CRAFTING A SCALE BLACK BRANT VIII

AT LEFT:

Black Brant VIII – a Nike-Black Brant VC sounding rocket produced by Bristol Aerospace, Canada. On display at the St. Louis Science Center, St. Louis, MO. Photo by Paul Lubertowicz.

The Flying I-Beam Kids

NAR Team #473

Crafting a Scale Black Brant VIII

By John Brohm, NAR #78048

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Introduction

Most rocketry enthusiasts have some familiarity with the Black Brant VIII, a two-stage sibling within the ubiquitous Black Brant family of sounding rockets. Produced in Canada by Bristol Aerospace, the Black Brant VIII is a visually striking prototype, especially when rendered in the livery presented by the round formerly on display at the St. Louis Science Center.

Photo 1: Black Brant VIII – BBVC Sustainer Left, Nike M5 Booster, Right

Photos by Tim Harincar

That St. Louis Science Center round was the same one Peter Alway documented in his Rockets of The World 2002 Supplement, pages 26-28. As detailed in Peter's Supplement, an operational Black Brant VIII consisted of a Nike M5 booster, mated by means of an interstage adapter to an upper stage Black Brant V. Depending on the launcher, the upper stage Black Brant V was either a three-finned version B or a four-finned version C. The vehicle on display at the St. Louis Science Center was of the four-finned VC variety, the type enjoying its first flight November 17, 1976, its last flight occurring September 17, 2004 (ref: Astronautix.com).

My interest in the round was sparked when Peter released that 2002 ROTW Supplement. Shortly thereafter, I built a basic 1/10th size model, and in 2004 I started an initial version of a 1/8th size model as a consequence of a set of Bristol blueprints and photographs gifted to me by Taras Tataryn. That model was eventually finished in 2014, and was entered in Team Scale competition by The Flying I-Beam Kids at NARAM 56.

More recently, Taras kindly offered me a cache of Science Center photos taken by Paul Lubertowicz; Paul's photos of the Science Center round resolve a number of ambiguities, particularly with the Nike booster and the Black Brant VC payload section. The detailed information conveyed by Paul's photos permits a more accurate model to be developed, and so in this article, I'd like to share with you my new Black Brant VIII build.

References

Let's begin by declaring our references.

Peter's 2002 ROTW Supplement provides an excellent reference for the vehicle and its general arrangement, and the dimensions provided in Peter's drawing track directly from Bristol's Black Brant VIII General Arrangement blueprint, Drawing 600-02025. Additionally, a pair of photos of the St. Louis Science Center round is featured on Page 2 of the Supplement, opposite the Table of Contents. From this material quite a satisfactory model can be constructed, there being no need to obsess further unless one is so inclined.

However, for those Poor Unfortunates so afflicted, a copy of Bristol's General Arrangement blueprint is essential, as it provides additional information and dimensioned drawings for the Interstage Adapter and its drag brakes. Accordingly, we'll take vignettes from that blueprint at the appropriate points in our build. One should note, though, that the Bristol drawing, while more detailed in some places, still overviews the total vehicle as a line drawing, which unfortunately over-simplifies some of the detail surrounding the Sustainer fin can, its mounting arrangement, and certain other aspects. For an accurate build, photos of the real thing are needed.

Fortunately, for this we have access to color photos provided by Tim Harincar and Paul Lubertowicz (courtesy of Taras Tataryn), and we'll pull the relevant images into play as the build progresses. We will also make use of Atlantic Research Corporation's "Standard Fins – Nike Rocket Motor" brochure, as it includes a detailed sketch of the fin mounting arrangement as well as more precise dimensions for the Nike fins. From our good friend Josh Tschirhart, we have an excellent detailed drawing of the Nike motor itself, as well as a few photos of other relevant Nike-based rounds that help lift the tablecloth on this complex aerospace vehicle.

Scale Factor

Before we touch our Xacto® knife, we must first establish the model's Scale Factor. Just as was done for our 2014 model, we'll set the Scale Factor reference as the OD of the prototype's Black Brant VC Sustainer motor case – 17.26". Our model's sustainer airframe will be BT-70 based, so the Scale Factor is established at 7.785, or slightly larger than 1/8th size, approximating the standard scale of 1.5" to the foot.

The Nike Booster

Let's begin by reviewing the Nike motor drawing prepared by Bob Biedron, later amended by Josh Tschirhart.

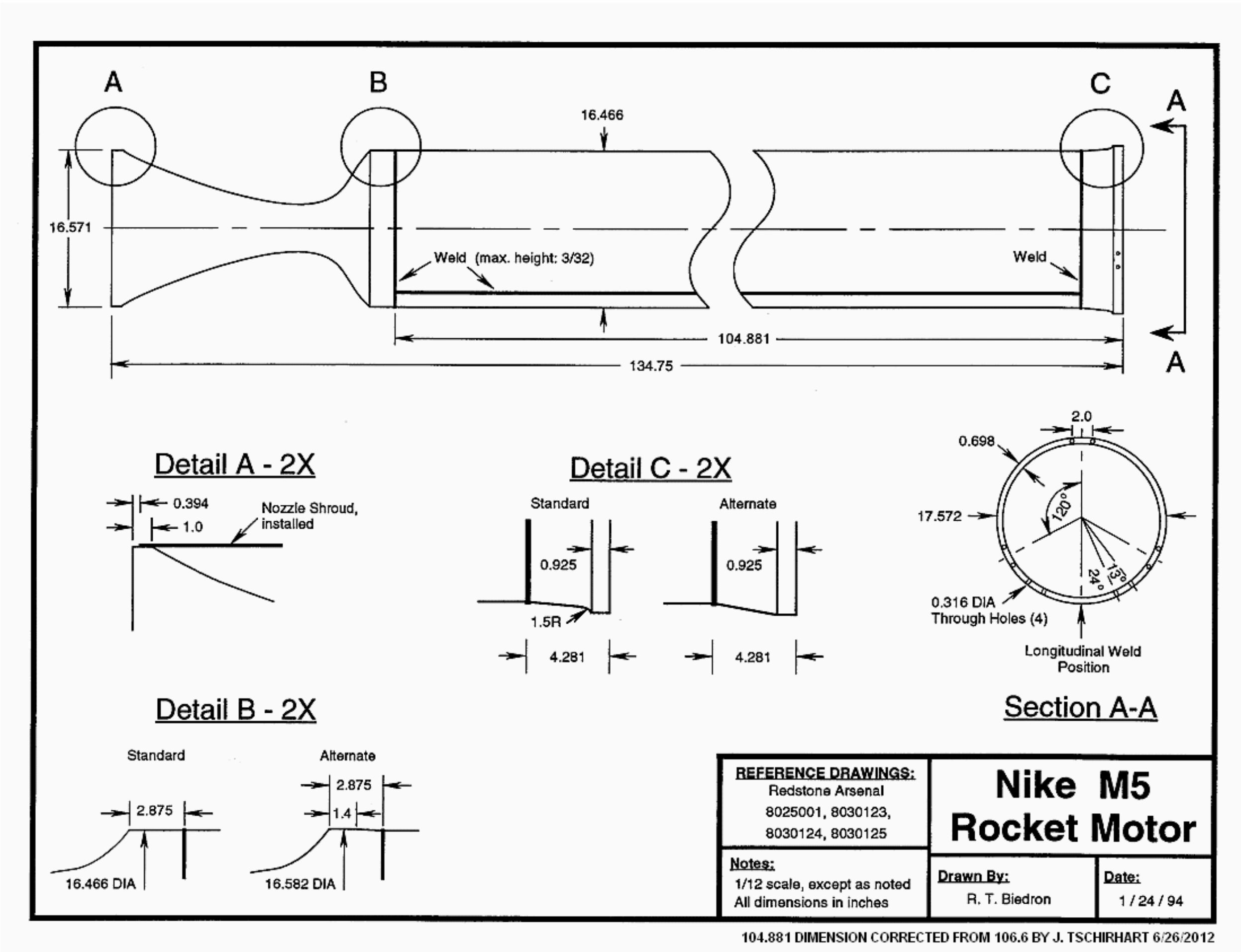

Figure 1: Nike M5 Motor

(http://meatballrocketry.com/nike-motor-data/)

In addition to the detailed motor dimensions, of interest to us is the forward flange version (Detail C in the Nike motor drawing) that we'll need to model. The Bristol blueprint depicts this feature as the "Alternate", or conical, transition as the following cut from the blueprint shows.

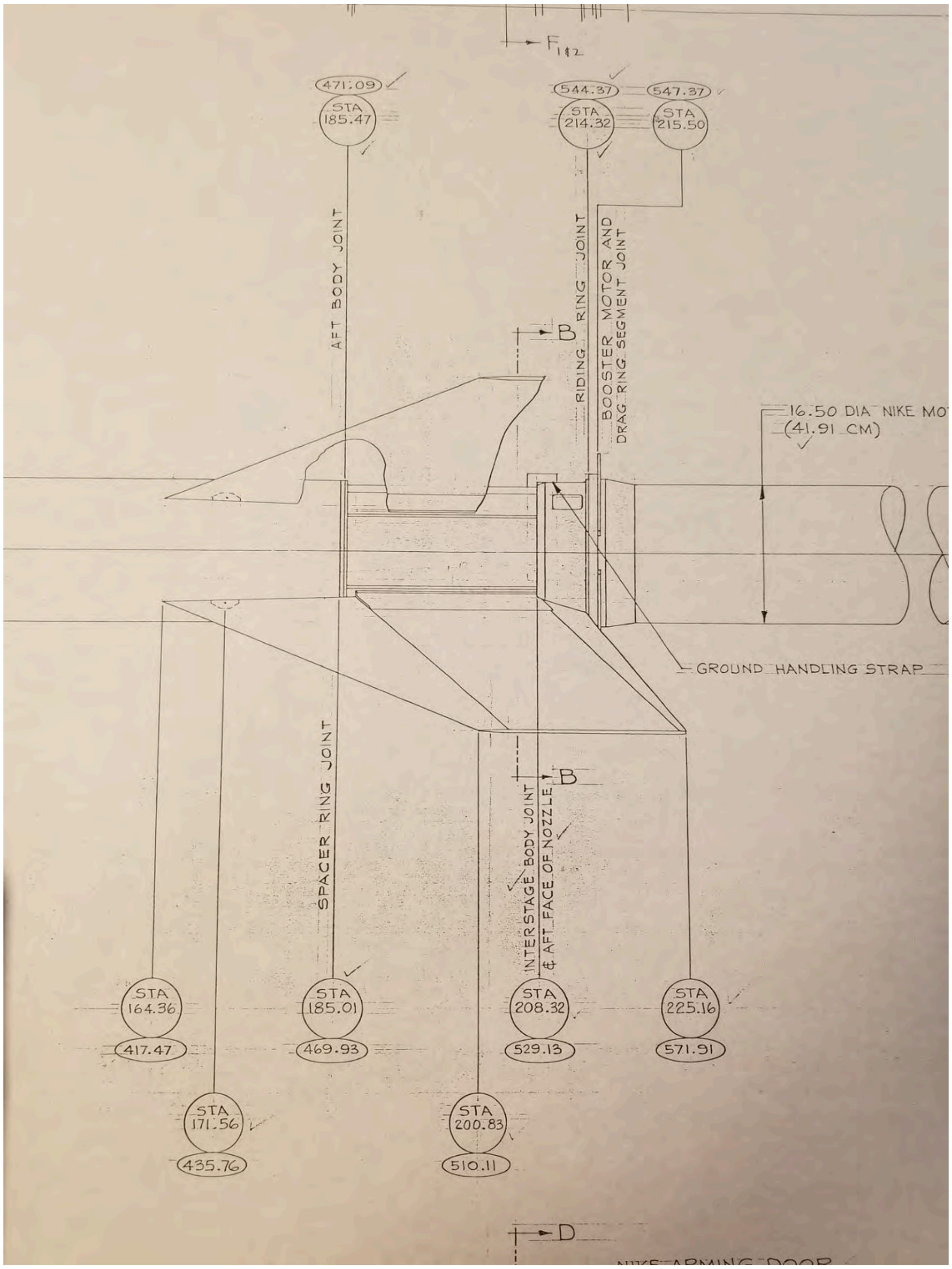

Figure 2: Nike Forward Flange

Bristol Drawing 600-02025

Photos of the prototype round suggest this as well:

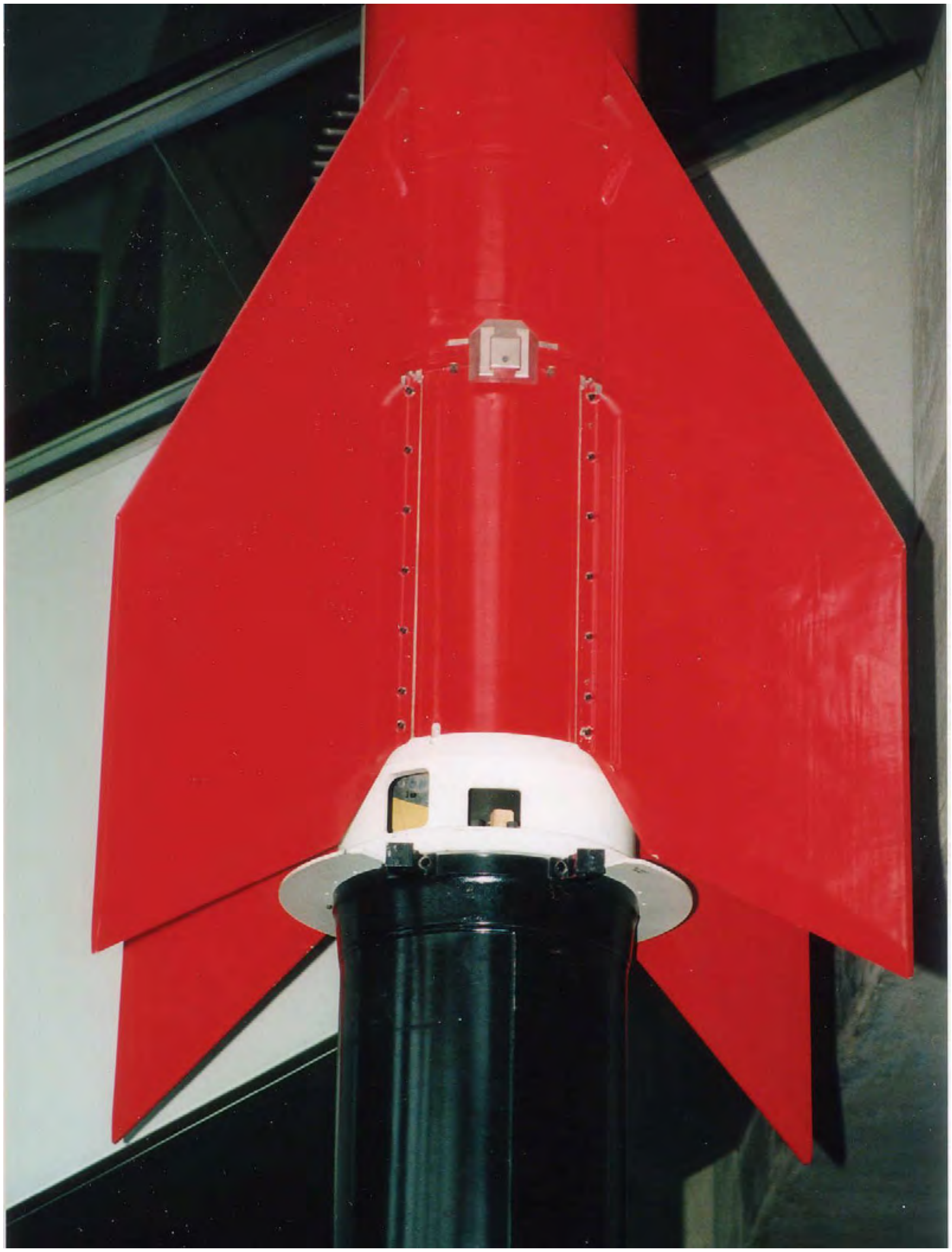

Photo 2: Nike Forward Flange & Interstage Adapter

Photo by Paul Lubertowicz

Even though the conical transition is apparent on the prototype, there still appears to be a bit of an edge to the bottom of the flange, and we'll take that feature into account at the appropriate stage in our construction.

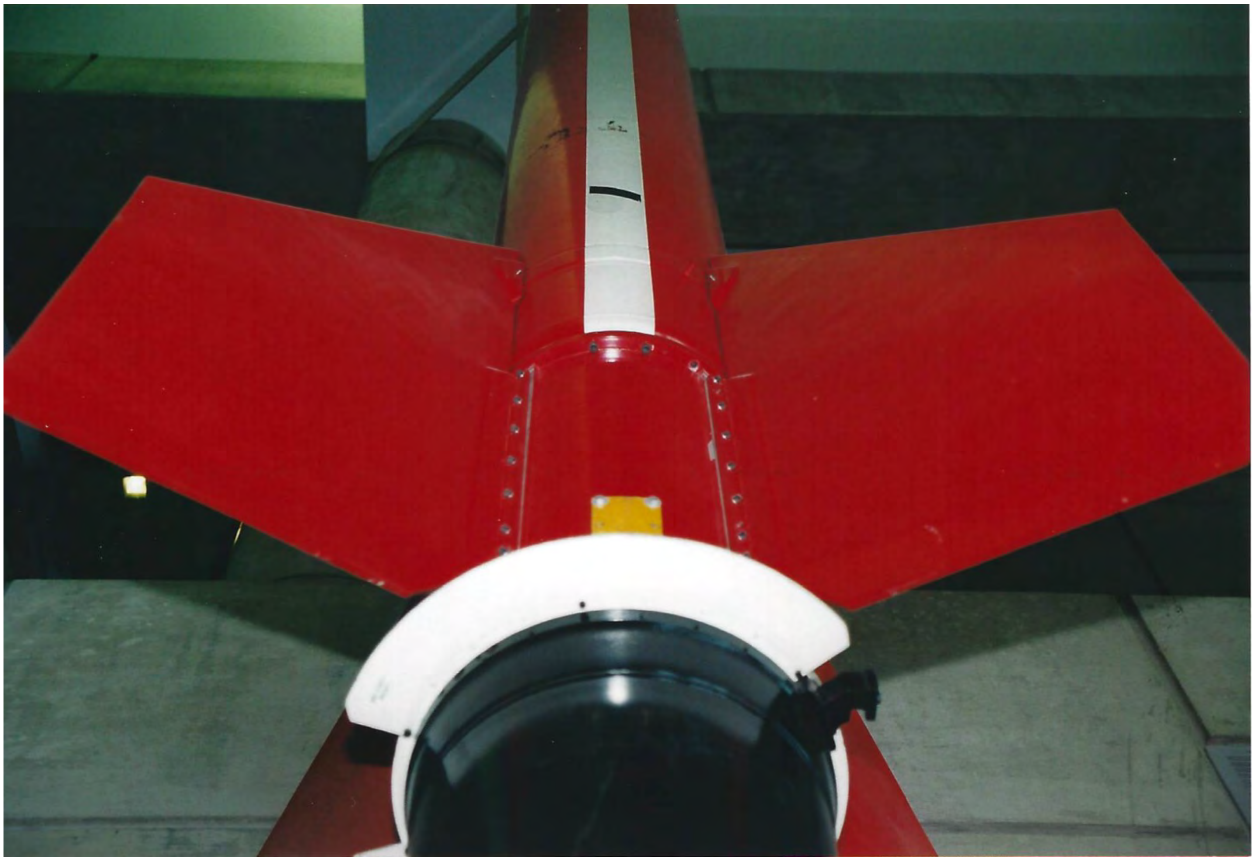

Photo 3: Forward Flange Lip

Photo by Paul Lubertowicz

At the business end we need to take a close look at the booster fins, and the manner in which they were mounted to the motor. First, we need to determine which type of fin was in use, and careful examination of the following photo provides the answer.

