success of their embryonic space program, Soviet leaders quickly recognized that the R-7 was far from an ideal ICBM as it could only be launched from a limited number of dedicated sites. Preparing the missile for flight took far too long, limiting both the tactical flexibility and the strategic threat of a Soviet response. Despite these shortcomings the utility of the R-7 as a satellite booster was startlingly clear, and plans to construct a wide range of variants for orbital use were quickly formulated.

The rail trip from the assembly hall to the launch pad is only 2 kilometers in length, but takes almost two hours to complete.

These R-7 variants were used to loft biological payloads, conduct geophysical research, photograph the surface of the Earth, and even journey to Mars and Venus. In 1959, one of the early satellites launched by the R-7, dubbed Luna 3, circled the Moon and returned the first photos of the far side of the lunar surface. The R-7 was produced and flown in such quantity and such a wide range of variants that it was informally referred to within the Soviet military and space communities as semyorka, roughly translated as “old number seven.”

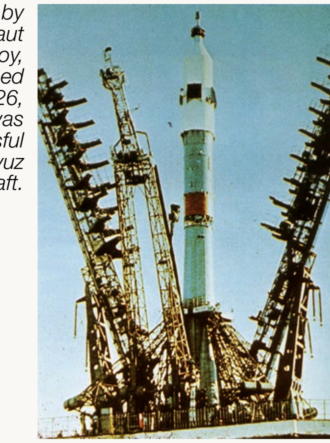
The pace of these early R-7 variant flights came to a crescendo on April 12, 1961, with the flight of Vostok 1, the first human space flight. A 27-year-old Soviet Air Force pilot, Yuri Gagarin, became the first human to orbit the Earth, completing a single rotation of the planet before parachuting back to the surface. The R-7 launched a total of six crewed Vostok missions between 1961 and 1963, including the first orbital rendezvous between two spacecraft (Vostok 3 and 4), as well as the first space flight by a woman, Valentina Tereshkova (Vostok 6).

Later R-7 variants included Voskhod, a Vostok spacecraft extensively modified to support a three person crew. In March 1965, Voskhod 2 featured the first ever spacewalk when Soviet cosmonaut Alexei Leonov left the spacecraft for a brief 12-minute sojourn in the vacuum of space.

Throughout the early 1960s the expansion of R-7 variants became unwieldy for Soviet space program administrators to manage, so a decision was made to standardize the booster components and systems, making production more efficient and operation simpler. The name given to this unified booster configuration was Soyuz, or “Union”.

The integrated escape tower, spacecraft faring, and second stage of Soyuz TMA-8 are carefully positioned for mating with the lower portion of the booster at the Baikonur Cosmodrome. (NASA)

Commanded by Soviet cosmonaut Georgy Beregovoy, Soyuz 3 launched on September 26, 1968, and was the first successful flight of the Soyuz spacecraft.



THE SOYUZ BOOSTER

First flown in 1966, the Soyuz booster is the most frequently used space booster in history, and is still in active use today. Designed primarily to support the Soyuz spacecraft with which it shares a name, early flights of the new unified R-7 variant launched uncrewed test flights in the program. The first crewed launch in the Soyuz program took place on April 23, 1967. Following a successful launch and 18 orbits, cosmonaut Vladimir Komarov experienced a number of technical issues with the new spacecraft, including power generation problems, communications systems gaps, and a complete failure of the stabilization system. Following a fiery reentry the craft suffered from a parachute deployment failure, and Komarov died upon impact. He was the first person to die during a space mission.

Following the tragedy of Soyuz 1, the spacecraft was extensively modified, and on October 26, 1968, cosmonaut George Bergovoy launched on board Soyuz 3. After completing 81 orbits of the Earth over the next four days Soyuz 3 landed safely in Kazakhstan in blizzard conditions. Intriguingly, following the launch of Soyuz 3 Soviet authorities released a photograph of the liftoff, the first official release of a photograph of any R-7 booster variant.

The launch of Soyuz 3 inaugurated a series of crewed launches that continue to this day, including frequent ferry missions to the International Space Station. Soyuz boosters have flown over 2,000 missions in the past six decades with high reliability, making the series the most flown orbital class booster in history.

The Soyuz vehicle is transported to the launch pad with the rocket motors leading the way. A wide range of protective covers can be seen in this view, most of which will be removed prior to launch. (NASA)

Before launch, the crew enters the upper orbital module of the Soyuz spacecraft via this entry door located on the aerodynamic fairing, then move downward to their launch couches in the descent module below. (NASA)

SOYUZ BOOSTER DESIGN

The Soyuz booster can be described as either a three stage rocket or a “two-and-a-half-stage” rocket. A central core (designated Block A) is surrounded by four strap on boosters (known as Blocks B, V, G, and D), giving the vehicle its iconic profile.

At launch the central core and all four strap on boosters are ignited simultaneously. Just before two minutes into the flight the escape tower atop the Soyuz spacecraft fairing is jettisoned, and seconds later straps holding the four strap on boosters in place are severed just as they expend their propellants. The last bit of residual thrust from the boosters angles each slightly away from the central core, followed by the opening of valves that vent remaining pressure from the liquid oxygen tanks on each unit. This choreographed dance allows them to separate cleanly from the central core in a dramatic and graceful motion known as the “Korolev Cross.”

The spent side boosters fall away from the central core of the Soyuz booster in a distinctive pattern called the “Korolev Cross.” (ESA)

The core and strap on boosters of Soyuz TMA-8 begin generating thrust prior to launch. (NASA)

The central core has larger propellant tanks than the strap on boosters, permitting that element to continue operating. Approximately 157 seconds into the flight small solid propellant rockets within the spacecraft fairing separate it into two halves, exposing the Soyuz spacecraft housed within. At ~285 seconds post-launch the second stage (Block I) comes to life, just before the central core begins to shut down. The sequencing here is critical, as the propellants must remain seated in the base of their tanks during the startup phase. The open lattice interstage truss connecting the central core to the second stage plays a role in this sequence, allowing second stage ignition to take place while the two units are still connected. An instant after the second stage begins producing thrust explosive bolts at the forward end of the interstage truss fire, freeing the second stage from the central core.

Boosted by the second stage the Soyuz spacecraft continues the journey into orbit. The stage burns until approximately 815 seconds after liftoff, at which point the Soyuz spacecraft separates from the spent stage. Retrograde thrusters on the second stage fire to initiate a deorbit, and the job of the booster is complete. The spacecraft is now free to begin the orbital phase of the mission.

