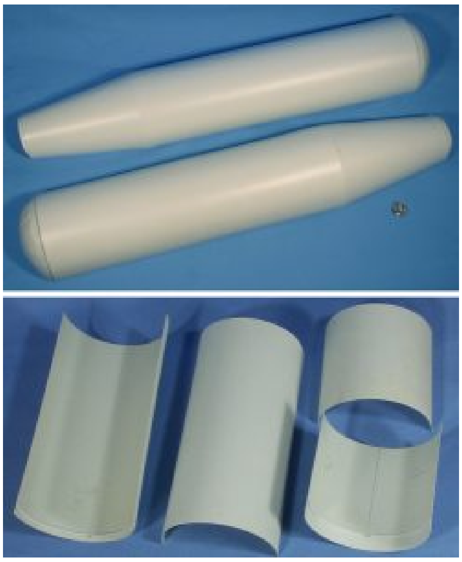
NASA’s Saturn IB in 1:48 Scale

Part Two –

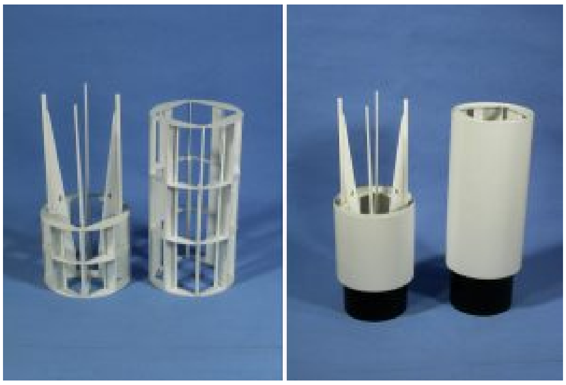
Ap7-KSC-68PC-185

Fabrication (Cont.)

The S-IVB upper stage consisted of the Aft Interstage Aerodynamic Fairing, the Aft Interstage (which on the actual vehicle is a large hollow structure that houses the J-2 engine and its thrust structure), the S-IVB Aft Skirt, propellant tank skin and the Forward Skirt. On top of this stage was the Instrument Unit (IU). As all of these cylinders had the same diameter I ended up building two similar cage-like structures to which I could attach the cylindrical skins. I originally thought I’d split the model at the interstage-aft skirt joint for transportation purposes so I built a sliding interface connection into the inner frameworks. The exterior skins for the upper part of the vehicle were vacuuformed in two large halves. The vacuuformed pieces for this included all of the above as well as the Spacecraft Lunar Module Adapter (SLA). After attaching the skins to the frames, the exteriors were prepped using the same techniques I had used on the first stage propellant tanks.



The basic vacuuformed shapes for the aft interstage, S-IVB/IU and SLA are in the upper photo while the cylinders for the aft interstage and S-IVB/IU are in the lower photo.

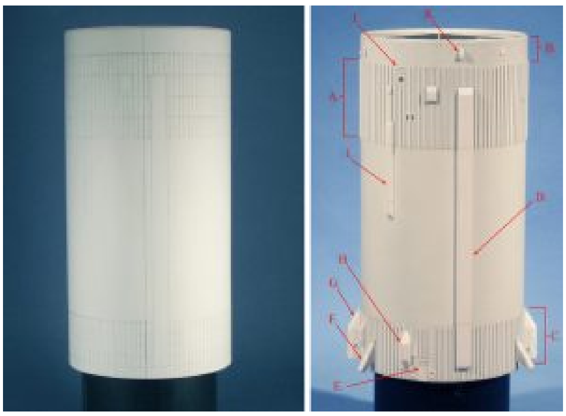


In the left image are the lower and upper second-stage support structures. On the right, the stage cylinders are added. The shorter one is the *interstage structure and the longer one is the S-IVB and IU cylinder.*

On the real vehicle, there were 112 external S-IVB interstage and aft skirt stringers, 1.375” by 1.00” in size, for the most part equally spaced around the cylinder. On the model, I chose to replicate these with 112 .030” by .020” Evergreen strips. To space the stringers I generated a plan view drawing of the cylinder with 112 equally spaced lines, sat each cylinder on this plan and ticked off the location for each stringer. Then using a long “L” shaped straight edge I penciled in their locations. Marking these points and transferring these lines introduced some error, which was expected, so to attach the stringers I made three guides. The first had the ideal width, while the other two were slightly thinner and fatter in width. To start attaching the stringers, I glued the four cardinal point stringers in place, being careful to keep these vertical on the cylinder, and then using the ideal width guide began to add the adjacent stringers. As I filled in each of the quadrants I kept a lookout for discrepancies, and when they showed up, which they did, I’d use either the smaller or larger guide to get the stringers “back in line”.