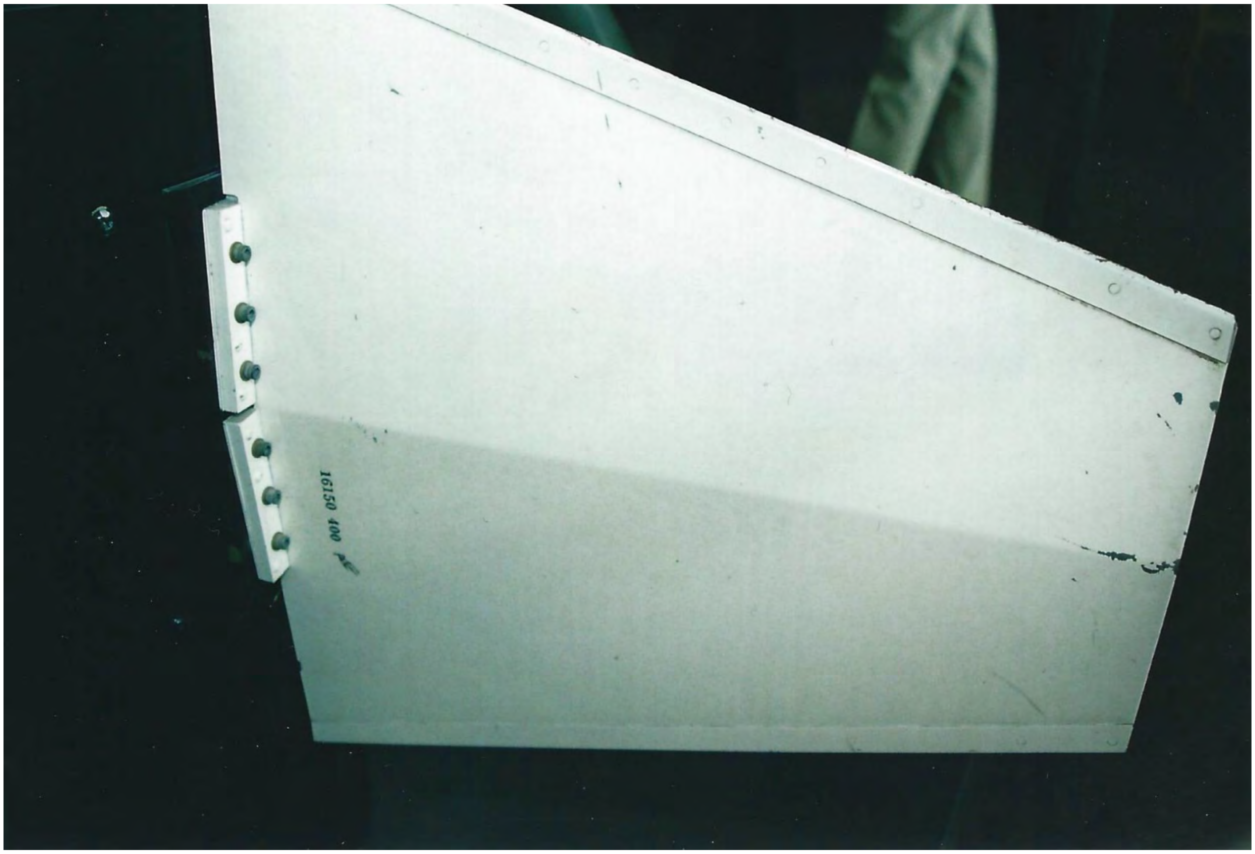

Photo 4: Nike Fin Mounting

Photo by Paul Lubertowicz

The part/serial number printed near the root of the fin shows, under magnification, "**16150 400 P**". This data places the fin in the lightweight standard fin family, as per ARC's Standard Fin brochure.

The ARC Nike Fin brochure offers us further information about these fins. Page 3 of the brochure presents a detailed sketch that illustrates how the fins are fastened to the motor. One can see the nozzle end is fitted with a circular cage, or "shroud", which is bolted to the nozzle, and which provides flat mounting plates to accept the fin flanges. A sheet-metal "sleeve" is then screwed on to the assembly to fair the nozzle/fin area for aerodynamic purposes.

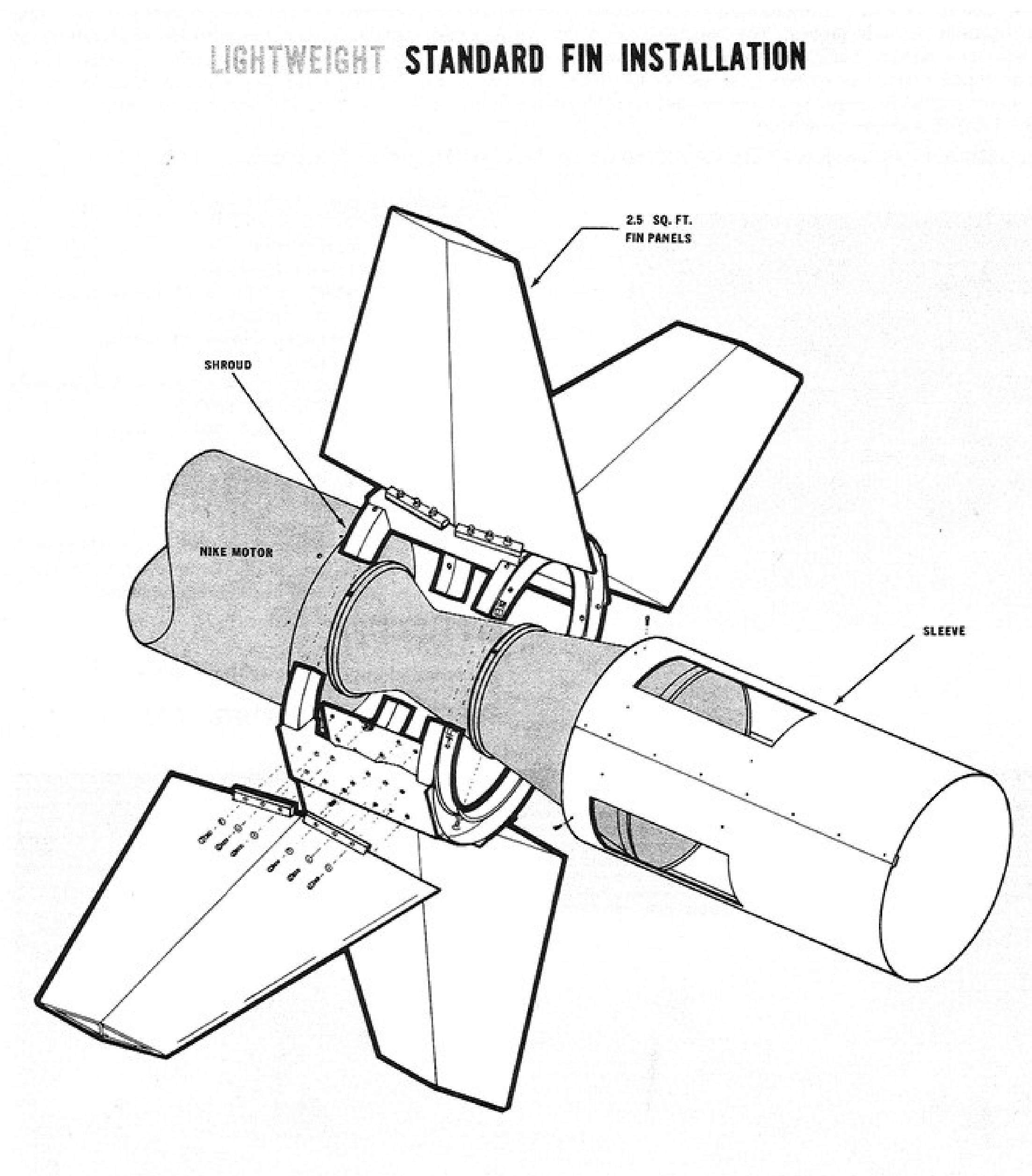

Figure 3: Nike Fin Installation Details

(http://meatballrocketry.com/wp-content/gallery/scale_data/nike_data/nikefins.pdf)

On Page 5 of the brochure, we find detailed dimensions for the standard Nike 2.5 square foot lightweight fin, as well as the dimensions for the sheet-metal fairing sleeve.

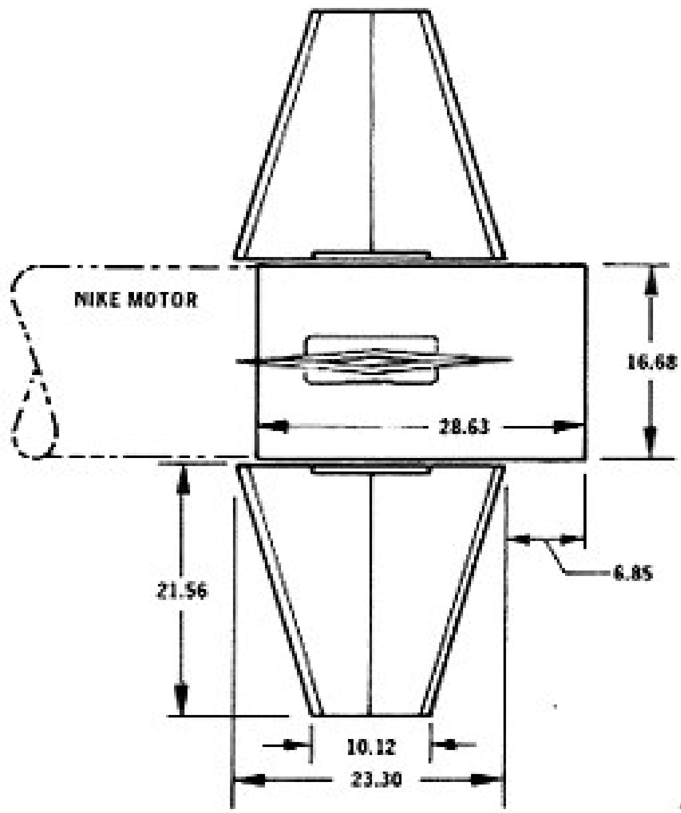

Figure 4: Lightweight Standard Nike Fin

(http://meatballrocketry.com/wp-content/gallery/scale_data/nike_data/nikefins.pdf)

One can see the drawing suggests the presence of a gap between the fin root, the sleeve and the motor; we can confirm the presence of this gap in the following photo, taken of an alternate Nike-based round.

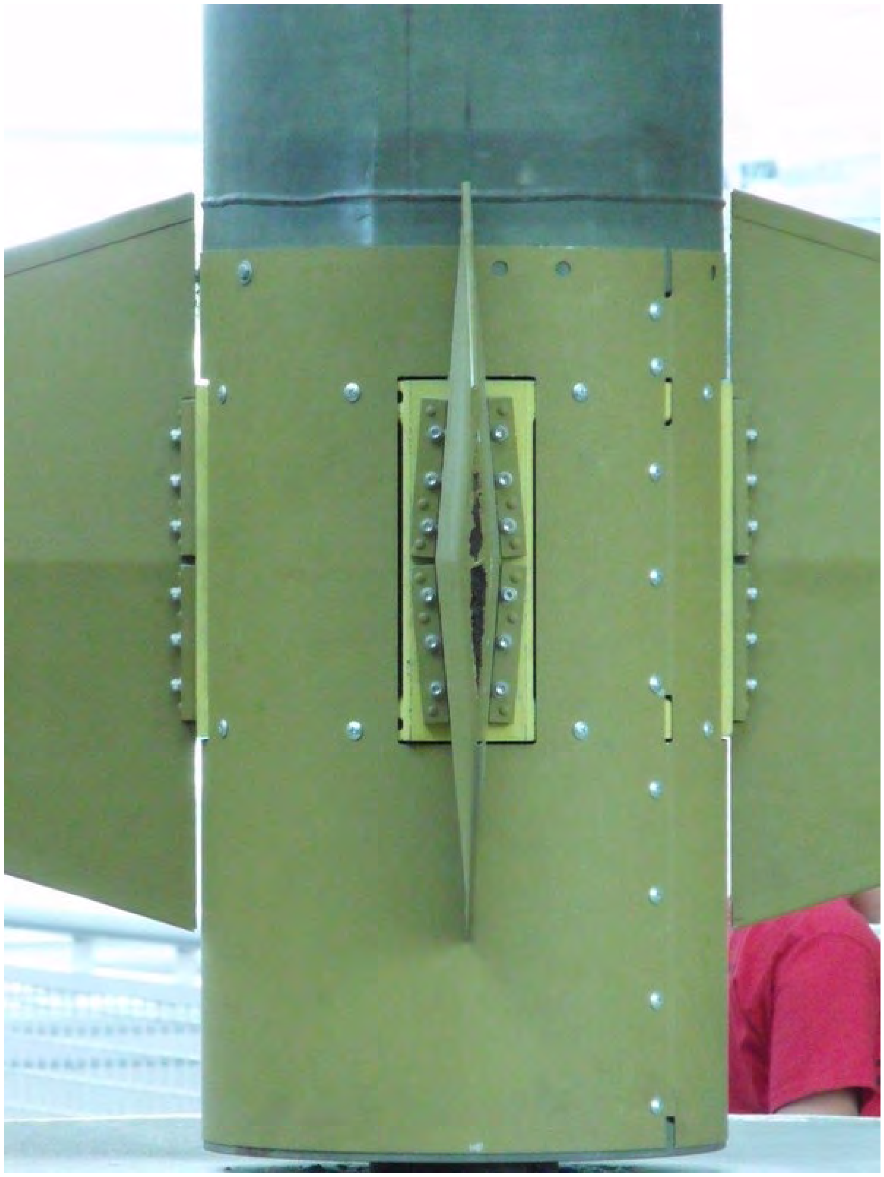

Photo 5: Nike Fin Can

Photo by Josh Tschirhart

(http://meatballrocketry.com/nike-orion-photos/)

Photo 5 actually shows the fin can of a Nike booster that's part of a Nike-Orion round, but it's plain the round is using the standard Nike fins, with the standard fin mounting and fairing arrangement depicted in our earlier Figures 3 and 4. Photo 5 offers us visible evidence of the fin mounting cage, or shroud, peeking through various spots in the sleeve, and we can readily see the gap between the fin root and the motor. Note how the fin mounting plates, which appear to be welded to the shroud, sit proud of the sleeve once everything is bolted down.

For an accurate build we need to take all of these details into our modeling calculus. And as we do, we will encounter certain details that expose some differences between our reference materials.

For example, the Nike fins themselves. The drawing provided in the ROTW 2002 Supplement very accurately tracks the dimensions provided in the Bristol blueprint. But comparing the blueprint to the ARC drawing (Figure 4), we find the Bristol dimensions are marginally larger for tip and root chord. Which drawing is "more correct"?

The short answer is we can't be sure (or at least I can't be) – we don't have evidence of the specific round Bristol may have measured for their drawing, nor do we have the source material Bristol may have used for the Nike portion of the vehicle (Bristol doesn't make the Nike motor or fins). But we do have math – the dimensions in the Bristol/ROTW drawing provide a Nike fin 2.568 square feet in area, whereas the dimensions in the ARC brochure (and maker of the fins) provide a fin area of 2.502 square feet, almost exactly as advertised. So, while I can't be absolutely sure which reference is "more correct", for my build I elected to use the fin dimensions provided in the ARC brochure.

Build Strategy

We will arrive at a more realistic result if the model's construction can follow the construction of the prototype. For the fin can, we'll represent the shroud cage with a pair of centering rings of scale thickness and of the right diameter. These will be flattened at the 90-degree points to properly seat scale-sized fin mounting plates. Once constructed and mated to the booster airframe sections, we'll wrap the fin can area with a scale-sized sleeve, just like the prototype.

Construction

Josh Tschirhart's amended Nike motor drawing shows a prototype diameter of 16.466", which, at our Scale Factor returns a scale diameter of 2.115". There is no commercially available airframe tubing in this size, and since we're striving for an accurate scale build, we need to consider our options here.

We could opt to have a commercial vendor roll a Kraft paper tube of the required diameter, but what would one do with 100+ extras left over from a minimum order? With an abundance of encouragement supplied by an overly anxious spouse, this option was quickly discarded.

Perhaps we could roll our own. Top Shelf Scale Competitors often roll thin-walled fiberglass or Lexan tubes for their specialty models, but my goal was to work with conventional materials, if possible. I also wanted to avoid fabricating a specialty wrapping mandrel, as well as the concomitant custom couplers and centering rings, so "No" to fiberglass in this case (with no offense intended to any Top Shelf competitors out there).

That leaves the option of working with the nearest diameter, commercially available, tube, and in this case ST-20 (OD=2.042") is the closest to our needs.

Some quick math shows that we need to add 0.037" to the radius of the ST-20 to get to the required scale diameter. When I built my earlier 2014 model, I had wrapped the ST-20 with a layer of 1/32" balsa; that, plus the glue and finish, should have brought the tube very close to the scale diameter. And it did, but I also found that the balsa sheet edge joints were very difficult to finish smoothly due to the harder cured cement at the sheet edges. Recalling that unhappy finishing experience, I elected to fabricate this new booster airframe with a different technique.