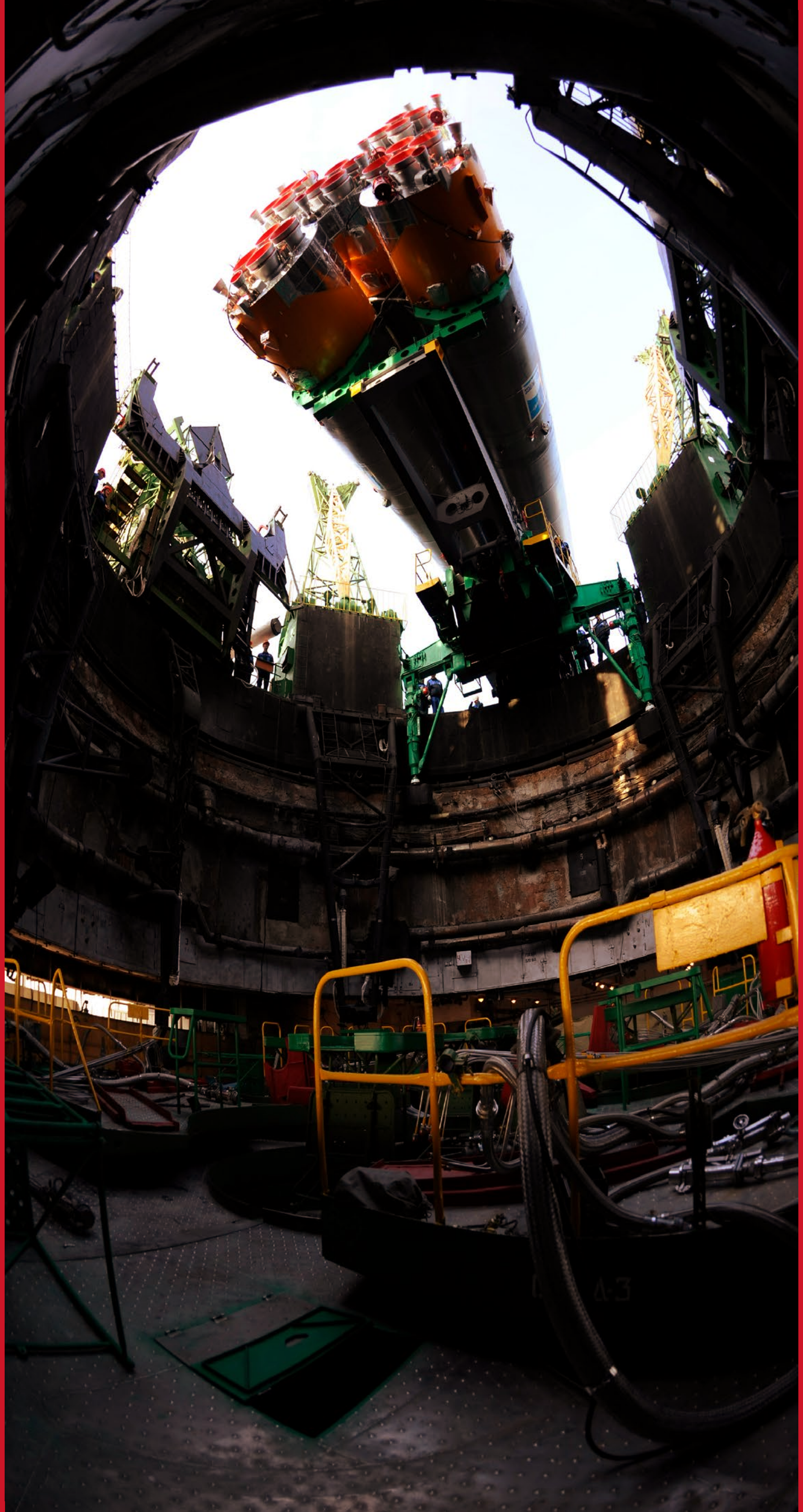
The distinctive open interstage truss on the Soyuz booster allows for “hot staging,” or igniting the second stage rocket motor while still attached to the lower assembly. This insures that propellants in the second stage are firmly positioned in the aft portion of the tanks, preventing cavitation of the turbo pumps designed to deliver propellants to the combustion chamber. (NASA)

SOYUZ ROCKET ENGINES

In the years following World War II rocketry scientists, engineers, and technicians in both the U.S. and the Soviet Union drew significantly from the groundbreaking research done in Germany during the conflict, often guided by the same German engineers who originally developed those technologies. The heritage of the V-2 and the engine that powered it was reflected in the design of hardware produced in both countries, and echoes of that technology can still be found in modern aerospace hardware.

The RD-107 rocket engine was developed under the leadership of Valentin Glushko at OKB (Experimental Design Bureau) 456, and drew heavily on lessons learned from the rocket engine at the heart of the V-2 missile. As Soviet rocket engines grew beyond the size of their German ancestors, they began to suffer from a catastrophic condition known as combustion instability, an unpredictable and dangerous oscillation within the combustion chamber of the unit, capable of destroying the engine, the booster, and the payload.

In meeting the challenge posed by combustion instability Glushko and his team decided to abandon their pursuit of larger combustion chambers, opting instead to equip their new rocket engine with four individual, smaller combustion chambers. The same amount of thrust would be produced as a single larger chamber, but the instability demon would be tamed. To simplify the design all four chambers would be fed propellants from a single set of turbines. Guidance would be derived from two additional vernier nozzles added to the RD-107 cluster, capable of swiveling in a single axis.



The aft end of the Soyuz booster is positioned over the launch pad prior to being moved to a vertical position. Once the rocket is in place the work surface will be removed, exposing the flame trench below.

This baseline design was extended to the very similar RD-108 engine, featuring four vernier nozzles. As the R-7 booster design emerged, the four strap on boosters were each equipped with a single RD-107 engine, while the RD-108 engine was mounted in the central core. As more advanced R-7 derived booster designs emerged in later years, versions of the RD-108 optimized for performance in the vacuum of space were installed in the upper stage.

While the basic design of the RD-107 and RD-108 has been enhanced over time to improve performance, efficiency, and reliability, and even extended to include variants optimized for different propellants, the fundamental blueprint of the engine family has endured. The original design for the rocket engines developed for the R-7 in the 1950s are essentially the same as that found in the Soyuz boosters of today. Over the past six decades almost ten thousand RD-107/108 family engines have been produced and flown, more than any other liquid propellant rocket engine in history.[1]

[1] By contrast, the most produced solid propellant rocket engines in the world are those manufactured by Estes Industries, with over 500 million successful units to date.

THE SOYUZ SPACECRAFT

The Soyuz booster is designed for a wide range of tasks, but none garners more attention than as an orbital launcher for the crewed spacecraft with which it shares a name. Over 140 of the single use Soyuz spacecraft have been built and flown over the past six decades, carrying over 290 humans into orbit. Continuous improvements over six design generations have expanded the capabilities of the Soyuz, and today the spacecraft's primary mission is to ferry crews to and from the International Space Station. This current version of the Soyuz spacecraft is able to loiter in space docked with the Station for over a year, allowing crew members to spend extended periods living and working in orbit. Following the retirement of NASA's Space Shuttle in 2011, a Soyuz spacecraft was the only path to orbit for ISS crew members until the advent of the SpaceX Crew Dragon in 2020.