The forward skirt was similarly treated. The number of stringers was less (108) and their size smaller (I used .015” by .030” Evergreen strip) but the attachment technique was the same. On both of the skirts, the areas around the stage’s exterior umbilical connections and cable raceways covers caused the stringers to vary a little from the pattern and this was dealt with as the stringers were applied. All of the fairings, antennas and cable covers that protruded out from the second stage and instrument unit were made either from styrene sheet, vacuuformed shapes or a combination of both, After these odds and ends were created, some of these were applied to the stage prior to painting.

On the left is the S-IVB aft interstage after being marked-up. At the bottom work has started on the aft interstage aerodynamic fairing, a 27-inch tall corrugated structure, which covered the S-IB spider beam. The corrugations are faked using .030” half-round, 36 pieces were used for every 1/8 segment of the fairing. The image on the right shows the finished interstage. The larger fairings house the retro-rockets used to assist in separating the first and second stages during flight.



On the left is the S-IVB/IU with the upper and lower stringer pattern laid out. The horizontal lines drawn within each skirt indicate the rivet bands of the stage's interior ring frames. The right image shows the stage in a final test fit after all the external detail has been added. A. forward skirt, B. instrument unit, C. aft skirt, D. external cable raceway, E. aft umbilical connections, F, ullage rocket fairing (1 of 3), G. auxiliary propulsion systems module, H. LH2 fill line faring, I. auxiliary tunnel, J. forward skirt umbilical connections, K. VHF telemetry antenna.

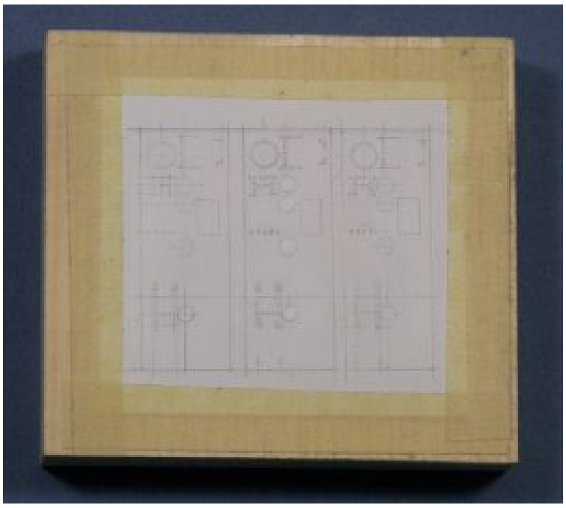
The conical section that makes the transition from the instrument unit to the service module (the SLA) was treated the same as all the others and after the seams had been dealt with the external detail was added. The eight prominent hinge and upper panel corner fairings were laminated from two layers of an extra SLA piece and then sanded to shape. I used my Dremel drum sander to do most of the basic shaping with finer grit sandpaper blocks to refine the edges. After the shapes were finished they were attached to the SLA. The rest of the detail on the SLA consisted of .005", .010" and .015" strip, all of which were glued down with Tamiya Extra Thin cement. As before, the locations of all of these details were taken from my original set of drawings and were then transferred onto the cone.

The Spacecraft Lunar Module Adapter (SLA). The image on the left shows the detail locations laid out in pencil. On the right, the detail has been added. The "saw-tooth" reinforcing strip at the bottom of the SLA is cut out of .005" styrene in four sections. Most of the rest of the detail is made out of .010" and .015" strip styrene.