Using Contact Cement, a spacer frame comprised of 0.015" thick Styrene strips was placed about the ST-20 core, together with a longitudinal 0.015" thick Styrene joint strip.

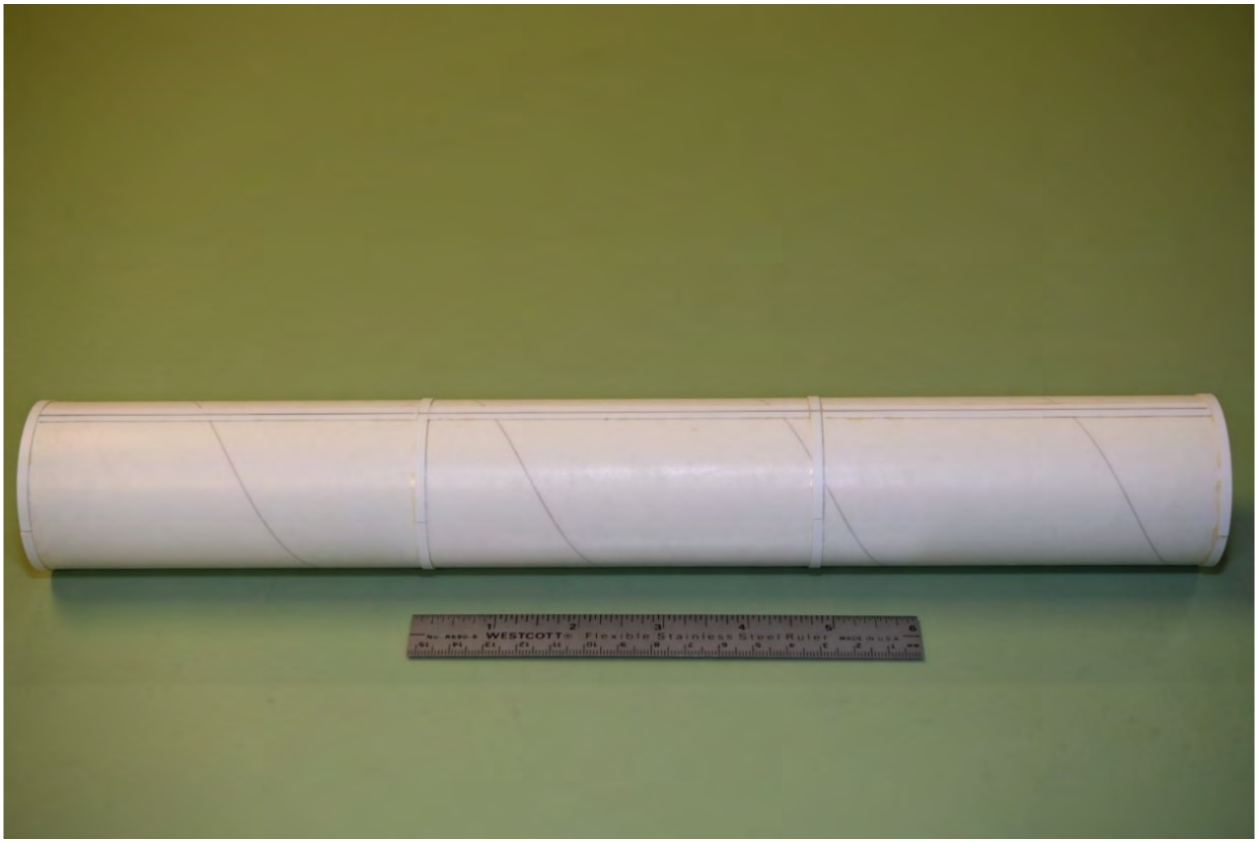

Photo 6: Styrene Strip Spacer Framework

A length of BT-70 was then split and temporarily wrapped around the core to mark the overlap; the overlap was then removed.

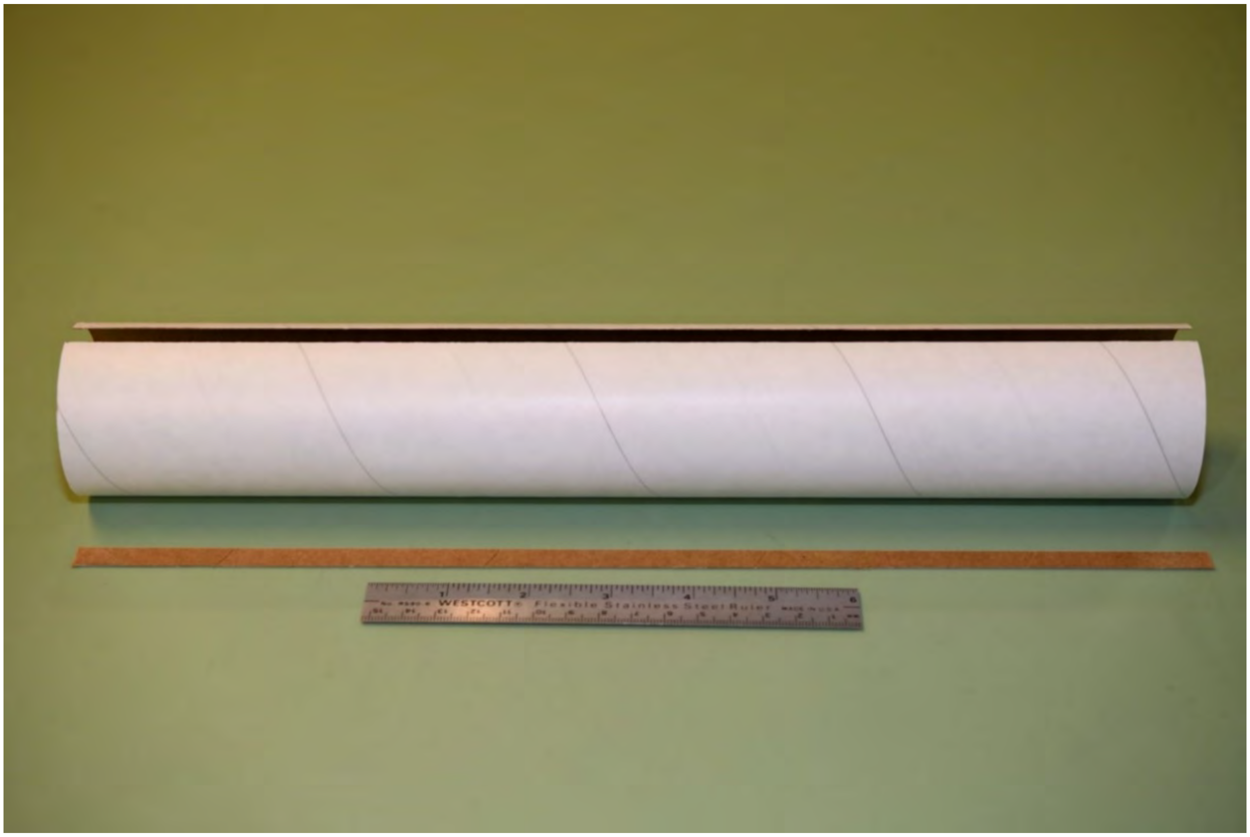

Photo 7: BT-70 Wrap

Contact Cement was then sparingly applied only on the main longitudinal Styrene joint strip and allowed to dry. A few beads of 15-minute epoxy were placed on the core in the open areas between the Styrene spacers, and then the BT-70 wrap was pressed in place. Some smooth gentle pressure around and along the surface ensured the epoxy was evenly spread between the tubes; we don't want any bulges here.

Other than the joint strip, no cement was placed on the spacer frame – we're shooting for a nice smooth outer tube, and epoxy or contact cement on those spacer strips risks ripples or bulges appearing on the outer surface.

Once cured, the native tube was filled and sanded per usual practice, preparing it for the next steps.

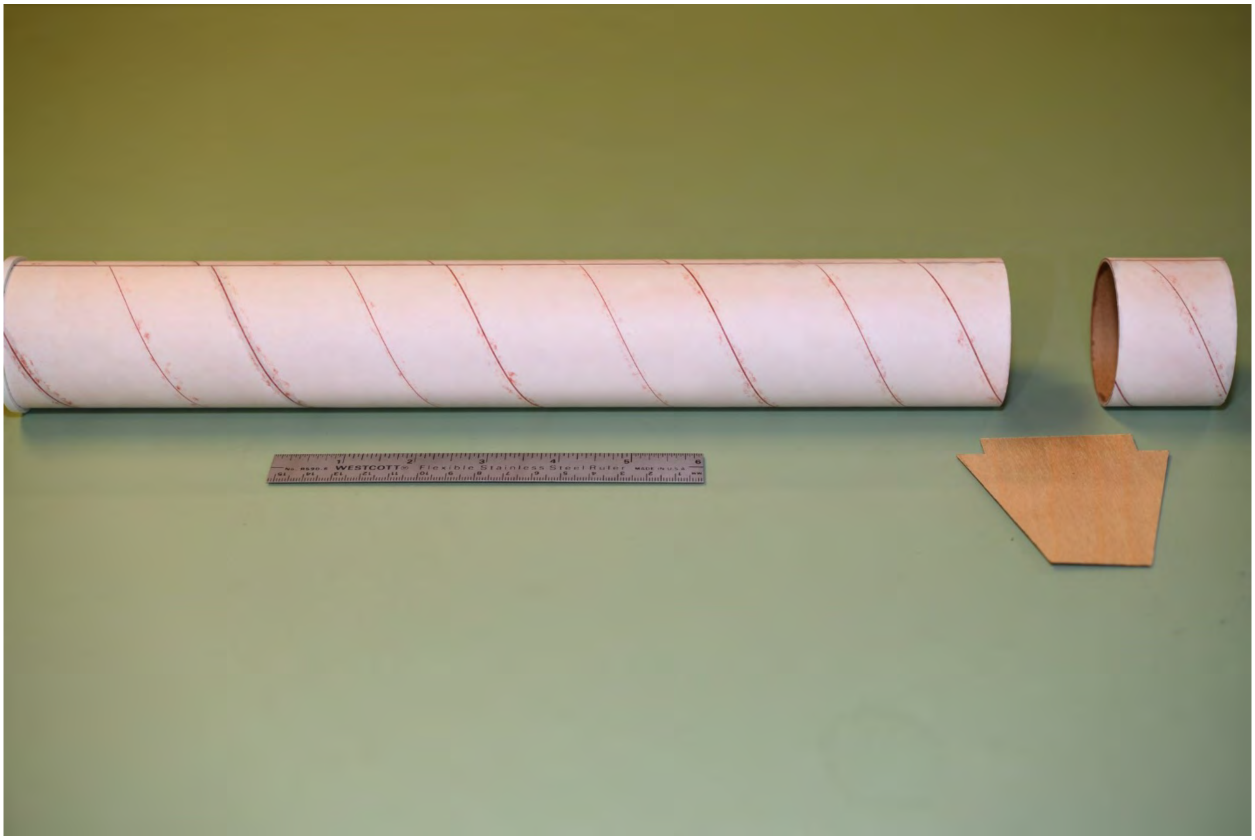

Photo 8: Native Booster Airframe

The Nike Forward Flange

The Nike motor drawing in our earlier Figure 1 shows the forward flange as having an OD of 17.572"; that returns a scale diameter of 2.257". We need to add 0.070" to the radius of our airframe to reach that target.

The prototype flange has a length of 0.925", or 0.119" at our scale factor. The forward end of the airframe is marked for this depth, and then the flange is built up with 0.125" wide x 0.020" thick Styrene strips. Contact Cement is used to secure the first strip, mainly because I like the instant bond it provides as the strip is wrapped round, and it solidly grabs the strip ends; no lifting. Each follow-on strip was glued to the underlying Styrene strip with Tamiya Extra Thin Cement. Strips were added, with the diameter frequently checked, until the flange reached the required diameter.

Once cured, the flange was sheared flush to the airframe with a coarse grit, leaving the flange at the required scale length.

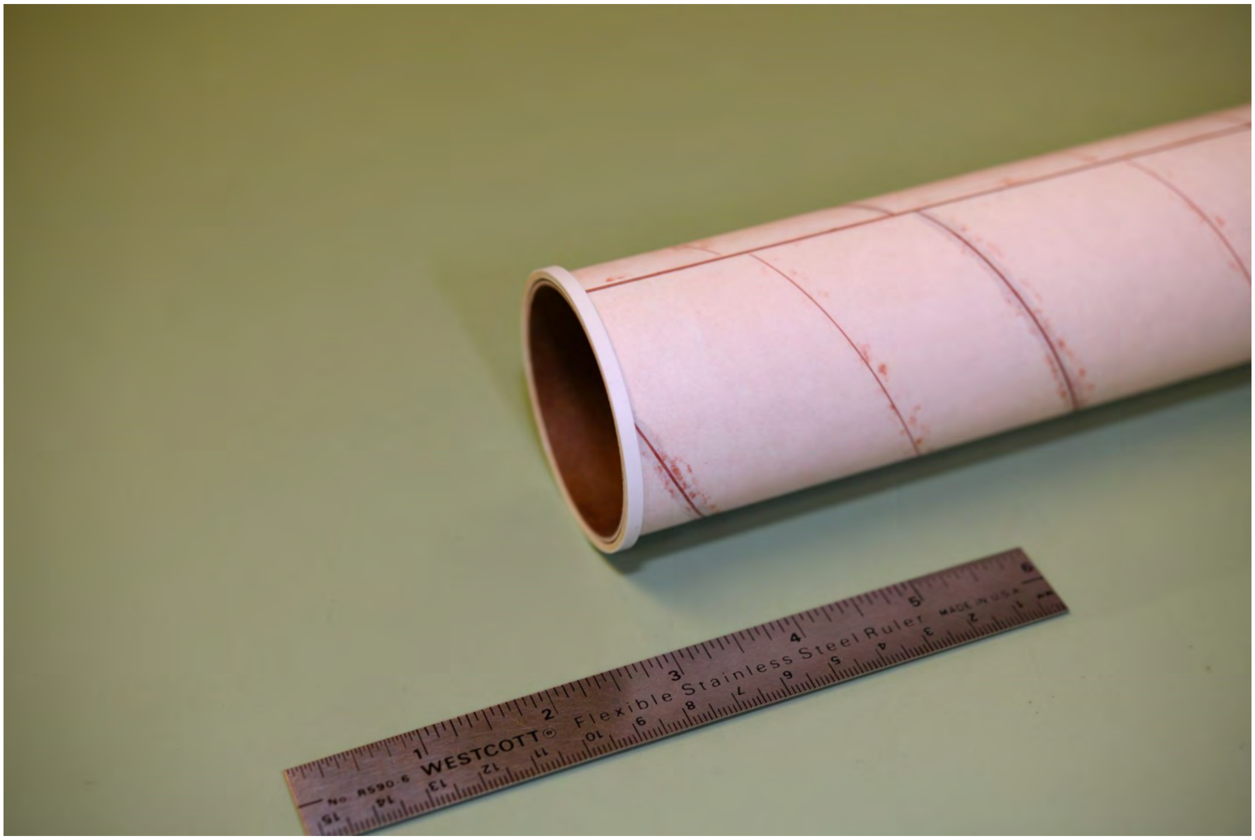

Photo 9: Forward Flange

Next, a conical transition was fashioned from 67# cardstock. Computing and plotting the transition shroud is easily done with any of the various online transition template widgets, but we must keep in mind to subtract a short distance from the computed length of the transition to allow for the fairing of the aft edge. In this case, that fairing distance (easily calculated with some trigonometry) is 0.055” (almost 1/16″). A trial fit is shown in the following photo, and one can see I’ve marked for the fairing distance.

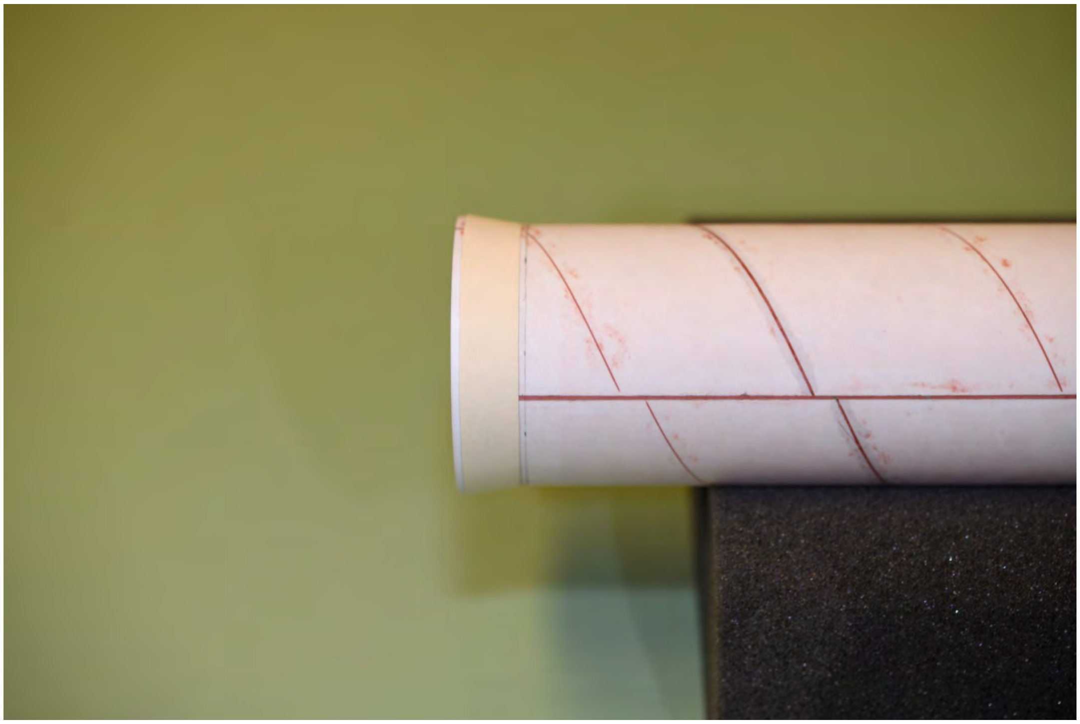

Photo 10: Transition Dry Fit

As Photo 10 shows, I like to allow for an overlap on the forward side of the transition; once the epoxy sets, I can shear the overlap with an appropriate grit, revealing a nice, crisp joint.