In the integration hall at the Baikonur Cosmodrome technicians inspect the separation plane between the escape tower and the spacecraft fairing.

The escape tower, Soyuz spacecraft, and second stage are ready for integration with the lower portion of the TMA-8 booster vehicle. (NASA)

The Soyuz spacecraft consists of three main components. At the forward end is a pressurized orbital module, allowing crew members room to live and work while on orbit. Aft of that is the pressurized descent module, which houses the crew during launch and reentry operations and is the only element designed to return to Earth intact. At the rear of the spacecraft is the unpressurized service module, which provides power, propulsion, and consumables for the vehicle during flight.

At launch the entire spacecraft is housed atop the Soyuz booster within an aerodynamic fairing, topped with a solid propellant-powered escape tower designed to pull the spacecraft free of the booster in the event of an emergency during the early launch sequence. Four deployable grid fins are arrayed on the outside of the fairing, tasked with providing stability in the event of an escape tower activation. Approximately two minutes after launch the escape tower is jettisoned and seconds later the fairing separates and falls away.

Vital for crew safety, the escape tower mast is attached to the aerodynamic spacecraft fairing of Soyuz TMA-8. (NASA)

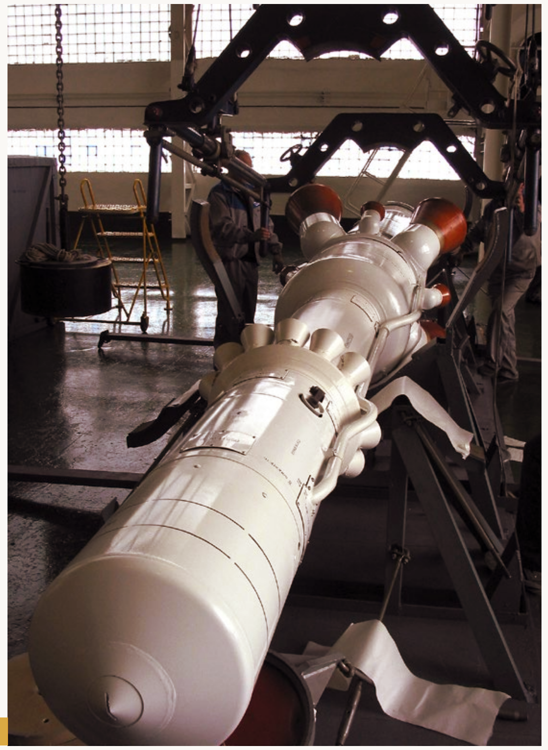
In the vehicle integration hall at the Baikonur Cosmodrome a crane moves the escape tower into place for mounting onto the spacecraft fairing. (NASA)

Once on orbit two solar panels are unfurled from the service module, and the spacecraft begins orbital operations. In the case of a mission to the ISS, time to rendezvous is typically about two days, dependent on differences between the orbital planes of the Soyuz and the station. As the ISS is approached a docking mechanism at the forward end of the orbital module engages with the docking port on the ISS New crew and cargo are moved onto the station, while old crew and trash can be transferred onto the spacecraft for a trip back to Earth.

When the time comes to return the crew straps into the descent module, detaches from the ISS, and establishes an attitude with the service module forward in the direction of flight. At a point roughly half an orbit from the touchdown target a retrorocket located in the base of the service module ignites. This slows the spacecraft, starting the trip back to the Earth's surface. The orbital and service modules are released, exposing the heat shield on the aft surface of the descent module. As the heat shield begins to contact the upper reaches of Earth's atmosphere a rapid deceleration begins, and the heat shield begins to glow red hot from friction, shedding ablative layers to protect the module and crew within a protective cocoon of plasma. Nearing the touchdown zone a drogue parachute is released at ~10 km above the surface, stabilizing the descent. At about 8 km the main parachute begins deploying. Once the parachute is fully inflated the heat shield is jettisoned, exposing a suite of six solid propellant retrorockets designed to cushion the final contact with the ground. These retrorockets fire when the descent module reaches a scant 8 meters above the surface raising a cloud of dust as the capsule touches down, bringing the mission to a close. Recovery teams then converge on the site to secure the spacecraft and crew.

A simplified cargo variant of the Soyuz spacecraft called Progress is used for supply runs to the ISS. This spacecraft lacks the life support systems, heat shield, and recovery systems of the crewed version, making it less expensive to produce while increasing cargo capacity. Progress is also equipped to transfer fuel and water to the space station. Once cargo and consumables are offloaded from Progress the vehicle can be loaded with trash and deorbited, burning up in the atmosphere upon reentry.

The escape tower is prepared for installation atop the Soyuz TMA-8 spacecraft. (NASA)