The Apollo spacecraft Service Module (SM) started out with the two .040″ thick vacuuformed halves being squared up. A circular ring and disk were cut out of sheet styrene to keep the upper and lower edges of the SM in round. The butt joints of the SM were supported with "T" shaped re-enforcing beams that ran the length of the cylinder. The upper fairing on the SM was created out of a .030″ thick cylindrical section that was set back .040" from the SM exterior and the eight electrical power system (EPS) radiators were cut out of an extra vacuuformed SM skin. The raised radiator "ribs" were cut out of .010” by .030” strip and added to each radiator. I used a strip of .0150” by .020” below and between each of the EPS radiator panels. For the two environmental control system (ECS) radiators I glued two rectangles of .005” sheet to the SM cylinder and used .030” half round for the “ribs”.

On the left, the service module’s EPS radiator backing, outer skin and the upper and lower support rings. On the right the completed EPS radiators ring the upper portion of the CM. While on the lower portion, one of the ECS radiators has yet to have its half round “ribs” installed.

The SM RCS panels were cut out of .005” sheet and tiny “rivets” of .005″ styrene were punched and individually glued to each sheet to represent the bracket attach points for the RCS propellant tanks. I took a very fine hypodermic needle and filed the end to make the punch. The RCS quad housings were scratch-built and the 16 reaction control system (RCS) nozzles added, Glenn Johnson of RealSpace Models supplied the nozzles.



Three of the Service Module's RCS panel skins are attached to a wooden bock to allow for the raised detail to be added. The RCS panels on the SM are handed so two of these panels will be attached to the SM. The third is a practice or pathfinder panel. The rectangular shape on the right side of each panel is where the RCS quad will be attached.

I choose not to replicate the command module as the boost protective cover (PBC) covered the entire CM. The PBC skin was vacuuformed over the original command module (CM) form with a .040″ styrene CM skin in place. The additional thickness at the apex was created with a second, thinned down PBC skin. The external details were cut out from an additional BPC skin and styrene sheet of various thicknesses.

The BPC includes two circular window openings. One over the hatch window and the second over the left-hand rendezvous window. The hatch handle fairing has yet to be attached and the cutout for the CM-SM umbilical has not been made. Note the blow-out ports over the CM RCS Thrusters.

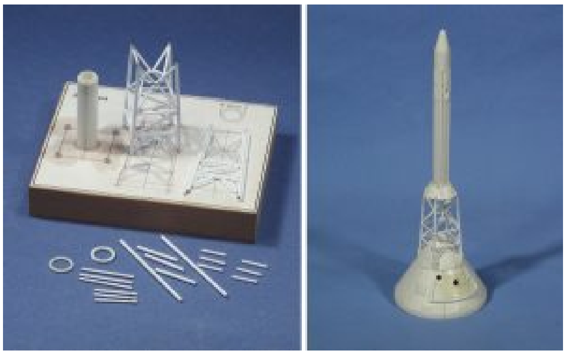
The launch escape system (LES) rocket motor skin was also pulled off of a wooden master as was the structural skirt. The external details added included the two jettison motor nozzles, external cable conduits and on the aft skirt, the tower attachment lugs and the four launch escape motor nozzles.

In the upper image are the major parts used to create the structural skit which transitions the LES tower to the LES rocket motor casing. The progression of the skirt in on the left and the LES escape motor nozzles are on upper the right. The lower image shows the underside of the finished structural skirt.

On the left are the vacuuformed LES motor casing halves with partially completed casing below. To the right is the shape that was used to create the LES jettison motor nozzles. The right image shows the complete LES motor casing and structural skirt.

To construct the lattice-like tower for the escape system, I used Plastruct .080” and .060” rod and made a jig to build the tower sides. I made up four sets with two of them containing the outer legs. I then attached these four sets together using the upright portion of the jig to align the sides. The ring, which is included near the top of the tower was cut out of a solid chunk of .060” sheet stock and when finished, was placed in the upright jig with the pre-assembled tower around it so that the eight upper support tubes could be added. After this had dried I removed the tower from the jig and added the eight lower ring tubes.



In the left image is the jig for making the Launch Escape System’s truss tower. The right-hand portion of the jig shows the layout for the truss itself while on the left-hand side is the tower assembly area. The cylinder holds the ring level and at the correct height. The right-hand image shows the Boost Protective Cover (BPC) and LES combination after all detail work was completed.