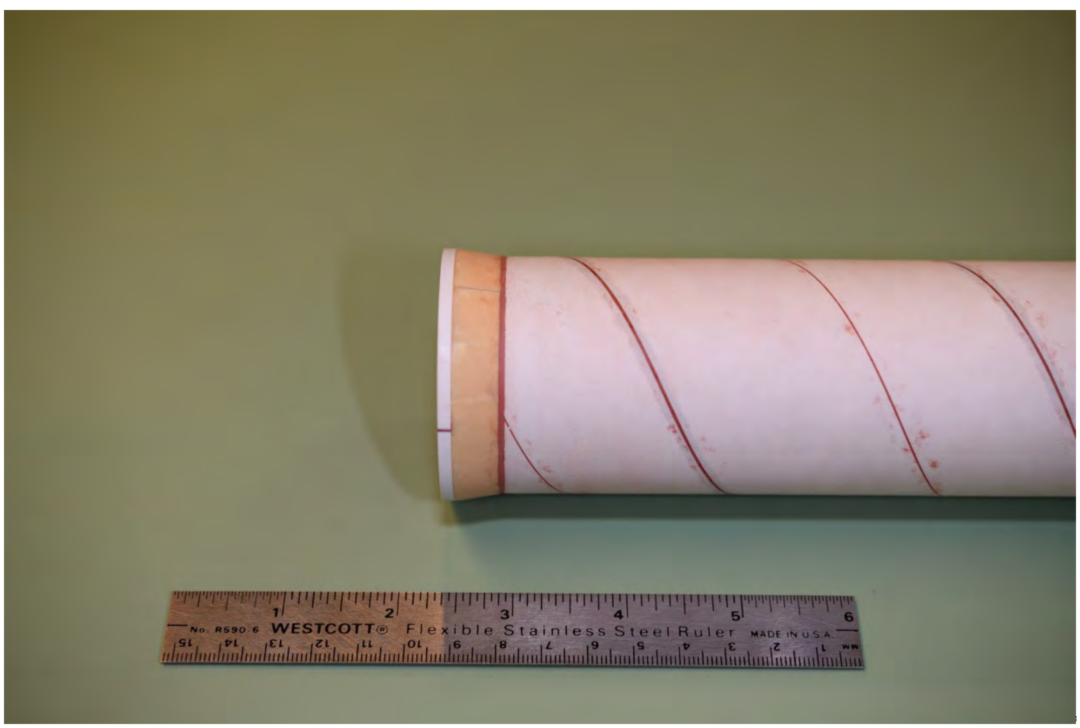

Photo 11: Native Transition

The photo also shows that the transition's aft edge has been faired; with this, we'll set the forward booster section aside, and turn our attention next to the Nike booster fins.

Nike Booster Fins

Each of our Nike booster fins will be built up from a 1/32" thick plywood core, each core sized so that its leading and trailing edges sit tangent to the inside face of scale sized 0.010" thick Styrene skins. Having the core edges sit tangent will permit the skin edges to close naturally, providing each fin with the scale knife-edge look we're seeking.

Fin construction begins with the preparation of the plywood cores. Unfortunately, the 1/32" ply supplied in my local craft and hobby shops seems to come standard with a built-in warp; that warp will compromise our fin construction. We can mitigate the warp by building up each core from two pieces of 1/64" thick ply, with the inherent warps glued opposed with thick CA.

Each laminated core ends up around 0.040" thick, in part due to the fact that most 1/64" ply is actually finished 0.5 mm ply (0.020" thick). Gluing the blanks together creates a lamination thicker than our target, and so with some industrious surface sanding we arrive at four warp-free fin cores of the required thickness.

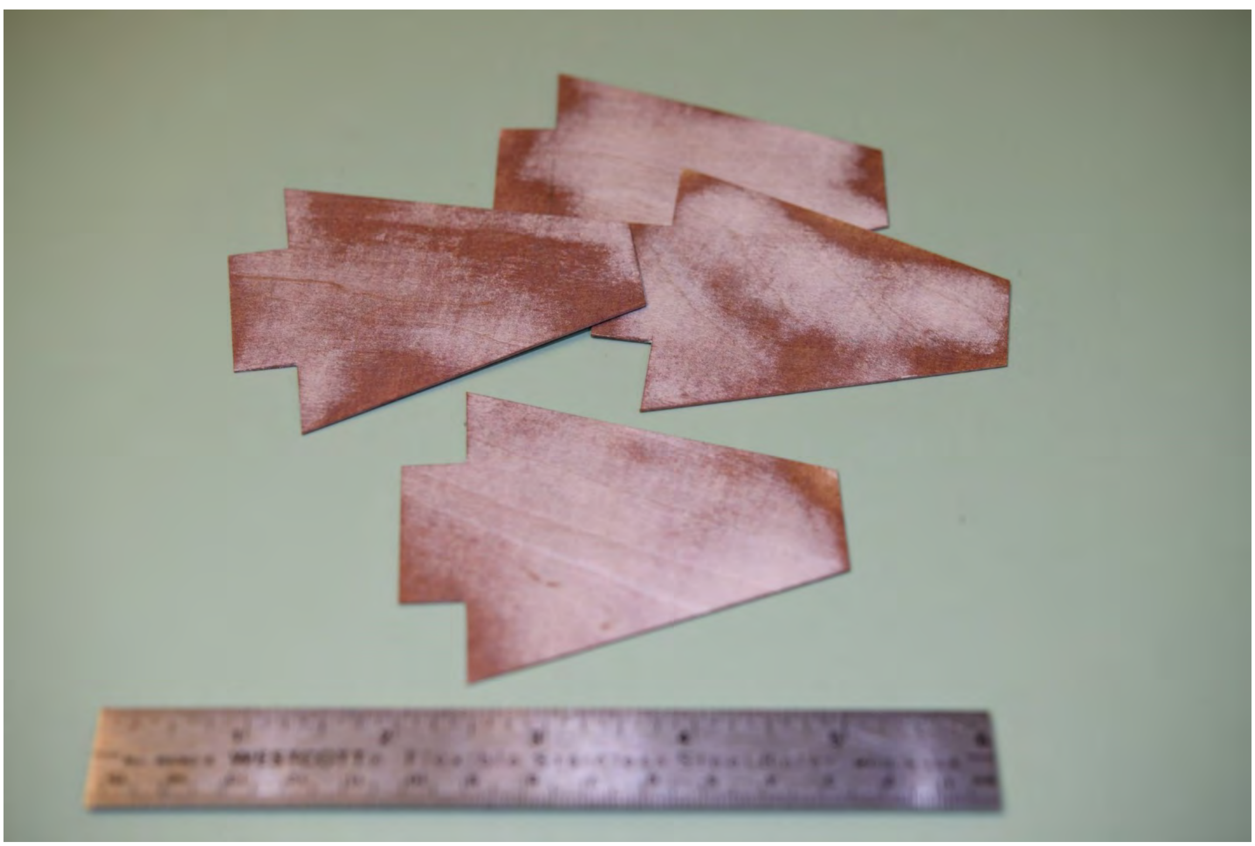

Photo 12: 1/32" Thick Plywood Fin Cores

One should note that I've trimmed the fin cores at the tip about 1/32" short of the full-scale span. This is so there will be a small well at the tip once the fin skins are applied, allowing the tip to be filled and sanded smooth.

With this type of built-up fin construction, it's fairly typical to face each core with a balsa slab that is then sanded to the required tapered diamond shape. However, I find that my attempts to hand-sand the slab are often inconsistent, so I opted for a different approach.

In this case, a 1/32" thick plywood center spar was glued to each side of each core, each spar precisely cut to the angle of the taper, root to tip. A pair of 1/32" ply strips was added to support the spar, and to stiffen the core.

Photo 13: Fin Center Spar

In Photo 13 one can see that I've also temporarily placed the fin plate, as a guide to keep the construction flush with the root.

Next, we'll add some 1/8" thick balsa strips along the fin root; once sanded to shape, these strips will provide the gluing surface for the skin root edge. We'll do the same to the tip for the same purpose.

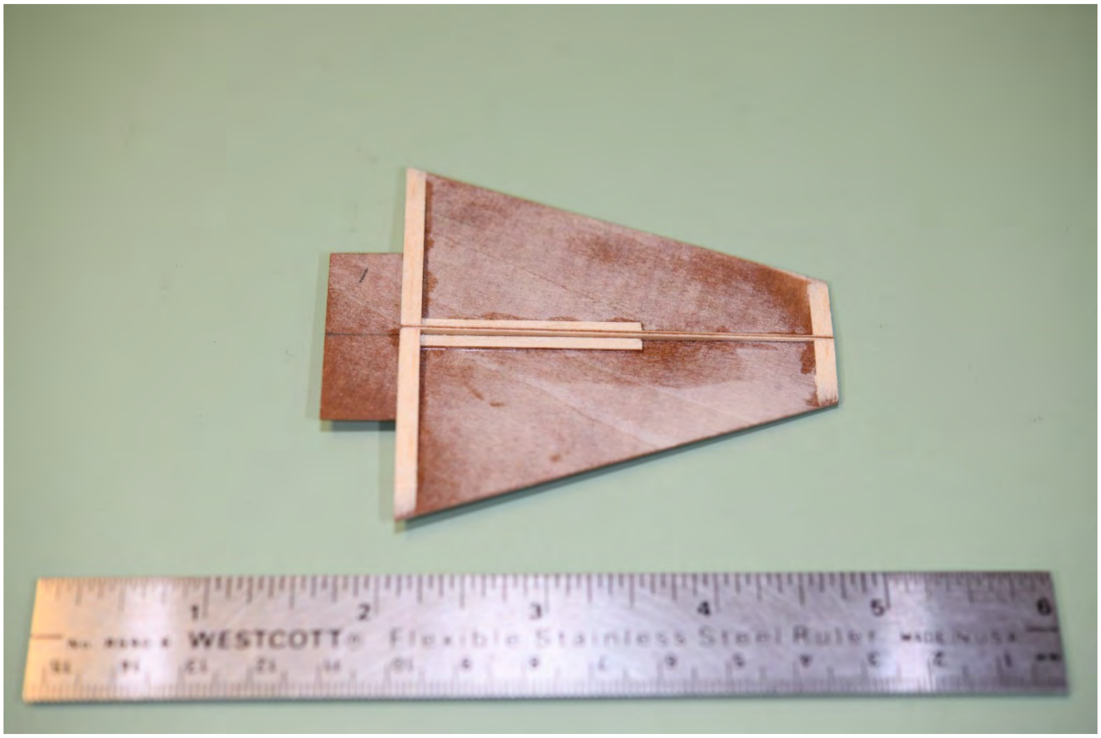

Photo 14: Finished Fin Core

Once sanded, we arrive at a stiff, lightweight and tight diamond profile, as the following photo shows.

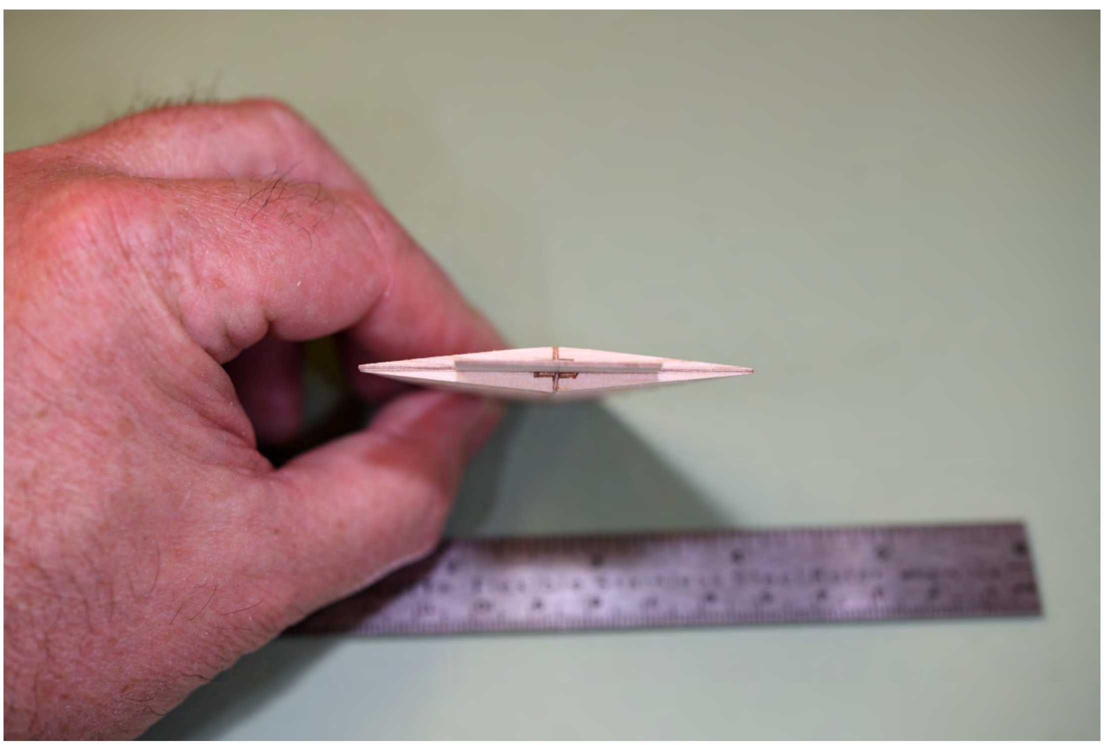

Photo 15: Fin Root

Our next step is to apply the Styrene fin skins. But before we set those skins, we need to detail them a bit to reflect the manner in which the prototype skins were fastened to the prototype's fin core. Our earlier Photo 4 offers a hint of a row of flush rivets along the center spar, and we can get a closer view of these rivets in the following Nike fin photo. If one looks more closely, one will also see two additional rows of rivets along the root, just above the mounting flanges.

Photo 16: Rivets, Rivets, Rivets

Photo by Josh Tschirhart

[**http://meatballrocketry.com/nike-orion-photos/**](http://meatballrocketry.com/nike-orion-photos/)

Simulating those rivets requires a riveting tool, and we can make one of those by cutting the end off of a glue syringe tip of a size that matches the diameter of our rivets. This is then inserted into a pin vise.

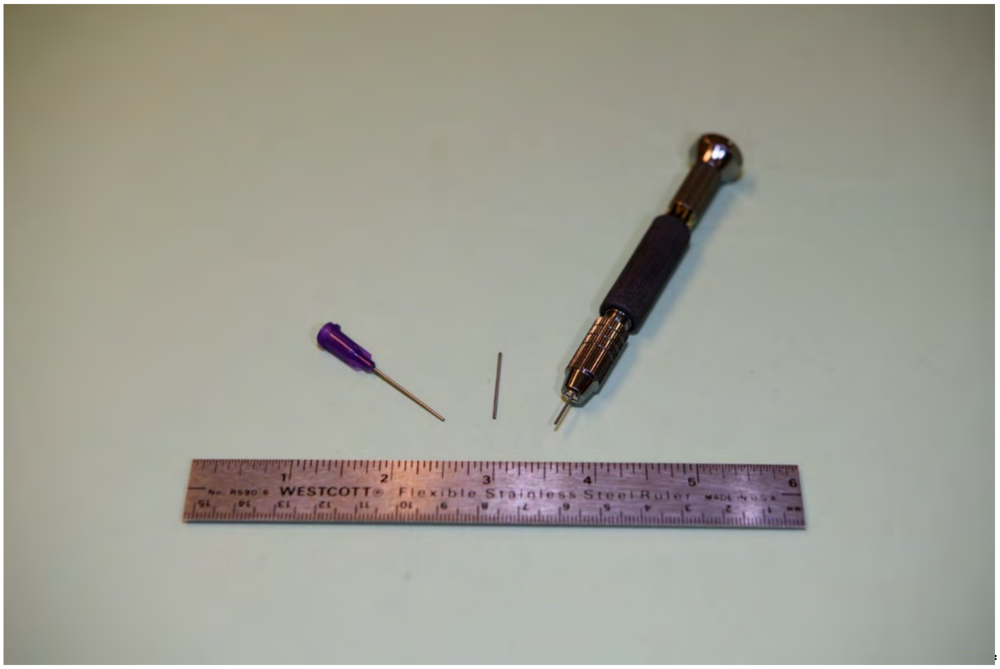

Photo 17: Riveting Stuff

Next, a rivet pattern template is prepared. Here, I'm punching the rivet hole pattern into a length of 0.015" thick Styrene, which I'll use as a guide for the riveting tool.

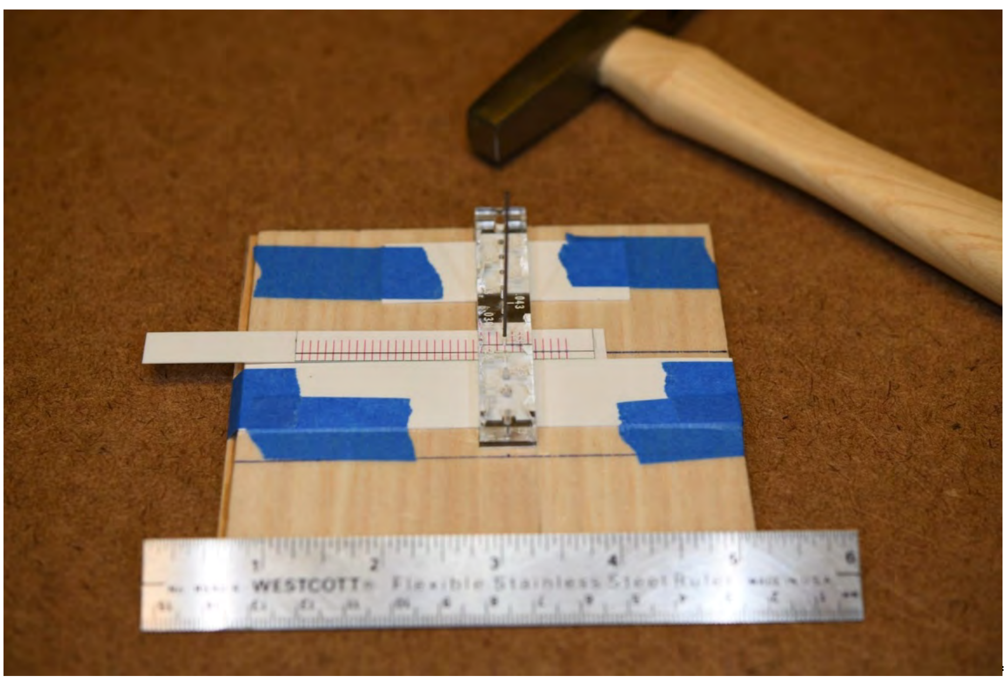

Photo 18: Rivet Template

The template is then taped in place on the fin skin, and with some consistent pressure applied with the riveting tool, hole by hole, we arrive at a set of flush rivet impressions on the skin.