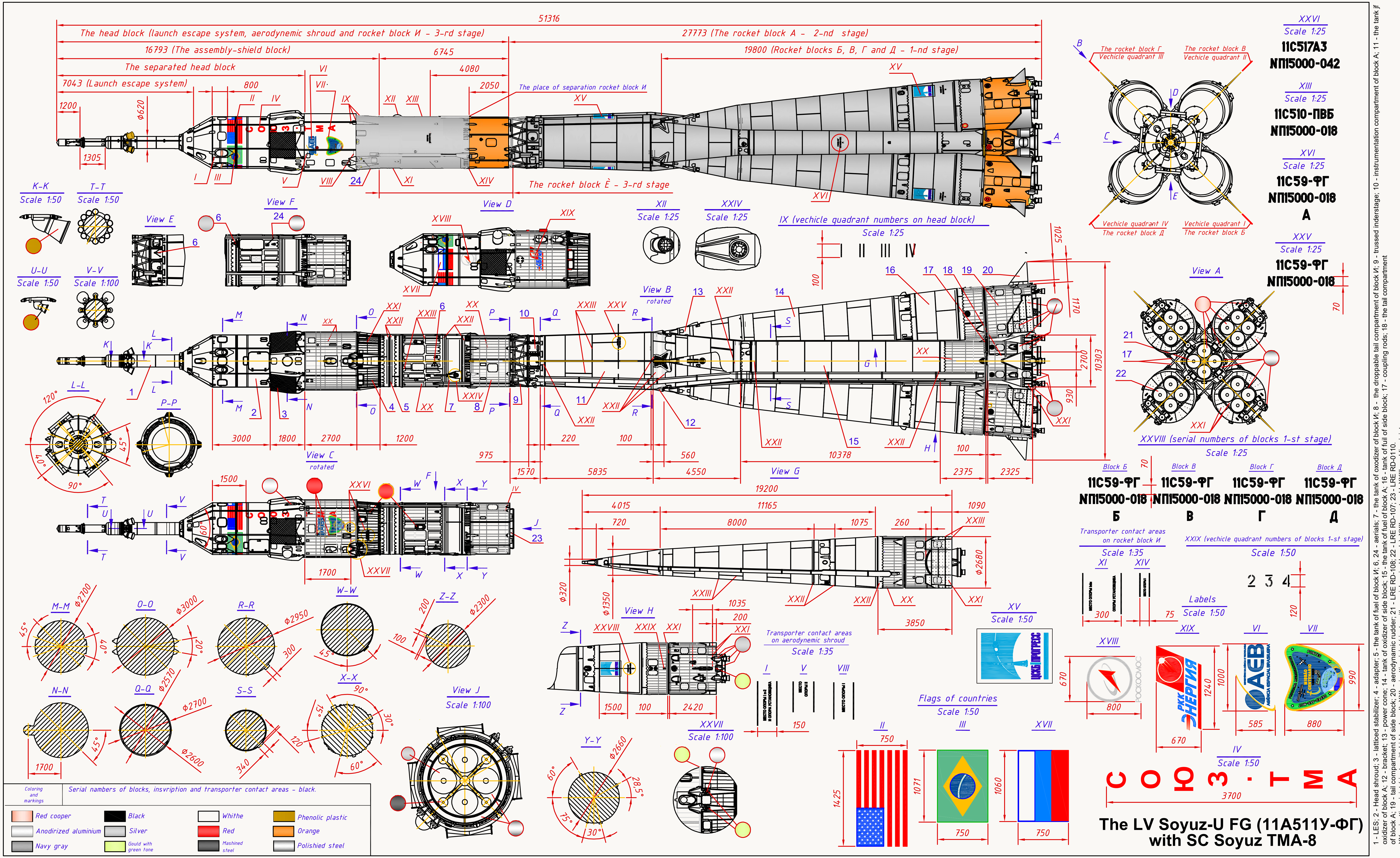
Three crewed Soyuz missions have experienced system failures that resulted in the initiation of abort modes. In April 1975, the upper stage of the booster propelling Soyuz T-18-1 toward a rendezvous with a Salyut space station failed during startup, triggering an automatic abort sequence. As the escape tower and spacecraft fairing had already been ejected an emergency separation of the spacecraft was commanded, and the Soyuz continued along a ballistic trajectory. The crew was initially concerned that they might land in China, making a safe and successful recovery fraught with political overtones, but the descent module landed in the Soviet Union at a point 145 km from the Sino-Soviet border. Intriguingly, while unsuccessful, the flight of Soyuz-18-1 is recognized as an official space flight as it achieved a maximum altitude of 192 km, well beyond the Karman line at 100 km.

The escape tower system has been called into service once, during the 1983 launch of Soyuz T-10-1, when it saved the crew of two on board after a strap on booster caught fire 90 seconds before the scheduled liftoff. The automated abort system swiftly pulled the spacecraft away from the stricken booster as fire engulfed the launch pad. Although badly bruised by their brief flight, the crew were quickly rescued at the landing site 4 km away.

The most recent failed Soyuz flight occurred in October 2018, during the launch of Soyuz MS-10. A strap on booster did not separate cleanly and collided with the central core, triggering an abort mode. The spacecraft separated from the failing booster and continued on a ballistic trajectory, falling short of the Karman line with an apogee of 93 km. The crew was recovered safely at a landing site 400 km downrange from the launch pad.

The configuration of the escape tower is one of the most obvious indications of which generation of Soyuz spacecraft is contained within the fairing. In general, shorter escape towers are indicative of earlier models, and more current variants feature longer escape tower masts.

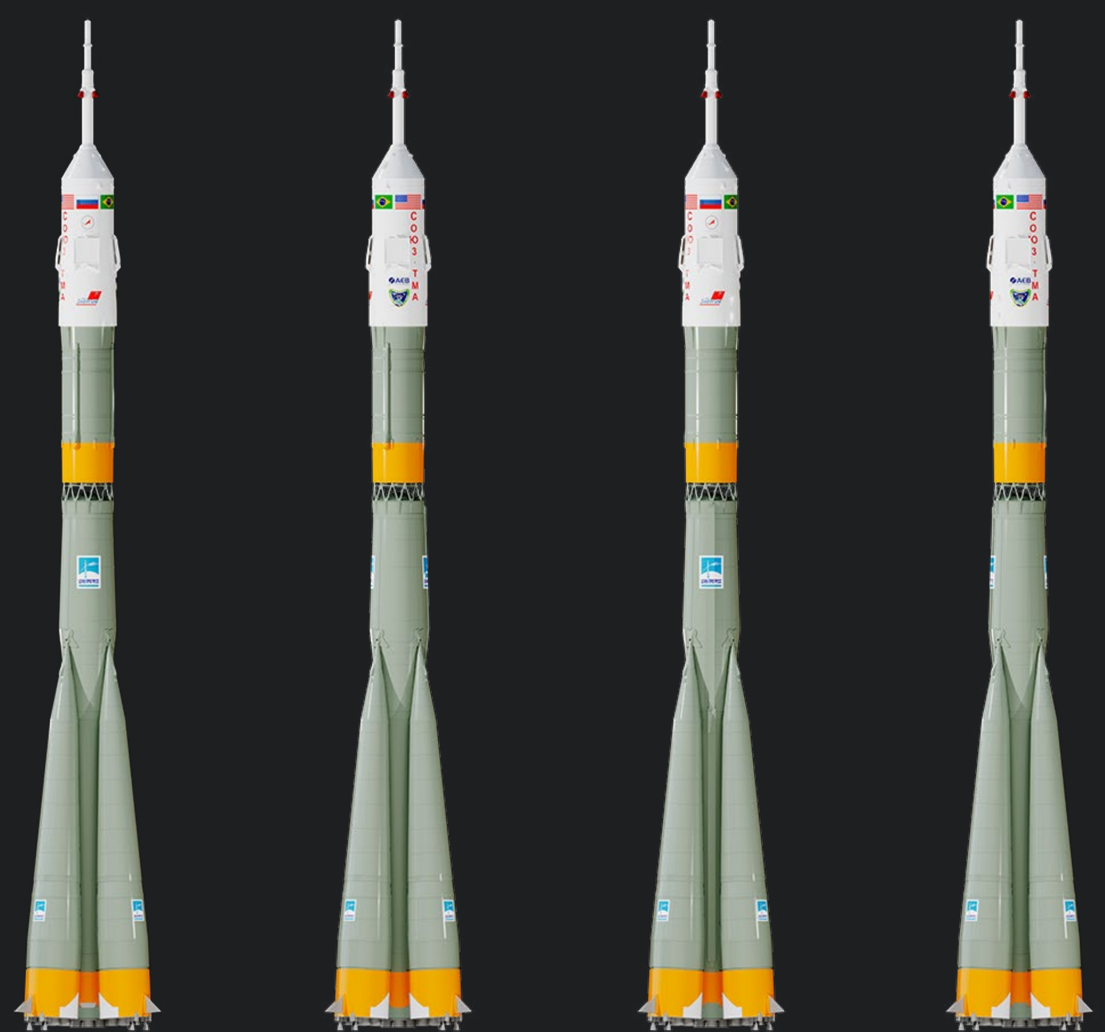
The distinctive multiple nozzles of the RD-107 and RD-108 rocket engines are visible as the Soyuz TMA-8 spacecraft and booster are moved by rail to the launch pad. (NASA)