Constant dry fitting of parts and sub-assemblies was essential as the build progressed, and after several overall dry fits I was confident in the procedures that would be necessary to do the final assembly.

Test fitting of all components was done constantly. The left image shows an early test fit of the LES, BPC, SM and the SLA. On the right is the final test fit of these same elements.

The left image shows a test fit after all the major sub-assemblies had been built. On the right is the final test fit prior to break down for painting.

Painting

The sub-assemblies were primed with a mix of Gunze's Mr. Surfacer 1000 and Mr. Thinner. Any seam work left was taken care of by brush applications of Mr. Surfacer 500, sanding sticks and the reapplication of the primer where necessary. I used Tamiya Flat White (XF-2), Flat Black (XF-1) and Dark Green (XF-61) for the majority of the model. I was going to blue my white and take the black down a bit but I had no idea how much paint was going to be used to finish this model so I used the colors straight out of the bottles. The engines were painted with Alclad II Steel, buffed out with some SNJ polishing powder and then lightly over sprayed with Alclad II Aluminum. On the service module I used the Tamiya White and a 50/50 mix of Alclad II Dull Aluminum and White Aluminum.

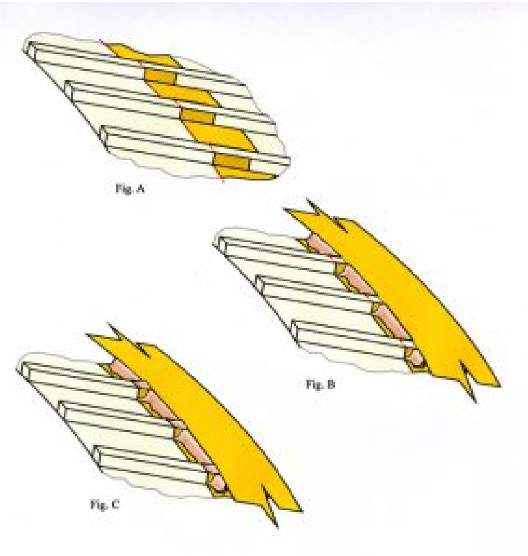
This detail shot of the aft interstage and S-IVB aft skirt includes the following: A. S-IVB auxiliary propulsion system (APS) Modules, B. the S-IVB aft skirt umbilical panel, C. interstage personnel access panel, D. vertical motion tracking markings, E. aft interstage aerodynamic fairing, F. ullage rocket motors and fairings, G. camera tracking markings, H. interstage retro-rocket fairings and I. the top of the first stage antenna panels and their antennas. Details

A., F., and H. were all painted separately and then added to the finished model.

I knew that the paint masking was going to make or break this project and there was quite a bit of it to do. The most challenging involved the horizontal black and white separations that cross the stringers on the S-IVB stage. After I'd gotten the white paint to the state I wanted my first masking attempt involved cutting some intermediate lengths of Tamiya masking tape about 3/16" wide and simply laying it first on the top of a stringer, burnishing it down the side, across the cylinder face up the side of the next stringer and so forth. When I had finished applying one of these masking strips the corners between the stringers and cylinder had all pulled up just a little and I couldn't get them to sit back down. As I couldn't figure how I'd fill these little "holes", even with a liquid masking agent and keep the edges straight, I knew this technique wasn't going to work.

After a bit of musing I came up with a plan "B". As the "valleys" between each stringer were made up of three planes, I decided to attach a separate piece of tape to each of those surfaces. This would make for a laborious application but eliminate the corner issue. I ended up cutting Tamiya masking tape to the same height as the stringers and using short segments, about 1/4 " long, taped each stringer side. The "valleys" were filled with wider pieces cut to fit between the stringers. To complete the edge masking, I added a wider strip along the top of the stringers but set back a little from the actual separation line. I then used liquid latex as a masking agent to fill-in between the areas were there was no tape as well as to seal all the edges between tape pieces. It took over four days to do all of the masking on the S-IVB and Aft

Interstage and a little over two days to paint and remove the masking. The results were better than I had figured I would get going in. There were some small over-sprays where I didn't quite get enough liquid mask and some black touch-up where the tape wasn't quite straight but overall the process worked quite well.