The riveting process is repeated on the opposite fin skin, putting us in position to glue the freshly pressed skins to the core; we'll use thick CA for this step. Next, we'll prepare the leading and trailing edge cuffs, which are fashioned from scale width strips of 0.005" thick Styrene. They too are fitted with their own rivet template, are pressed, and then are cemented in place with thinned MIG Ultra Glue (an acrylic adhesive), as solvent-based cements (and some CA's) are far too aggressive for these thin Styrene strips. Formula 560 Canopy Glue would also work very nicely for this step.

The finished native fin is shown in the following photo.

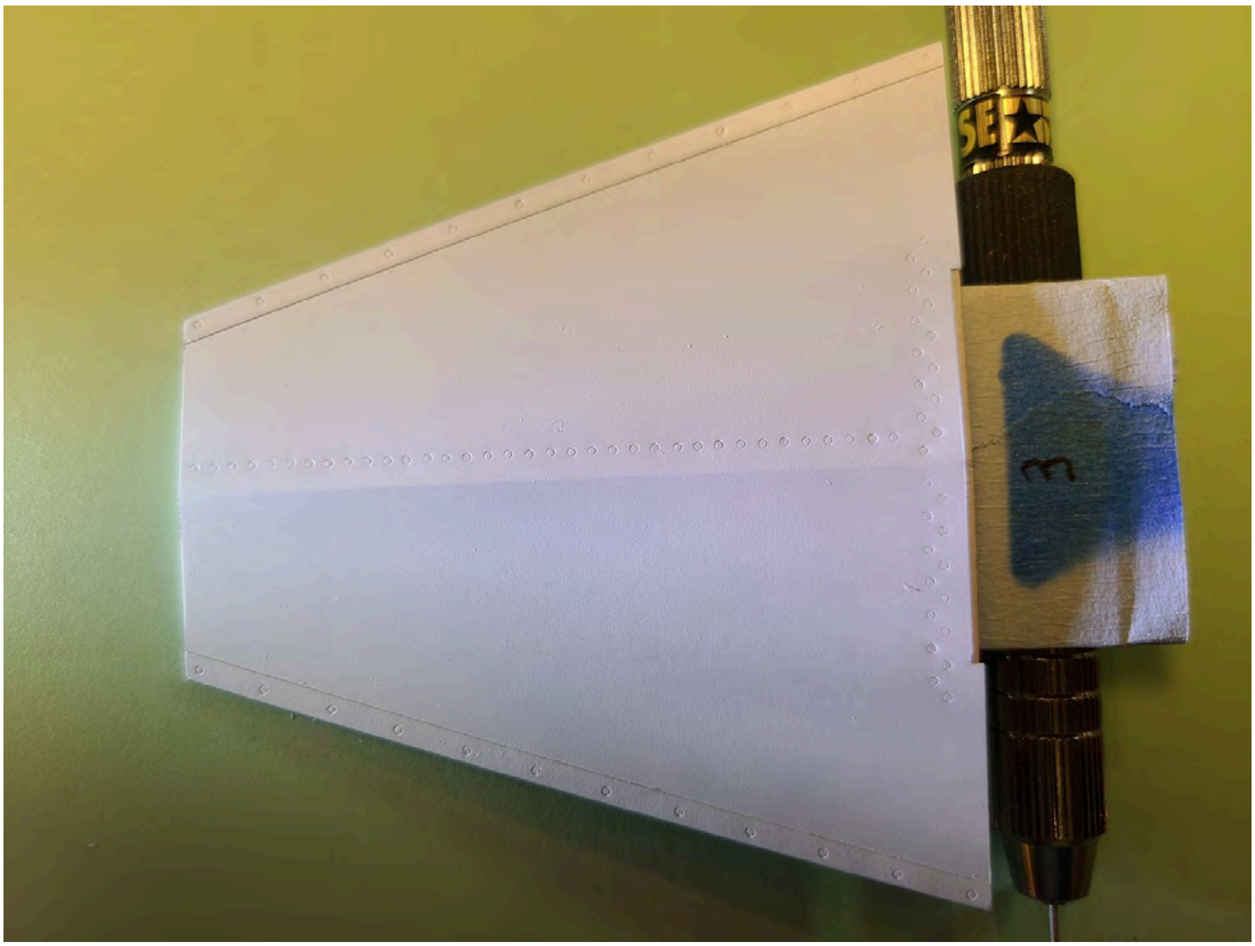

Photo 19: Finished Native Fin

The photo reveals a narrow cutout in the root of the fin skin, and this emulates the cutout we can just make out at the flange ends on the prototype fin in Photo 16. Most of that cutout will be covered by the fin mounting flanges when they are installed during final assembly.

The fin's open tip face was filled with Vallejo's Plastic Putty; for this application we need a non-solvent-based filler to avoid deforming the thin Styrene fin skins. This water-based acrylic compound did the trick, as would an epoxy and micro-balloons mix, or any other appropriate non-solvent-based filler.

Photo 20: Tip Putty and Cuff Glue

With some earnest lathering, rinsing and repeating, we arrive at four native Nike booster fins, ready for the Paint Shop.

Nike Booster Fin Paint

Having expended all that time and effort pressing those subtle surface rivets, it would be a shame to subsequently obscure them with a thick coat of rattle-can paint. We can mitigate this issue with a fine pigment and an airbrush.

To begin, we'll prime the fins by airbrushing them with Tamiya's Gray Liquid Surface Primer, thinned to airbrush consistency. Once cured, the fins were then airbrushed with GSI's Mr. Color #1 Gloss White lacquer paint, and set aside to dry.

Next, the serial number text was added to the fin roots, as seen on the prototype fins in our earlier Photo 4. While not all relevant photos are included here, Paul Lubertowicz's photo set does provide the serial number data for each fin. The text was prepared in MicroSoft Word, and printed onto Bare Metal Foil's Expert's Choice laser decal film with an HP LaserJet printer. The markings were then placed with MIG Ultra Decal Set, and snuggled down with MIG Ultra Decal Fix.

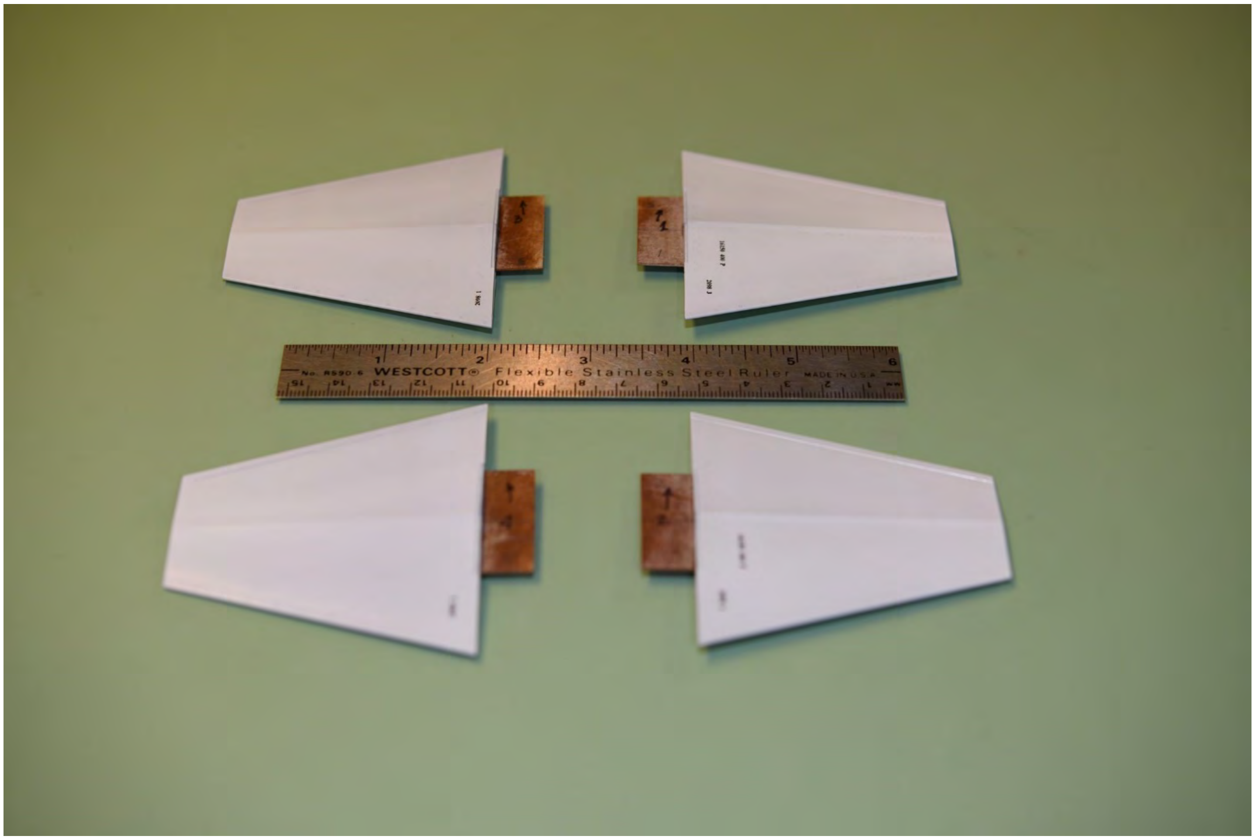

Photo 21: Finished Nike Booster Fins

And there you have it - four finished booster fins, ready for installation. Up next, the booster fin cage.

Booster Fin Cage

Let's start by gluing the aft fin can onto the MMT. Note the Styrene ring, which functions as a spacer.

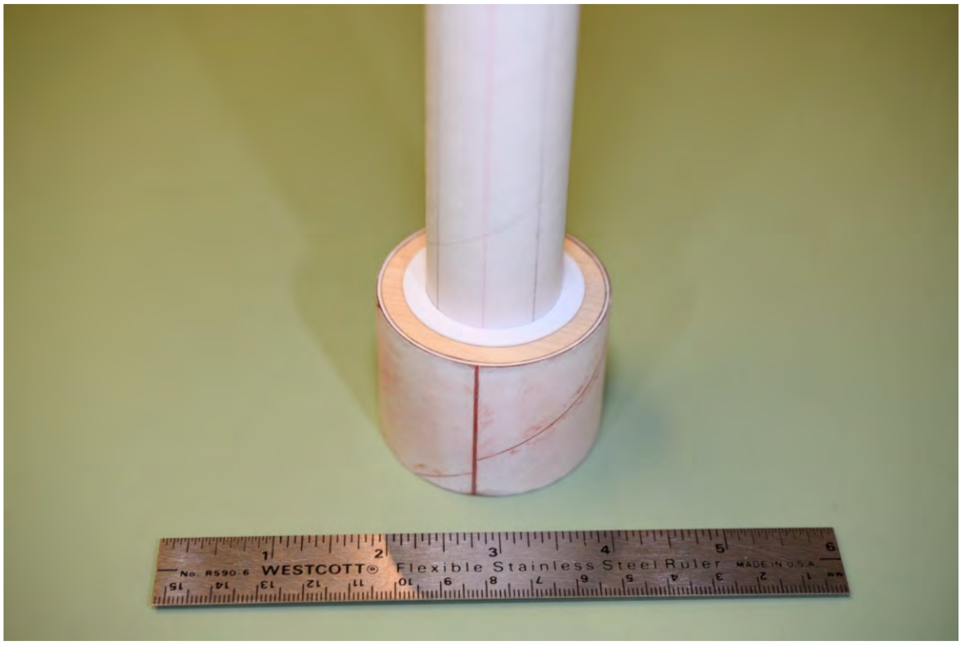

Photo 22 Aft Fin Can

Each 1/16" thick plywood fin plate is fitted with a pair of 1/8" square basswood supports; once installed, these plates lock the cage together, and the supports provide additional gluing surface area for the fin tabs.

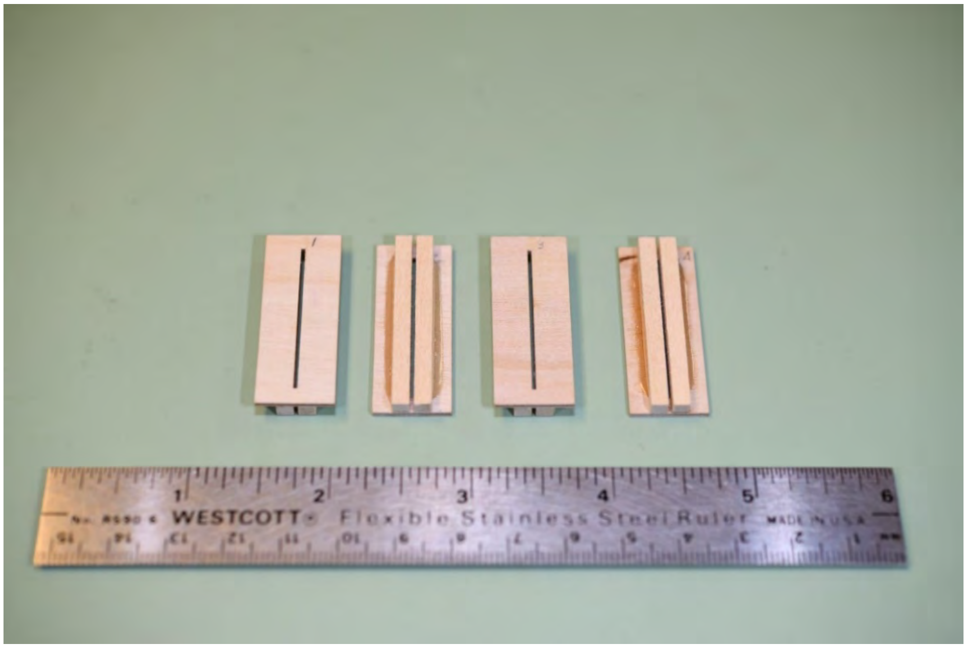

Photo 23: Modified Fin Plates

Some glue, and our fin cage is ready for installation.

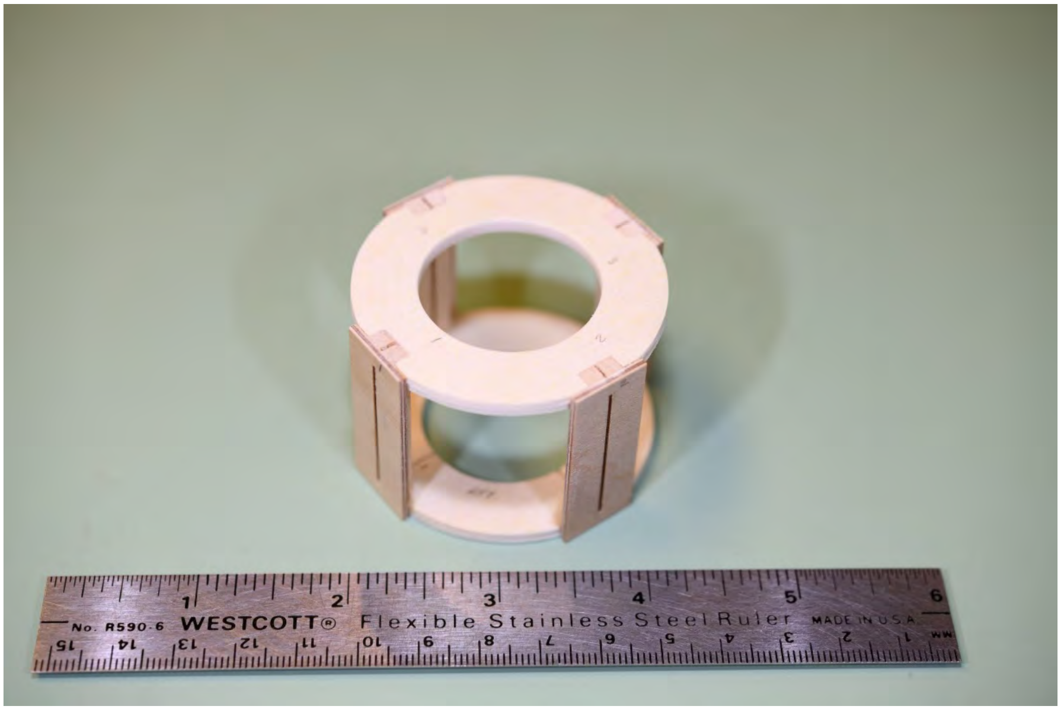

Photo 24: Fin Cage

A quick dry fit provides a glimpse of the skeletal assembly.

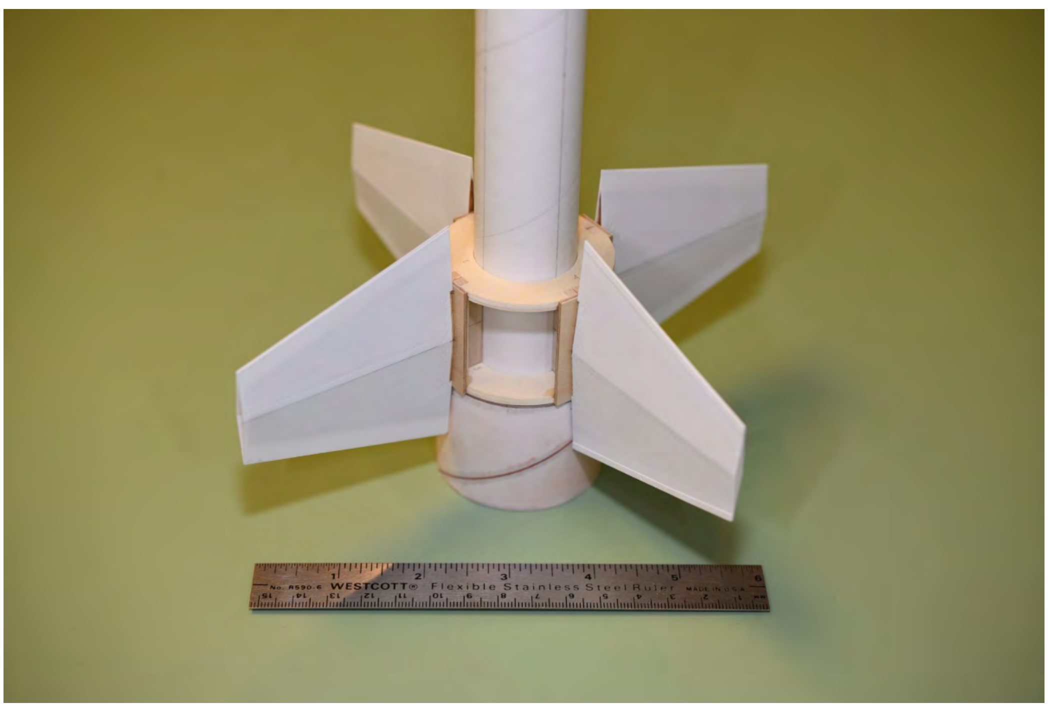

Photo 25: Fin Cage Dry Fit

Next, we'll add the forward Styrene spacer and centering rings, the shock cord anchor, and install the upper airframe, putting us in position to prepare the sleeve that fits over the nozzle area.