51316
The head block (launch escape system, aerodynamic shroud and rocket block И - 3-rd stage)
27773 (The rocket block A - 2-nd stage)
16793 (The assembly-shield block)
19800 (Rocket blocks Б, В, Г and Д - 1-nd stage)
The separated head block
7043 (Launch escape system)
The place of separation rocket block И
The rocket block È - 3-rd stage
The rocket block Г Vechicle quadrant III
The rocket block В Vechicle quadrant II
Vechicle quadrant IV The rocket block Д
Vechicle quadrant I The rocket block Б
XXVI Scale 1:25
11С517А3 НП15000-042
XIII Scale 1:25
11С510-ПВБ НП15000-018
XVI Scale 1:25
11С59-ФГ НП15000-018 А
XXV Scale 1:25
11С59-ФГ НП15000-018
K-K Scale 1:50
T-T Scale 1:50
U-U Scale 1:50
V-V Scale 1:100
View E
View F
View D
XII Scale 1:25
XXIV Scale 1:25
IX (vechicle quadrant numbers on head block)
Scale 1:25
View B rotated
View A
XXVIII (serial numbers of blocks 1-st stage)
Scale 1:25
View C rotated
View G
Block Б 11С59-ФГ НП15000-018 Б
Block В 11С59-ФГ НП15000-018 В
Block Г 11С59-ФГ НП15000-018 Г
Block Д 11С59-ФГ НП15000-018 Д
Transporter contact areas on rocket block И
Scale 1:35
XXIX (vechicle quadrant numbers of blocks 1-st stage)
Scale 1:50
Labels Scale 1:50
View H
Transporter contact areas on aerodynamic shroud
Scale 1:35
XV Scale 1:50
View J Scale 1:100
XXVII Scale 1:100
Flags of countries Scale 1:50
IV Scale 1:50
СОЮЗ-ТМА
Coloring and markings
Serial numbers of blocks, insvription and transporter contact areas - black.
Red cooper
Black
Whithe
Phenolic plastic
Anodirized aluminium
Silver
Red
Orange
Navy gray
Gould with green tone
Mashined steel
Polished steel
The LV Soyuz-U FG (11А511У-ФГ) with SC Soyuz TMA-8
Drawning by V.Minakov © 2008 - Scale 1:175
1 - LES; 2 - Head shroud; 3 - latticed stabilizer; 4 - adapter; 5 - the tank of fuel of block И; 6, 24 - aerials; 7 - the tank of oxodizer of block И; 8 - the droppable tail compartment of block И; 9 - trussed inderstage; 10 - instrumentation compartment of block A; 11 - the tank of oxidizer of block A; 12 - bracket; 13 - power cone; 14 - tank of oxidizer of side block; 15 - the tank of fuel of block A; 16 - tank of full of side block; 17 - coupling rods; 18 - the tail compartment of block A; 19 - tail compartment of side block; 20 - aerodynamic rudder; 21 - LRE RD-107; 22 - LRE RD-108; 23 - LRE RD-0110.
XX - rivetting joint (rivets with hidden head); XXI - riveting joint (rivets with semishperical heads); XXII - spot weld; XXIII - velding joint.

BUILDING THE ESTES 1/48 SCALE SOYUZ

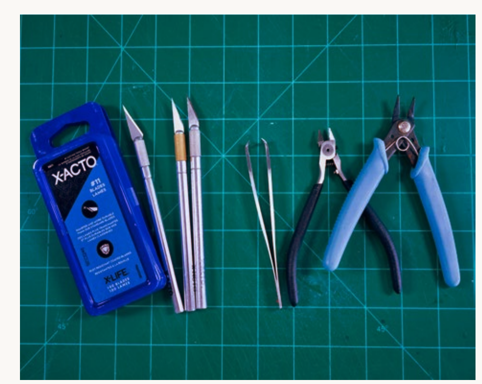
The Estes Soyuz kit in 1/48 scale comes with a comprehensive set of instructions to guide assembly and finishing. In constructing our prototype models we came across a few tips and tricks that builders may find helpful as they construct their examples of the Soyuz. These techniques should not be considered an alternative to the kit instructions, but rather an expansion. In some cases, the guidance that follows may even appear to contradict the kit instructions, but that is not the goal. Rather, the intent here is to share techniques and ideas that builders can use to improve their model while expanding their repertoire of modeling techniques. In short, take your time, check your measurements twice, test fit everything before using glue, use common sense, and have fun. You'll end up with a magnificent model!



Estes Tapered Sander

Estes Ultimate Tube Marking Guide

Razor saws



Knife blades and sprue cutters

Pin vise and drill bits

TOOLS

Standard hobby tools are more than adequate to build the Soyuz, and if you've constructed a few models (flying or not) you probably already have everything you need on hand. One non-negotiable tool you'll want to have nearby is a fine tooth razor saw, which is ideal to saw through cut lines on several of the blow molded components. Any brand is acceptable, and we've used varieties from X-acto, Zona, and Tamiya.

We're sticklers for fresh hobby blades, especially the straight pointed #11 variety. Go ahead and purchase a bulk pack - we grab boxes of 100 from our local hobby shop. Everyone is familiar with the adage that a dull blade is more dangerous than a sharp one. Dull blades can damage not only your thumb, but also the very nice model that you have on your workbench, so change blades frequently. A small cutting mat will help keep your workbench undamaged.

Static scale modelers always have a quality sprue cutter handy to cleanly separate injection molded parts from the sprues to which they are attached. A dedicated tool is available through hobby retailers for $10-12 (or a LOT more, if you get a fancy pair), but a simple side cutter works well, too. In a pinch, a pair of clean new toenail clippers will even do the job.

You'll also want to have some old favorites on hand:

- a sharp pencil (we use a mechanical pencil so the point is consistent in width and always ready)
- scissors (a standard pair for general use, plus a small pair for cutting decals)
- sandpaper and sanding sticks, along with a sanding block or two (we have everything from 80 grit to 2000 grit)
- the Estes tapered sander (new!) and Ultimate Tube Marking Guide (a classic!)
- an assortment of jeweler's files
- masking and clear tape
- a pin vise with an assortment of tiny drill bits

We also found a fine point Sharpie pen handy for this project to highlight cut lines on the blow molded components. Other unusual things we used were popsicle sticks and cotton swabs for spreading adhesives. If you have a Dremel tool, great! You can use it with the little sanding drum to thin the interior wall of the upper central core. If not, there is no need to run out to buy one.