The steps involved in masking across the stringers. Fig. A shows the three adjacent pieces of tape that defined the "valley" around sides of the stringers. Fig. B shows the larger piece of tape that is placed over the stringers but slightly lower that the actual masking line. Also the liquid masking agent used to "fill in" the lower end of the valley is shown. Fig. C shows the liquid masking agent that is filled-in between the three adjacent tapes on *the top of each stringer.*

The S-IVB forward skirt/IU interface. The results of masking across the stringers can be seen. The metallic gray and white antennae were painted separately and attached during the final assembly. The two adjacent white tracking markings were made out of five separate pieces of white decal film for each rectangle. The two black holes are skirt vents and were made out of .005" styrene sheet with the oval shape cut out. The vents are backed with a light-blocking box

Decals and Finishing

Rick Sternbach of Space Model Systems supplied the decals for this project. I did some preliminary research but Rick fleshed out the details and produced a one-off set on his Alps printer. (Later Rick produced a similar set that was printed by Microscale.) For the “UNITED STATES” and “USA” lettering I cut away all the carrier film and using a simple paper guide, spaced the letters on the tanks accordingly. Doing this certainly made these a little harder to apply but the resulting lack of decal silvering more than made up for the extra hassle.

As much of the decal carrier film as possible was removed. On the large lettering decals that included all of the internal areas.

Rick also supplied a set of decals for the Apollo Command and Service Module that I used on the payload portion of the build.

After all the decals had been applied I used Testors Metalizer Sealer as the finish coat for the major sub-assemblies. I had used this before on one of my other projects and liked the subtle sheen it gave to the model. The last sub-assemblies constructed were the four sets of air scoops and the eight vehicle hold-down assemblies, which were attached to each fin. With the completion of all of the sub-assemblies I was able to turn to final assembly of the vehicle.

The first stage thrust structure after the engines, air scoops and stainless steel model support rods have been attached.

I used several different glues to attach the whole thing together. 90 and 5-minute epoxy attached the major sub-assemblies with Testors squeeze bottle cement and Aleens Tacky White Glue used to adhere the antennas and other smaller bits and pieces. When all was finished, the completed model stood about 57-1/4” tall with the outer diameter of the fins being 10-3/16” and the S-IVB cylinder diameter around 5-7/16”.

While it took over 20 years to see fruition, the actual modeling work was done between 2003 and 2010, with the majority of that over the last two and one half years. The shear size of this model taxed my workspace to the max. I had first stage fuel tanks and fins hanging from nails in the edges of shelving and upper stage cylinders placed on PVC ring stands all over my workbench. During the process I made extensive use of a “Lazy Susan” for both painting and building. In the end I figured I had cut over 3,600 pieces of styrene and used over 12 jars of Tamiya and Gunze paints. I finished the model about two weeks before the 2010 IPMS/USA National Contest and Convention in Phoenix where it won multiple awards including the Judges’ Grand Award “Best of Show”.

Reference List –

Just some of the documentation used to create the drawings for this model;

Saturn IB News Reference

GC 1044 September 1968

A PDF copy of this document is available through the University of Alabama at Huntsville Salmon Library.

Skylab Saturn IB Flight Manual

September 30, 1971

A PDF copy of this document is available through the NASA Technical Reports Server.

Apollo-Saturn AS-207 Vehicle Systems Information Drawings

Chrysler Corp. Space Division – Systems Engineering Branch

A PDF copy of this document is available in the Apogee Book "Saturn 1/1B" by Alan Lawrie.

Saturn IB Orientation – Systems Training Manual

Chrysler Corp. Space Division – Systems Engineering Branch

A PDF copy of this document is available through the University of Alabama at Huntsville Salmon Library.

NASA Apollo Command Module News Reference

North American Aviation (NAA) 1968

A PDF copy of this document is available through the NASA Technical Reports Server.

Rick Sternbach's Space Model Systems decals are available through –

http://www.culttvmanshop.com