Nozzle Sleeve

The nozzle sleeve should be crafted from a material that will readily wrap around the airframe, keeping in mind that there are four openings to be made to accommodate the four fin plates. It's those fin plate openings that cause some difficulty with the wrap - each of those openings break the tension in the material, and so as the sleeve wraps round, the edges of the openings lift. This effect skews the material choice towards something more flexible, the tradeoff being that usually more flexible materials tend to be thinner, and we have a thickness goal that we're trying to manage here.

From our earlier Figure 4 we can calculate the sleeve's scale thickness, and the math returns a value of about 0.014". Sheet Styrene is much too stiff for the diameter we're dealing with; 67# cardstock makes for a better and more flexible choice. Even though this material is easier to work with, it will still present edge lifting around the fin plate openings, so some balsa infill was placed in these areas to provide a surface to secure the edges to. The infill was sized to preserve the prototypical gaps around the fin plates.

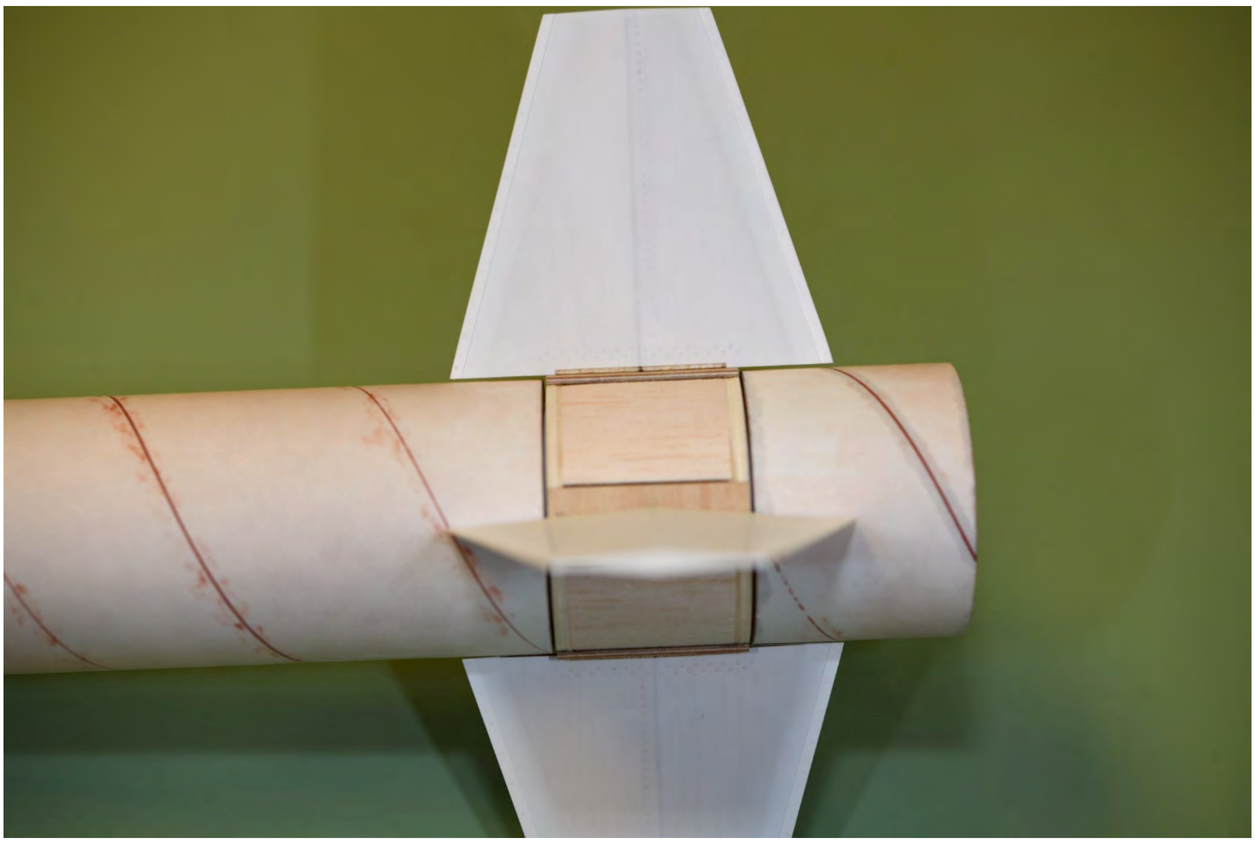

Photo 26: Balsa Infill

Since 67# cardstock is not thick enough to deliver the sleeve's thickness goal, an underlay of 24# printer paper was applied first.

As for the sleeve's layout, let's revisit the part. Our earlier Figure 3 and Photo 5 indicate an overlap seam that closes the sleeve on the nozzle area. We can just make out evidence of this seam on our prototype in the left side of the following photo, in between the launch rail lugs.

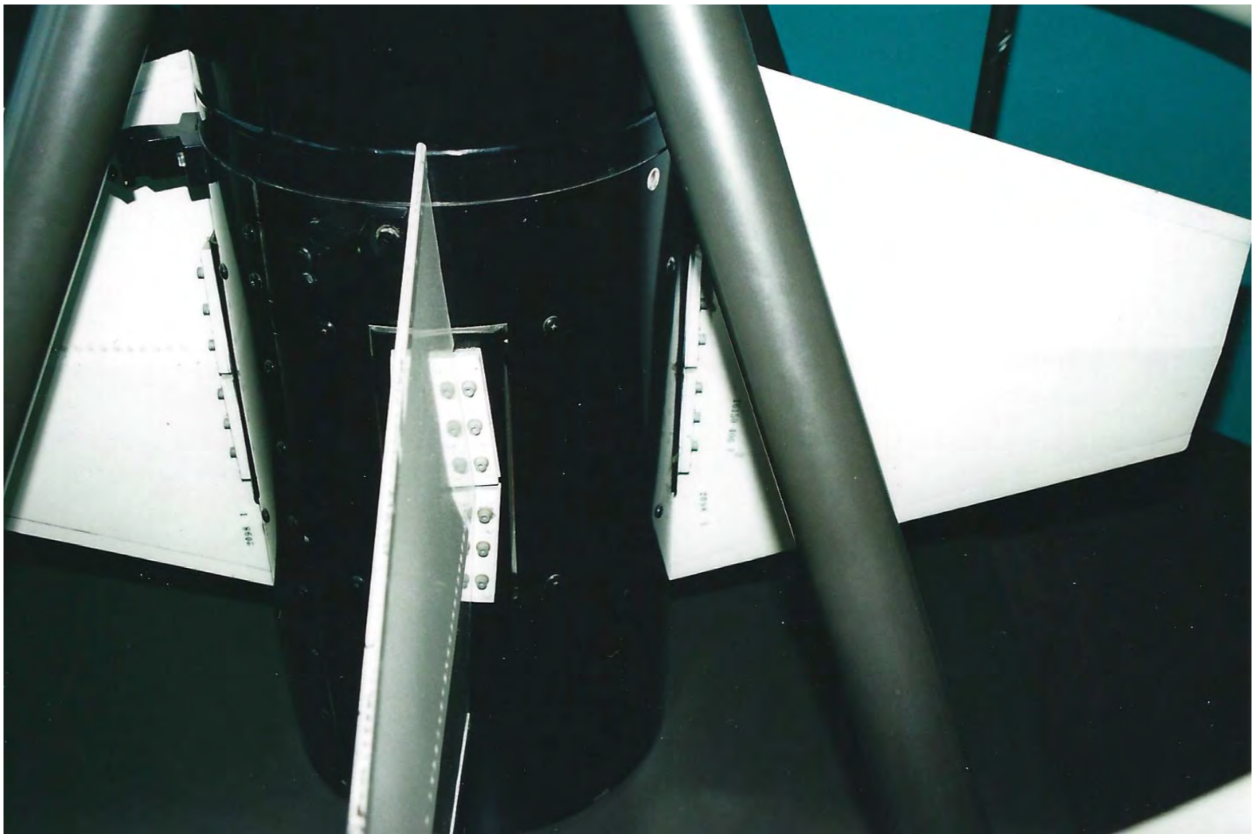

Photo 27: Prototype Booster Sleeve Seam

Photo by Paul Lubertowicz

The photo's angle, combined with the camera's flash, makes it difficult to properly assess the sleeve seam, so we'll refer to the following photo of a Nike-Orion booster which provides a much clearer view.

Photo 28: Booster Sleeve Seam

Photo by Josh Tschirhart

(http://meatballrocketry.com/nike-orion-photos/)

With this information in hand, the sleeve was drawn in CAD, printed on 67# cardstock, trimmed, and then placed on the model with thin CA.

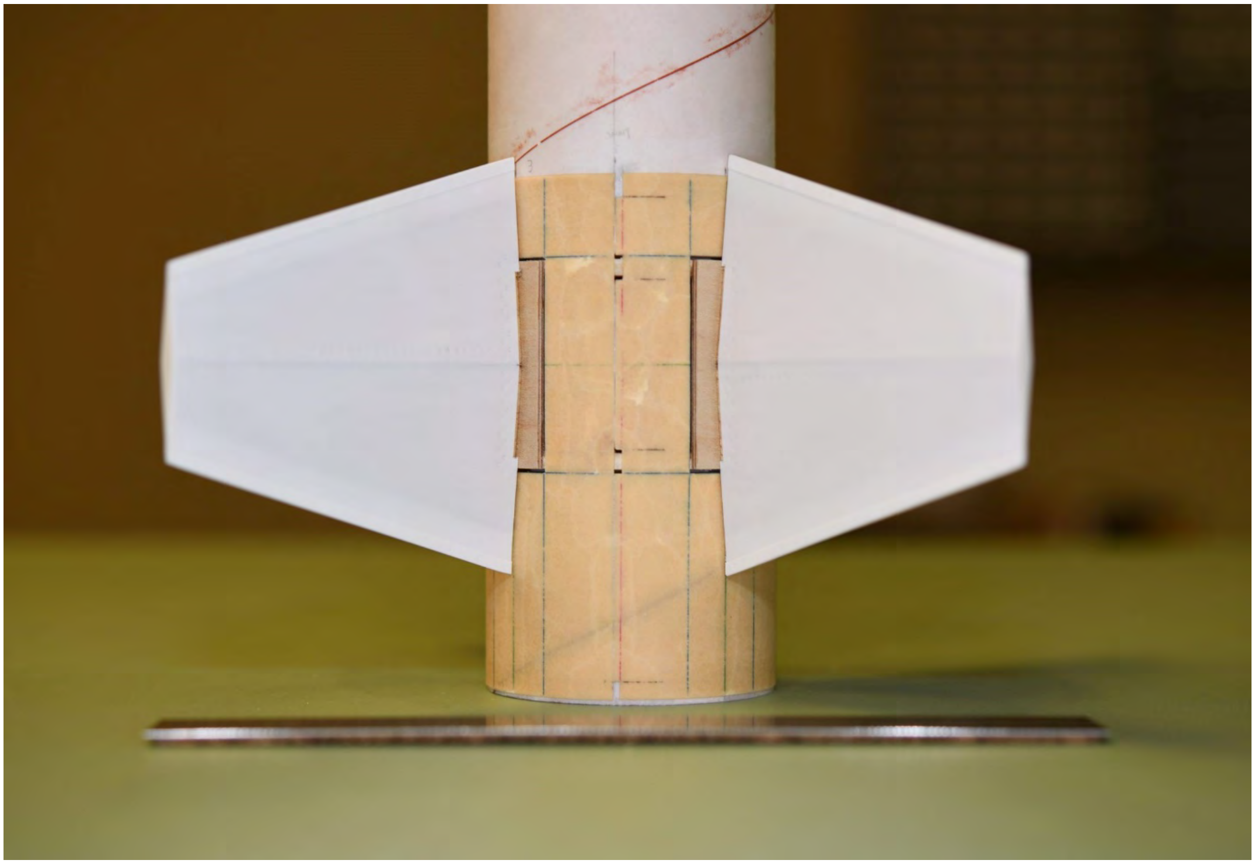

Photo 29: Model Sleeve Seam

The various sleeve screw fasteners seen in Photo 28 will be added once the booster airframe has been primed. But before we do all that, there's a remaining detail that we need to take care of.

Launch Rail Lugs

Our earlier Photos 2 and 27 offer hinting glimpses of the lugs that secure the booster to the launch rail. Unfortunately, the perspective presented in each photo prevents us from accurately scaling the lugs' full size and shape. Photo 27 does show that the top edge of the aft lugs is flush with the forward edge of the nozzle sleeve; this at least helps us properly locate the part on the model.

It should be noted that the booster's fore and aft lug pairs is an arrangement different from the lug scheme illustrated in Peter Alway's ROTW drawing and the Bristol blueprint; those drawings depict the lug arrangement for an inline launcher. This difference has later implications for the Drag Ring segments and their orientation when we construct the Interstage Adapter. As for the rail lug's proper size and shape, we have access to a Nike-Apache drawing prepared by Mike Dorffler, which helps resolve these issues.

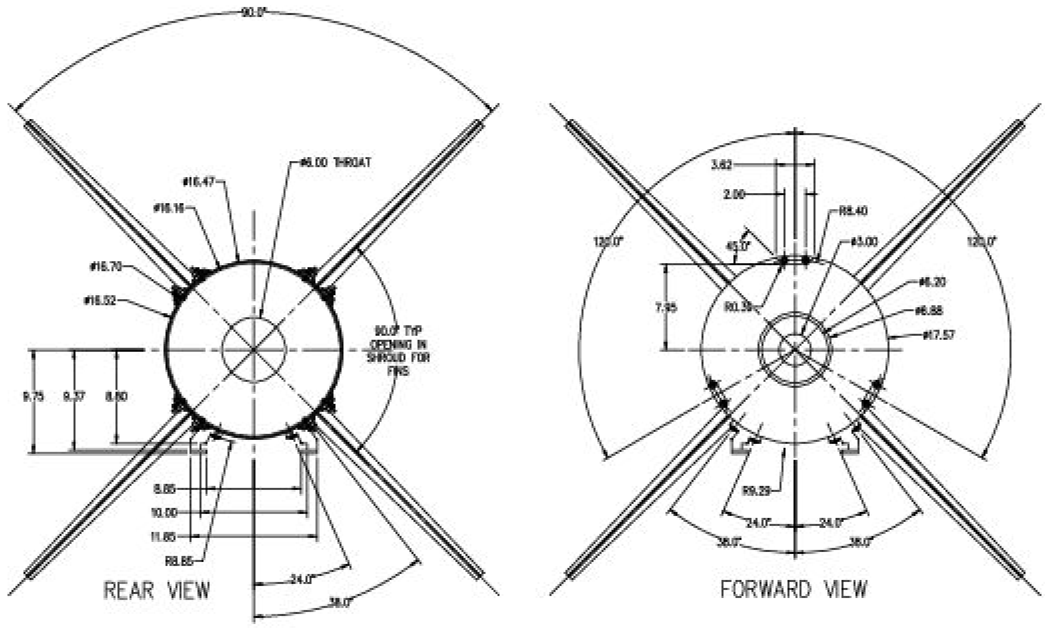

Figure 5: Nike Launch Rail Lugs

Drawing by Mike Dorffler, courtesy of Josh Tschirhart

From this data we'll craft masters built up from Styrene pieces and then resin-cast solid final parts for the model.

One of the tricky aspects about crafting these lugs is fashioning their mounting bases. As Figure 5 shows, the prototype's lug base is rather thick (about ½", or 0.064" at our Scale Factor), and it's milled to match the outer radius of the booster sleeve. One could attempt to use a strip (or strips) of Styrene for this base, but the tension in the material won't permit it to conform readily to the airframe's radius, at least not without permanently mounting the strip(s). As we're trying to avoid building up the part on the model, it means a different solution must be found to form these pre-curved bases.

To create the base, a molding frame was fashioned from strips of 0.060" square Styrene. Two molds of the proper length and width were created within the frame, one for the aft lug and one for the forward lug. The frame was then wrapped around the airframe, with a layer of waxed paper placed in between, and secured with masking tape. Some Apoxie Sculpt® clay was prepared and pressed into each mold, then screeded to the top of the frame.

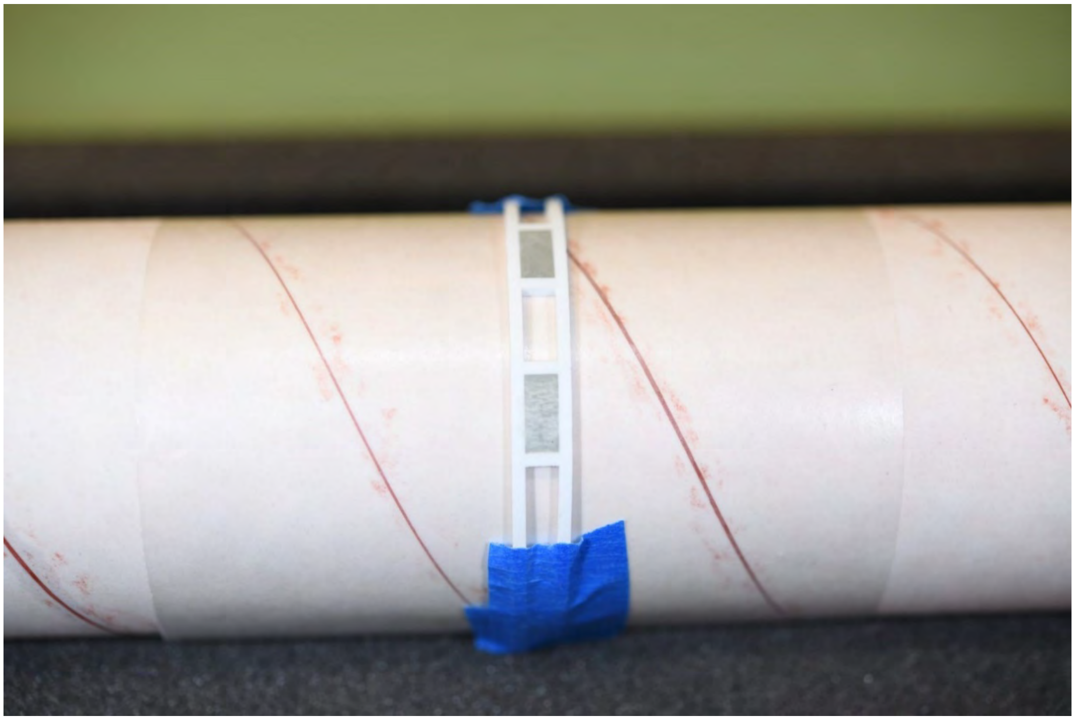

Photo 30: Lug Base Molding Frame

Once the epoxy clay had cured, the molding frame was removed from the airframe, and the now hard, curved bases popped from the molds.