ADHESIVES

Glues, so many glues! Chances are that you have most or all of these on hand already. When we built our Soyuz we used the following adhesives:

- Carpenter's yellow wood glue (Titebond II is great)
- Cyanoacrylate (CA) adhesives, both thin and medium viscosity, plus liquid accelerator (Zap or Bob Smith brands are both outstanding)
- Five minute epoxy (West Systems, Zap, and Bob Smith are all great)
- Liquid model cement (Tamiya Extra Thin is our preference, and we use a fine paint brush for application)
- Tube type model cement (The classic orange Testors tube is our pick, to be used in specific areas where the liquid variety would evaporate too quickly)

While we're on the subject, let's touch on cyanoacrylate (CA) glues. These are great for assembling certain tiny bits, but frankly they don't offer much strength. We also have a hard and fast rule outlawing their use on parts that have already been painted. While CA adhesives are marketed as "instant glues" the reality is that they can take as long as a day to completely cure, during which the adhesive releases a foul vapor which can leave a nasty haze on painted surfaces. Your only fix after such a disaster will be to sand and repaint the surface. So, CA glues should only be used before the paint goes on your model!

WASH THE PLASTIC PARTS

There are a significant number of plastic parts included in the new Soyuz kit, and all of them have been through a number of industrial operations on their way from the manufacturing plant to your workbench. Along this journey, they have encountered mold release, oily lubricants, and even finger grease during packaging operations. All of that accumulation on the parts can make it difficult for adhesives and paints to adhere securely, so we'll want to give all of the plastic elements a quick bath before assembly begins. It's not difficult or time consuming, just fill up the kitchen sink with lukewarm, soapy water (liquid dishwashing soap is fine) and swish the injection molded sprues and blow molded parts around a bit. Rinse them off with clean water and let them air dry thoroughly before moving forward. It's also a good idea to let the 3D printed resin interstage truss enjoy bath time, too.

PRIMERS AND PAINTS

Before any assembly takes place or any paint goes onto the surface of our model, prime the lower 9 5/8" (245mm) of the central core tube with several coats of Rustoleum Automotive Filler Primer (#249279), then sand with 220, 320, and 400 grit sandpaper until the spiral seams in the tube are filled and invisible. A couple of priming and sanding cycles are ideal to adequately fill the spirals.

Before applying any color coats, it is wise to apply a couple of light coats of Tamiya White Primer to everything. This primer differs from the Rustoleum filler primer, which is a high solids primer used to fill the spirals in the paper core tube. The Rustoleum primer will obscure the fine detail on our plastic parts, so instead we use the low solids Tamiya White Primer on everything else. After the Tamiya primer cures for a few hours lightly sand everything with 800 grit sandpaper. You'll be polishing more than sanding, actually, and it will leave the surface of your model in great shape for the color coats. We are big fans of Tamiya products, and use their spray primer, spray lacquers, and airbrushed acrylics almost exclusively.

PAINT COLOR SELECTION

Here's a question we need to tackle before construction and painting begin. What color is a Soyuz booster, exactly? The answer: no one knows.

The question of the appropriate color to paint a Soyuz booster has been debated by model builders for decades. Heck, we've stood in the hall at the Baikonur Cosmodrome where Soyuz boosters are integrated and had this discussion with actual hardware a few meters away! Unlike western military and aerospace organizations, Soviet and Russian authorities do not publish paint codes, color chips, Pantone colors, CMYK or RGB values, or any other information that might guide our coloration quest.

Poll 100 knowledgeable experts on the Soyuz booster for their opinion on the primary paint color and you'll get 30 people suggesting a green color, 30 more insisting that the color is grey, 39 calling it greenish grey or grayish green, and one colorblind weirdo insisting on mauve. We're on our own, so it's time for an educated guess, a shot in the dark, or a leap of faith.

PAINT COLOR SELECTION

After running a series of paint tests, we landed on a custom airbrushed greenish grey acrylic color mixed from two parts Tamiya XF-82 RAF Ocean Grey 2 plus one part of XF-62 Olive Drab. This approach will require an airbrush and the skills to use it, so you may want to consider the following options if you prefer the simplicity of a spray can:

- Tamiya AS-10 Ocean Grey (RAF) spray lacquer for a grayish option
- Tamiya TS-5 Olive Drab spray lacquer for a greenish option

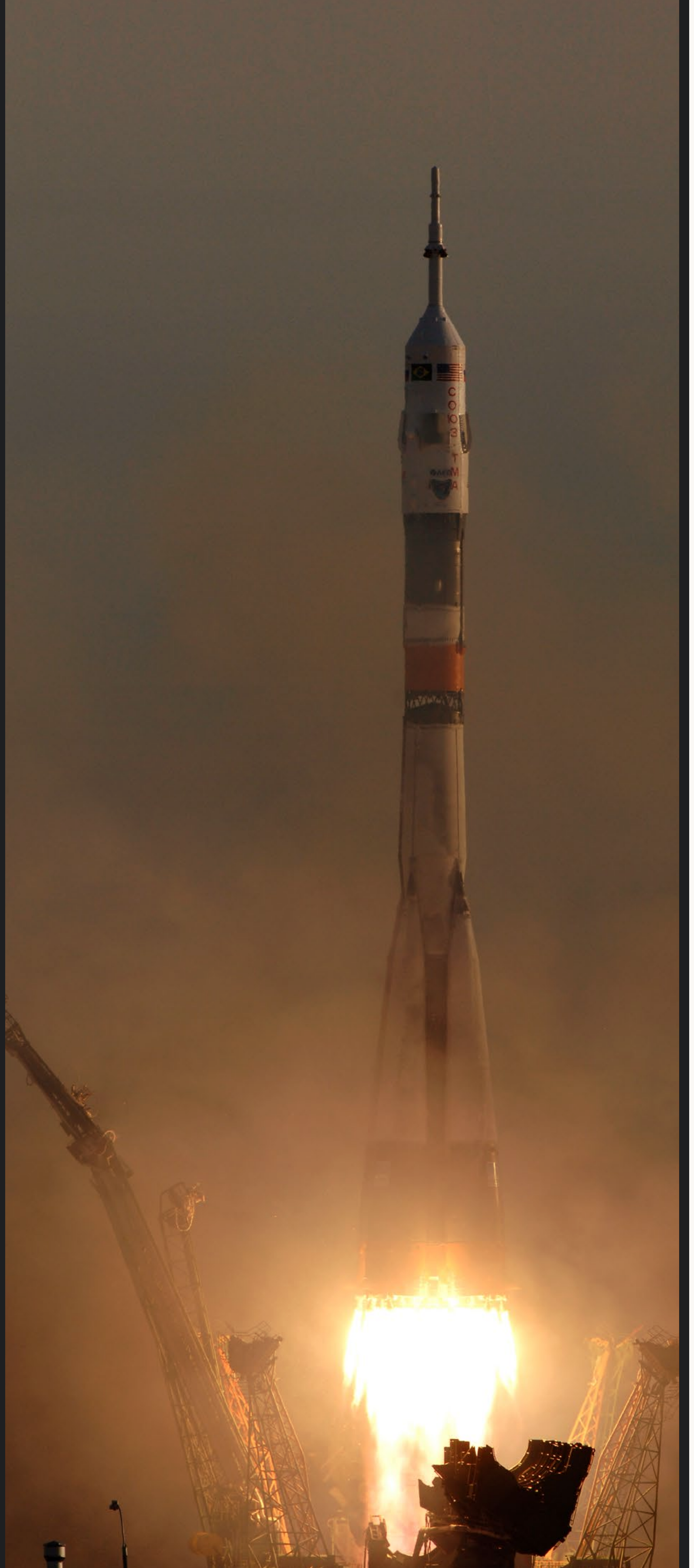
Another option suggested by John Boren, the designer of the Estes Soyuz kit, is to use Tamiya AS-29 Grey Green spray lacquer. Estes board member John Langford opted for AS-3 Grey Green (Luftwaffe), a choice also used on our second prototype model with great success. The bottom line here is that the Soyuz primary color is open to debate. The choice is yours, and regardless what decision you make you'll have the research and a story to back it up.

Here's a list of the rest of the Tamiya spray lacquer colors we used while building our prototype models:

- TS-7 Racing White (used for a warmer, contrasting shade on the grid fins)
- TS-12 Orange
- TS-15 Black (used on the motor retainer)
- TS-17 Gloss Aluminum
- TS-26 Pure White

On the development models the interior surfaces of the rocket nozzles were brush painted with classic Testors Red enamel paint, applied with tiny 3/0 and 10/0 paint brushes. The nozzles on the escape tower nozzles were airbrushed with a custom color based on Tamiya XF-69 Desert Yellow acrylic warmed up with a few drops of X-7 Red. If you choose some other earthy color to simulate the phenolic finish of the escape tower nozzles we won't rat you out.

Many photographs of Soyuz boosters on the pad and in the early stages of flight show evidence of white coloration. Surprisingly, that white shade is not paint, but ice. When the Soyuz oxidizer tanks are filled with liquid oxygen in preparation for launch, moisture begins to condense and freeze on the external surface of the rocket creating the illusion of a white surface. Simulating that would be an intriguing approach for a really creative interpretation of the model, but it is not an avenue that we have explored. If you go down that path, be sure to share your techniques and results with us.



IN WHAT ORDER SHOULD THE PAINT BE APPLIED?

The Soyuz is not a difficult model to paint, but the order in which the colors are applied makes a difference. Here's the sequence that worked well for us:

1. Spray the white areas and assemblies with Tamiya TS-26 Pure White spray lacquer. This includes the assembled escape tower and the spacecraft fairing portion of the forward upper stage element. The grid fins were sprayed with TS-7 Racing White spray lacquer separately.
2. Spray the orange elements with Tamiya TS-16 Orange spray lacquer. This includes the aft end of the strap on boosters, the lower central core thrust structure, the second stage thrust structure (called the "upper truss support" in the kit instructions), and the aft end of the blow molded upper stage element.
3. Mask and spray the metallic areas with Tamiya TS-17 Gloss Aluminum spray lacquer. This includes areas on the thrust structures of the strap on boosters, the central core thrust structure, and the aft bulkhead of the second stage thrust structure.
4. Mask and spray the green/grey areas with your selected color, either with a spray can or airbrush.
5. Paint small details such as the fins and rocket nozzles.

Once supercooled liquid oxygen is loaded into the oxidizer tanks on the Soyuz booster, moisture begins condensing on the outside surface of the tanks and freezing, creating a layer of ice. (NASA)

MORE THAN ONE WAY TO SKIN A CAT, ER, SOYUZ

Another of the early Soyuz kit prototypes was crafted by Estes board member John Langford, who offered some additional tips. John also opted for Tamiya spray lacquer paints, but chose AS-3 Grey Green (Luftwaffe) as the primary shade for his model. In addition, he took the “paint before you assemble” concept one step further when preparing the strap on boosters. By assembling and painting the aft bulkheads of the boosters separately, this simplified the masking procedures and even made the booster easier to handle during the paint process. Only once the booster airframe and aft bulkhead assemblies were completely painted was the bulkhead assembly glued into place.

Rather than paint, John used vintage silver metallic mylar from his stash to simulate the natural metal portions of the thrust structures. While the manufacturer of that mylar ceased operations decades ago, similar adhesive foil can be sourced today from the very predictably named firm Bare Metal Foil, who offer a variety of shades.

One other significant variation he discovered was to paint the orange shade at the aft end of each booster over the grey/green color, offering that this approach resulted in a slightly flatter, more realistic appearance for the orange. The bottom line is that model building is as much an art as science, and your creativity can help lift your model to the next level. The instructions included with any kit are a tool to help guide your project, but intelligent deviations from them can be entirely acceptable if your experience and intuition can help you uncover new approaches.

In the event that the escape tower is activated, the grid fins on the sides of the spacecraft fairing will quickly swing down into position, providing passive stability during boost. (NASA)

MASKING

Surprisingly, your choice of masking tape will help elevate your model to museum grade. We strongly recommend the use of Tamiya masking tape whenever tape is applied directly to the surface of the model, especially painted areas! Tamiya masking tape is available in 6mm, 10mm, and 18mm widths from your hobby retailer.

We also make extensive use of what we call “overspray masks,” which are simply sheets of plastic cut from used disposable grocery bags. We attach these to the Tamiya tape with inexpensive utility masking tape to protect the model from overspray while painting, both when using spray cans or the airbrush.

PAINT BEFORE ASSEMBLY WHENEVER POSSIBLE!

If there is any one idea you take away from this list of suggestions, please let it be this tip. Whenever possible, paint assemblies before bringing them together! Note that the kit instructions direct the builder to complete painting of the Soyuz before the strap on boosters are attached to the central core. It would be virtually impossible to mask and paint the orange and silver areas at the bottom of the boosters and core if they were integrated with each other first, and painting the lower half of the model as an integrated unit would be result in a sloppy mess.

Additionally the aft end of the second stage thrust structure would be impossible to paint if it were integrated with the interstage truss and central core first. If you elect to paint the grid fins in the contrasting Racing White color, it is far easier to do so before those parts are glued to the outside of the spacecraft fairing, and similarly the escape tower nozzles will be simpler and cleaner to paint before mounting them on the escape tower mast.

A climate control system located on the rail car provides conditioned air to the interior of the spacecraft fairing via large conduits. (NASA)

DECAL APPLICATION

Your Soyuz kit comes with a beautiful set of silk screened water transfer decals featuring the markings for a specific orbital mission, Soyuz TMA-8. This mission launched to the International Space Station on March 30, 2006, and carried a crew of three: a Russian commander, a U.S. astronaut, and the very first Brazilian astronaut, which explains the three flags found on the decal sheet. There are also markings for the Russian space agency (Roscosmos), the spacecraft manufacturer (Energia), and the Soyuz booster manufacturer (Progress). The logo of the Brazilian space agency (Agência Espacial Brasileira in Portuguese) and the mission patch artwork also appear, as does a vertical mission designation marking.