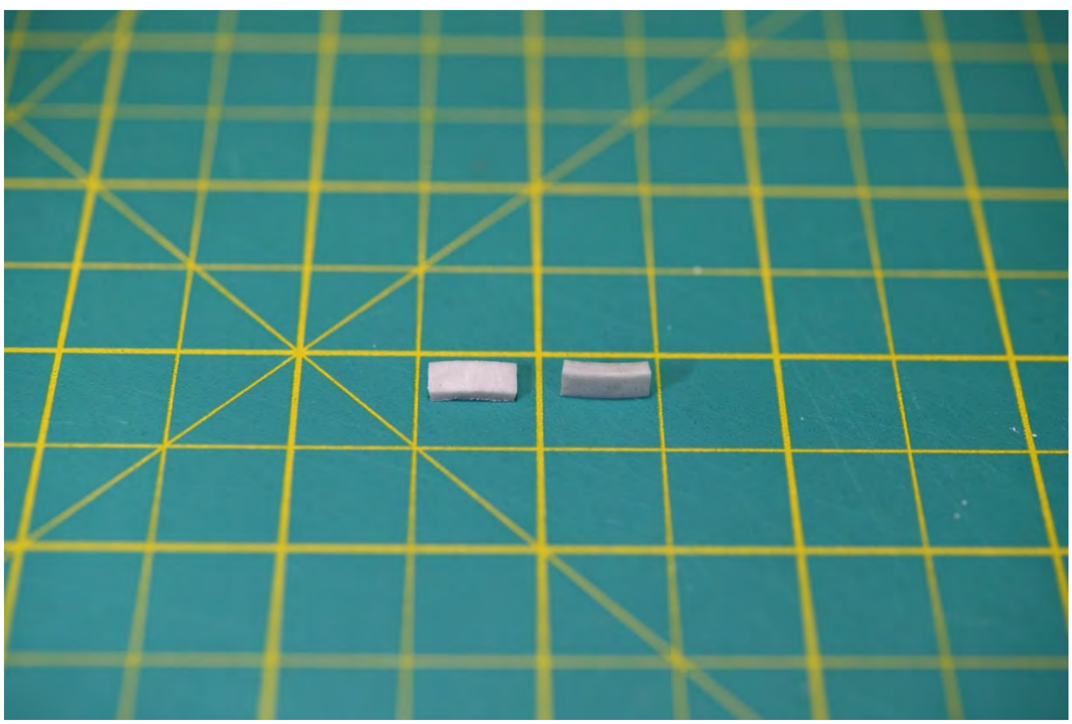

Photo 31: Lug Bases

The balance of each lug was built up from Styrene pieces and then glued to the clay bases. Some prep, and the lugs were ready for casting.

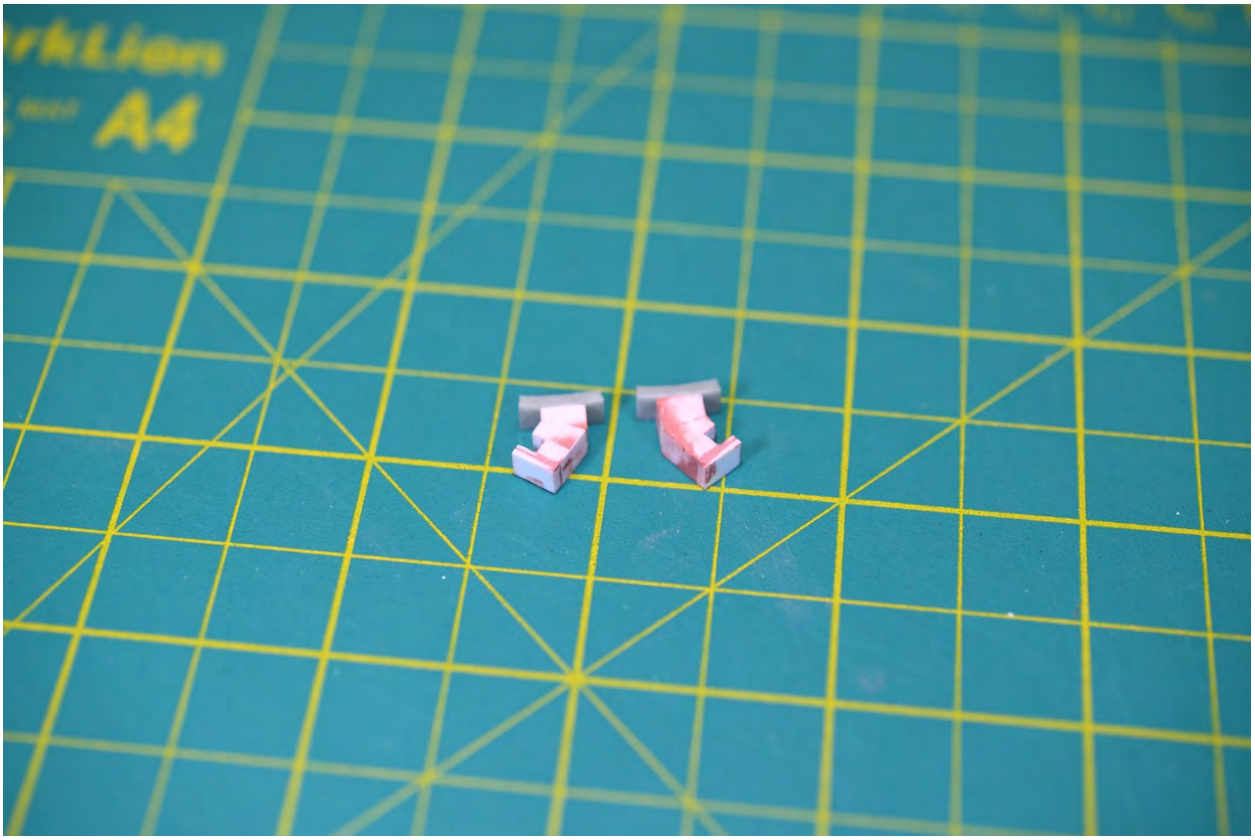

Photo 32: Ready for Casting

The lug masters were placed in a molding box fashioned from sheet Styrene, into which the silicone rubber molding compound was poured, and then allowed to cure. For this application I'm working with the Alumilite brand of casting products, but any quality resin casting system would do just fine.

Peeling the Styrene molding box apart reveals a rubber mold, ready for resin. A couple of quick resin pours and we have our set of cast lugs.

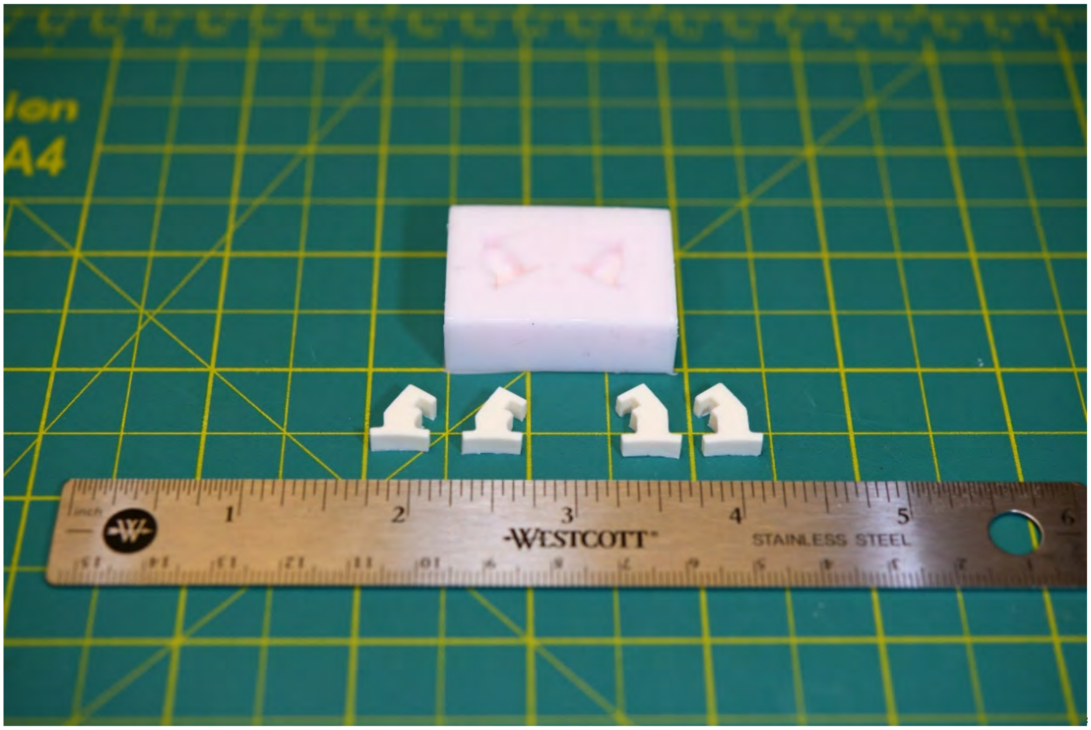

Photo 33: Cast Lugs

A trial fit gives us a preview of the aft end setting.

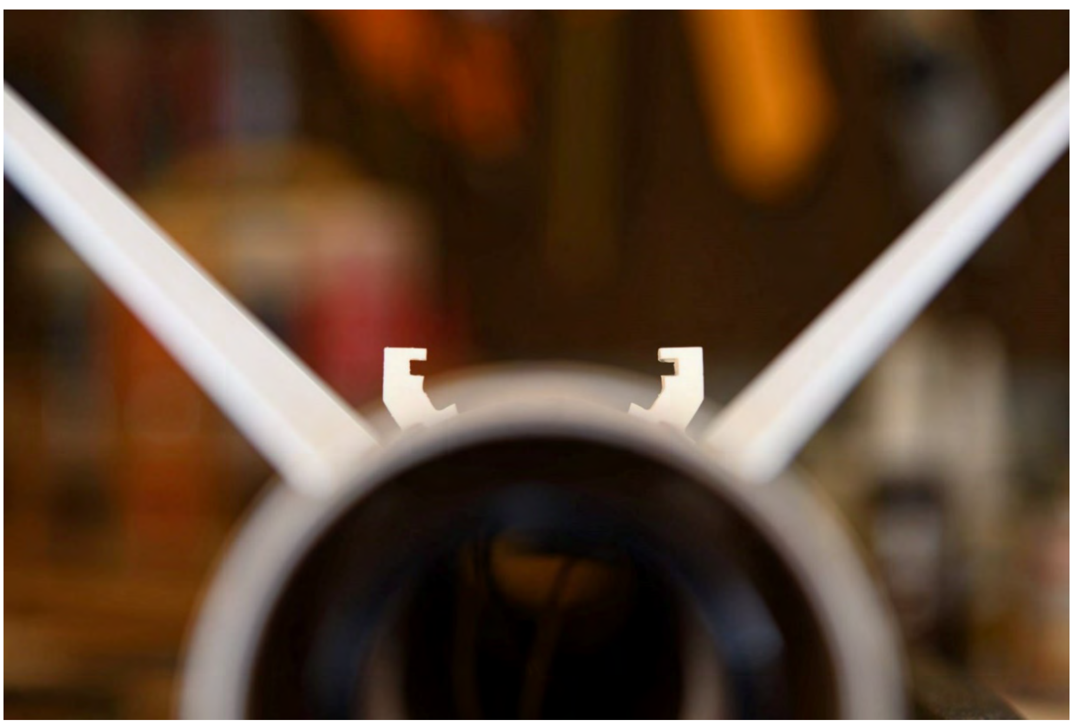

Photo 34: Lug Trial Fit

We'll clean up the residual casting flash, and install the lugs in their final positions, pinning them in place with short lengths of 0.040" diameter Styrene rod. Once the booster is primed, the mounting bolt details will be added. As for priming, it's time to head to the Paint Shop.

Booster Paint & Finish

Satisfied with a base of Rustoleum Automotive Primer, the remaining booster details were added: the case welds, the nozzle sleeve fasteners, and the launch rail lug fasteners.

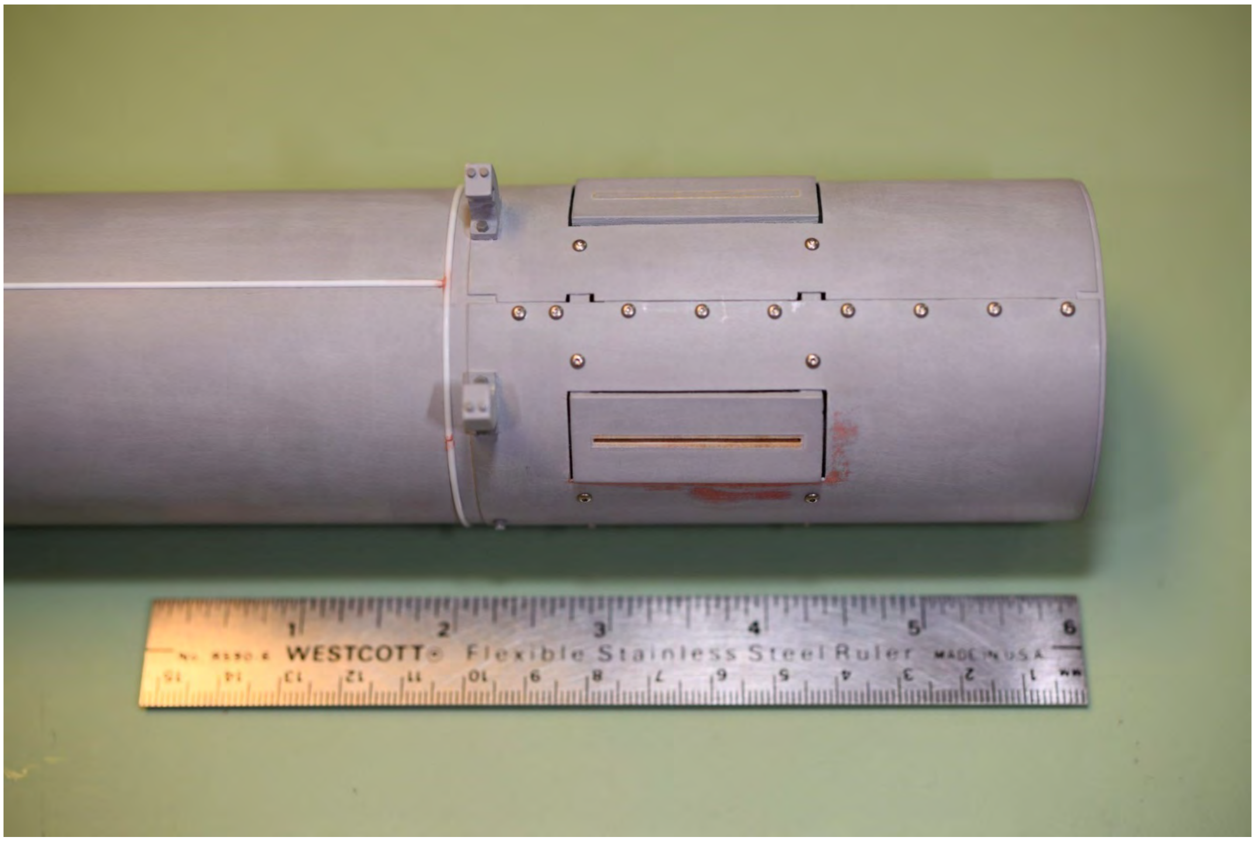

Photo 35: Aft End Details

The booster was then sprayed with Dupli-Color Perfect Match Universal Black lacquer.

While the paint was curing, the two NASA decals were scaled from the following photo, prepared in MicroSoft Word, and printed on Bare Metal Foil's Expert's Choice laser decal film with an HP desktop LaserJet printer.

Photo 36: Booster Markings

Photo by Paul Lubertowicz

Once the decals had been applied and dried, the booster was then over-sprayed with Rustoleum Crystal Clear enamel. Once cured, the fins were installed, arriving at an almost complete Nike booster.

Almost, but not quite. One may have noticed that the fin flanges, as seen in our earlier Photo 4, have yet to be installed. We've waited till this late stage to address these, as it's easier to create and detail these flanges as individual parts rather than as integral extensions of the fins, as we're about to see.

The fin flange base stock is 0.125" x 0.060" Styrene strip. Once cut to length, each flange is held in an alignment jig while it's pre-drilled for the round head stainless steel rivets that will be added. These flange rivets/pins are just barely visible in Photo 4, but are much more clearly seen in Photo 16. A set of right-hand and left-hand flanges is prepared, and then sent to the Paint Shop where the flanges are primed and sprayed white. Once cured, each flange is then placed back into the alignment jig to receive its mounting screws.