It is best to apply water transfer decals to a glossy paint surface. If you used the suggested Tamiya Pure White spray lacquer on the spacecraft fairing, that is an ideal glossy surface for decals. If you use an airbrushed shade for the green/grey areas, that paint is likely to yield a matte or flat finish. If so, consider applying a coat of Tamiya TS-13 Clear to the areas where the "Progress" decals will be applied. This will provide a glossy base for optimal decal adhesion, and we can go back and apply a unifying clear matte finish later after everything dries.

Prior to their flight the Soyuz TMA-8 crew greets well-wishers in the vehicle integration hall at the Baikonur Cosmodrome. (NASA)

We also recommend the use of a decal setting agent such as Microscale Micro Set before applying each individual marking. This is a mild acetic acid solution available through hobby retailers, and it is designed to prepare the surface onto which the decal will be applied by lowering the surface tension of the water used. In short, it makes the water "wetter," which improves decal adhesion and reduces the likelihood of silvering, a pesky and unsightly decal malady caused by trapped air beneath the marking. In addition, Micro Set also gently softens the decal, allowing it to conform to the surface of the model more closely. Just brush a bit of Micro Set onto the surface of your model with a soft brush where the decal will be applied, apply the marking, and let the setting solution work.

One final decal tip: persuading the "Progress" decal over the cable raceway on the central booster core will likely require the use of a decal solvent, such as Microscale MicroSol, Walthers Solvaset, or Tamiya Mark Fit Strong. Decal solvents are designed to soften the decal, allowing them to conform to irregular surfaces such as the cable raceway on your Soyuz model. Simply put the decal in place over the irregular surface as closely as possible, then gently brush the solvent over the top of the decal, allowing some to wick under the edges via capillary action. Next, leave everything undisturbed until the marking is completely dry. The decal may exhibit some unusual wrinkling as the solvent activates, but be patient and let the liquid go to work. It may take more than one cycle of solvent application for the deal to completely conform.

APPLYING A CLEAR FINISH

Once the individual assemblies of your model are completely assembled, painted, decaled, and dry, it's a great idea to apply a clear finish before final assembly. This will give your model a unified, consistent finish, as well as provide a bit of protection to the decals and any acrylic paint you used. The choice of what type of finish to apply - gloss, flat, or an in-between semigloss matte - is personal, but might also be guided by research into the actual vehicle. On the Soyuz TMA-8 mission prelaunch photographs clearly show a slight gloss, but not a shiny gloss like you might find on an automobile. Based on this we chose to use Tamiya TS-79 Semi Gloss Clear lacquer spray to clear coat our model. Two light layers of semi gloss clear were applied to the completed elements before final assembly.

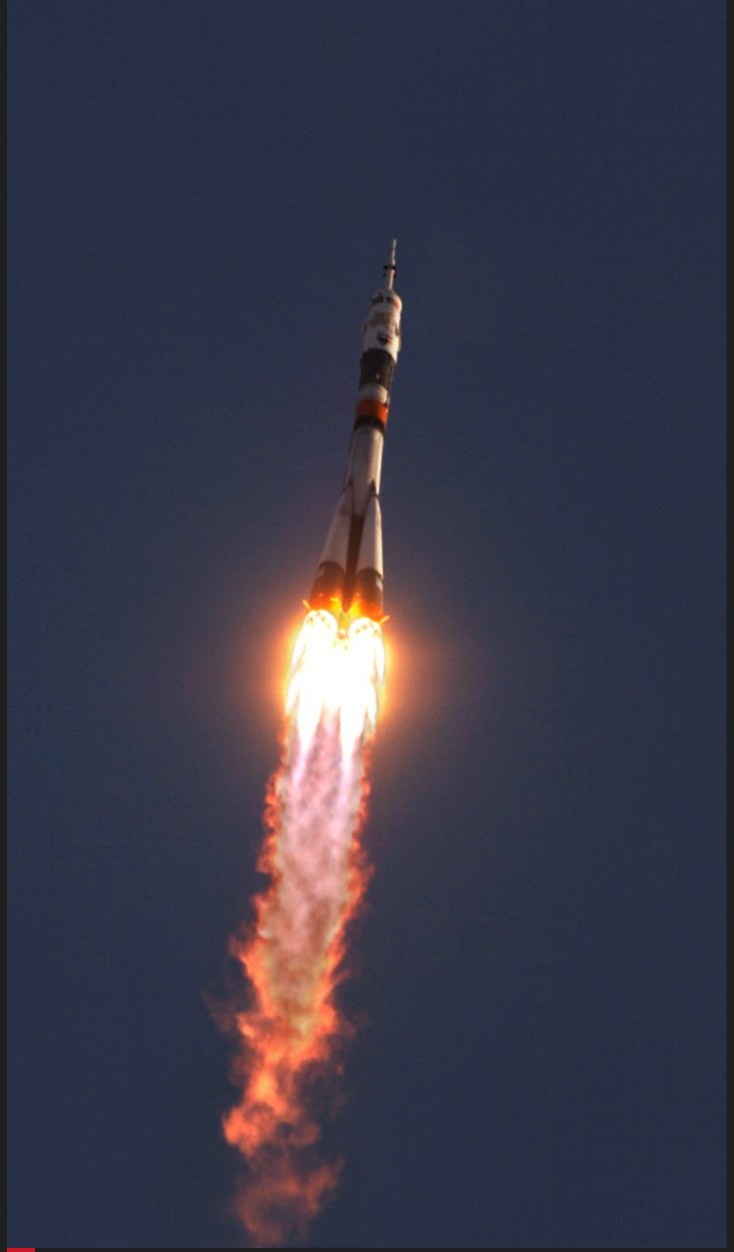
FINAL ASSEMBLY

Your workbench should now be covered with a variety of assembled, painted, and decaled elements all covered with a clear finish, and it's time to bring them all together. Intriguingly, what we're about to do now is not too far off from what happens in the integration building at Baikonur. We found it very helpful to fashion a simple holding jig from a cardboard box to hold the lower booster section throughout final assembly.

One critical thing to note at this point is that painted surfaces usually do not adhere well to each other. In particular the mounting tabs and surfaces for the central core and strap on boosters need to be cleared of paint. A sanding stick is great for this task, as is a jeweler's file to clear the areas to the sides of the mounting hole on the back side of each stream on booster. We mounted the boosters to the central core one at a time using tube type plastic cement, allowing each to dry completely before moving on the next element. Brush on liquid cement would have evaporated too quickly, and we didn't want to risk having CA glue create a haze on the painted surfaces of our model. Using old school tube type cement here slows down the process a bit, which is ideal.

Epoxy was used to mount the escape tower in place as well as to mount the second stage thrust structure to the aft end of the upper blow molded element. If you plan to fly your model this would be the point that the shock cords and parachutes would be installed.

Congratulations on completing your 1/48 scale Soyuz from Estes!



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