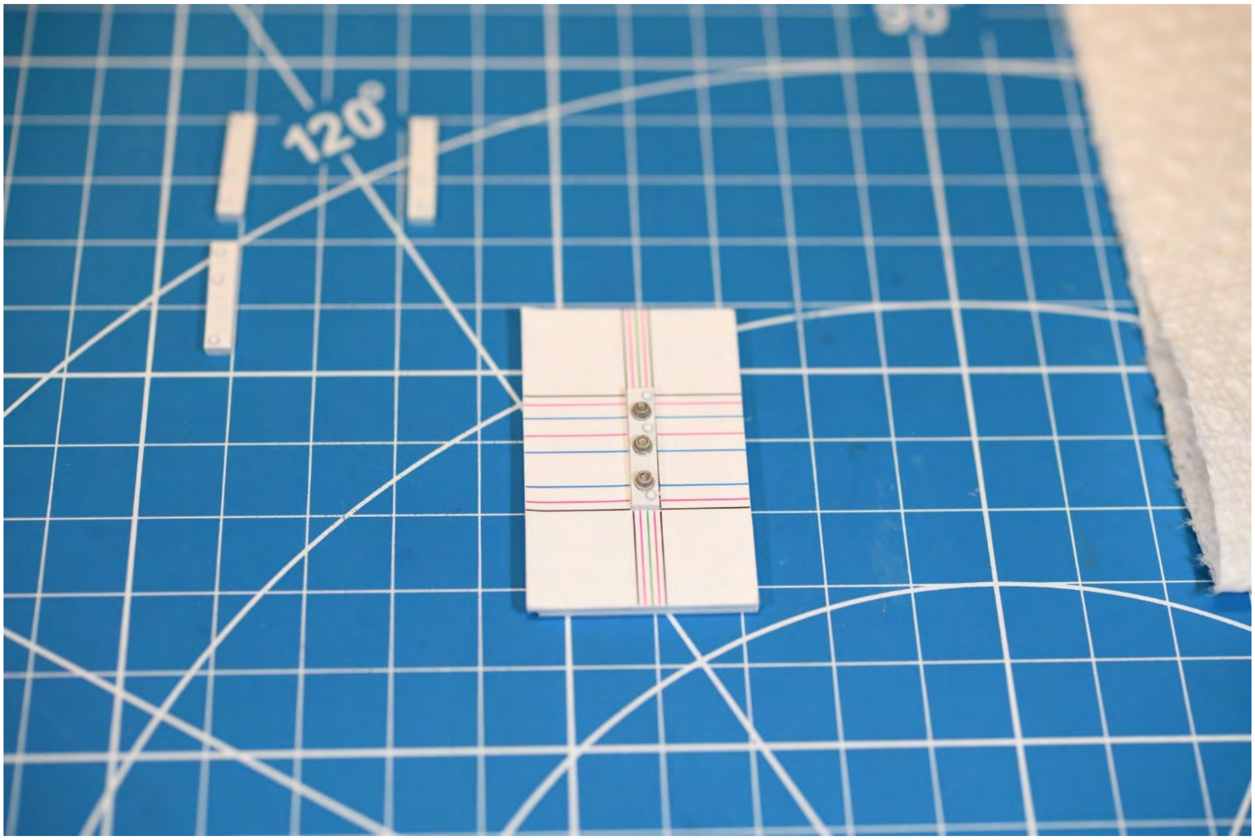

Photo 37: Mounting Screw Application

Each mounting screw is a miniature plastic socket head of the right size, glued to a 0.010" thick plastic disk punched from sheet Styrene, the disk representing the washer that seats each bolt head. Each of these bolt/washer assemblies was painted with Testors Model Master #1780 Steel enamel, and allowed to dry before application.

Each completed flange was then set in the appropriate position on each fin with carefully placed dots of MIG Ultra Glue. And with this, our Black Brant Nike booster is complete.

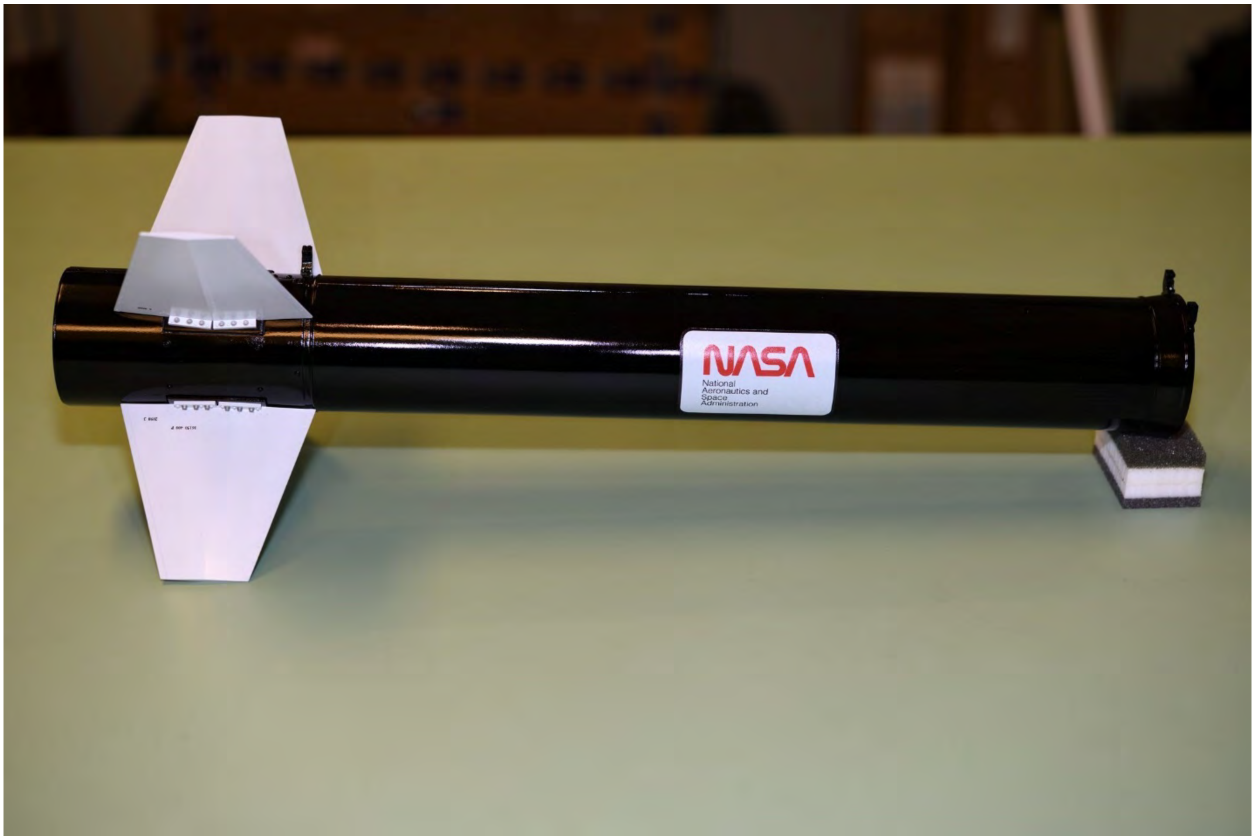

Photo 38: Completed Nike Booster

The Interstage Adapter

As our earlier Photo 2 shows, the Interstage Adapter mates the Nike Booster to the Black Brant VC Sustainer. In our model, the Interstage Adapter will also house the staging timer used to fire the Sustainer motor during flight. Let's take a moment and review the relevant documentation for this assembly.

From Bristol's blueprint we have the following plan view:

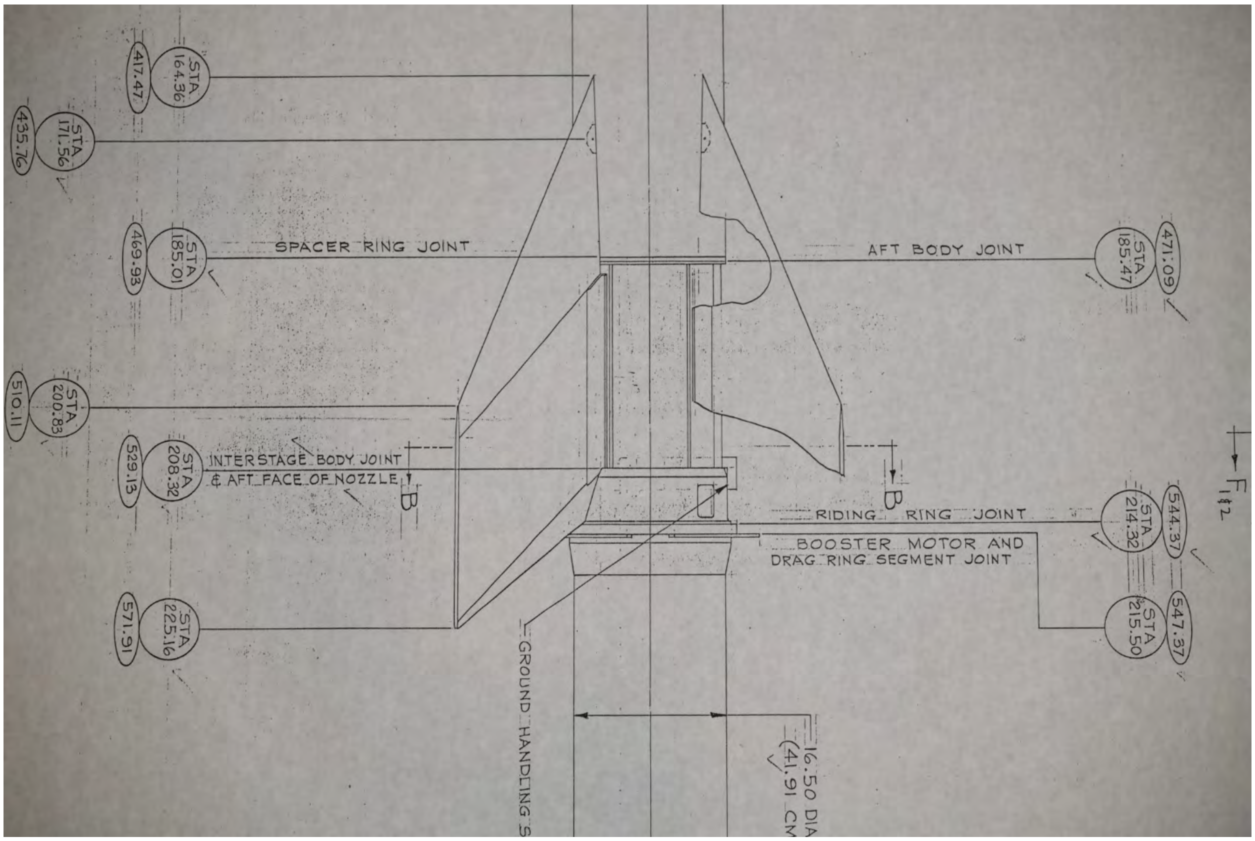

Figure 6: Interstage Adapter Plan View

Bristol Drawing 600-02025

We can take several observations from this diagram, starting with the Station numbers. One can readily see how these stations have been captured in Peter Alway's ROTW drawing, confirming the correlation between the original blueprint and Peter's drawing. There is, however, one tiny discrepancy in this area of the drawing, that being the Station number for the BBVC leading edge fin tip: the blueprint calls out this point as Station 200.83, while the ROTW drawing has it as 200.88.

The Interstage Adapter portion of the drawing corresponds well with the view we see in our earlier photo 2; the front end of the Adapter chamfers into the BBVC fin can, the Drag Ring segments are fastened to the underside of the Riding Ring, and the Drag Ring segments are separated to make room for the booster launch lugs.

Elsewhere, the Bristol blueprint provides a section view of the BBVC fin can, a view which offers us clear dimensions for the Drag Ring segments.

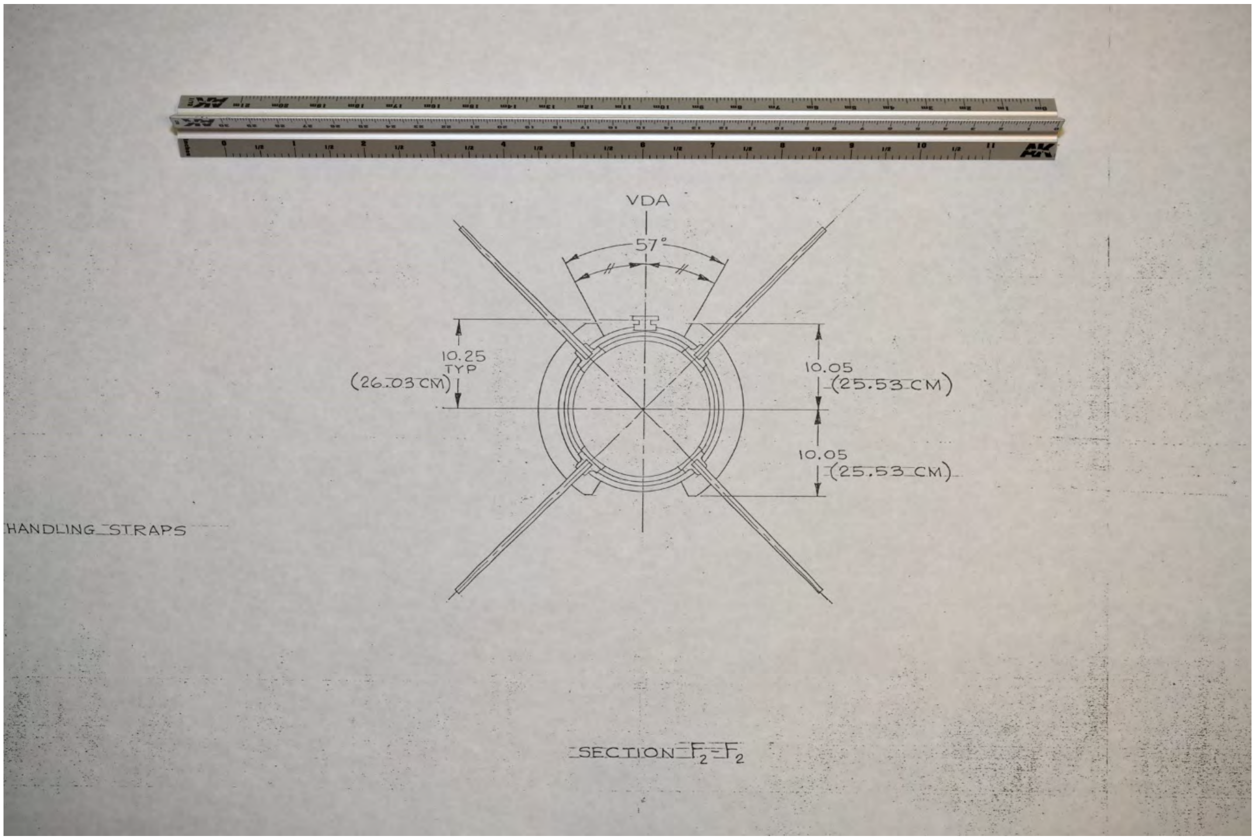

Figure 7: Interstage Adapter Section View

Bristol Drawing 600-02025

Note that no diameter dimensions are provided for the cylindrical portion of the Interstage Adapter itself; these must be scaled from the drawing.

The Bristol blueprint section view suggests the Drag Ring segments are spaced symmetrically about the Adapter; this symmetrical arrangement is repeated in the ROTW 2002 Supplement drawing, as shown in its Section View A-A, page 28. And this symmetrical arrangement would be just fine if the booster was to be launched from an in-line launcher. However, what the photos of our actual round show is that the Drag Ring segments are offset on the launch rail side to accommodate the wider lug spacing used for rail launches. We can see this in the following photo, which readily highlights the asymmetric Drag Ring segment layout on the prototype's Adapter.

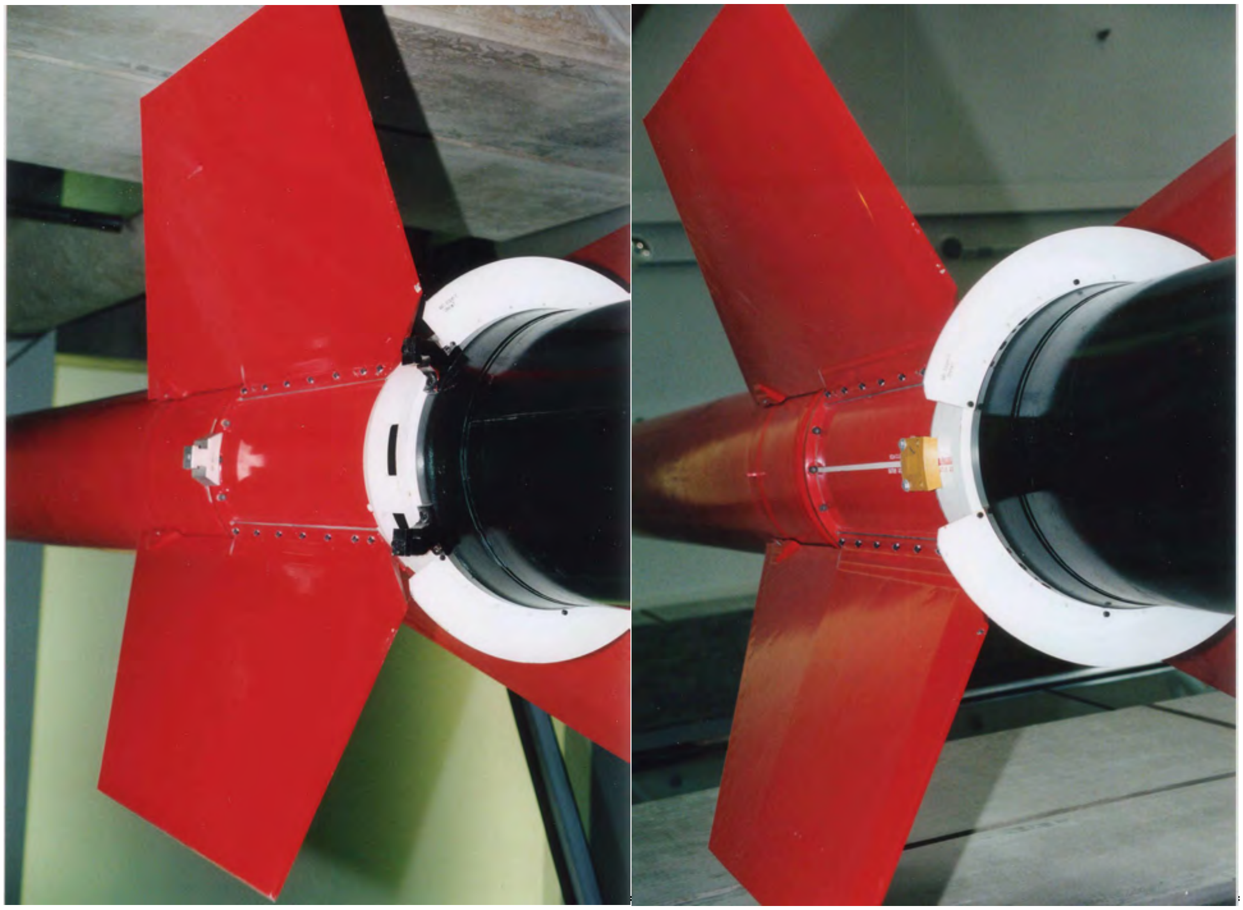

Photo 39: Wide Segment Gap, Left; Narrow Segment Gap, Right

Photos by Paul Lubertowicz

Close examination of Photo 39's righthand view also reveals a detail we'll take into consideration during the finishing stages of the Adapter; here we can see how the Vehicle Datum Axis (VDA, the white line on the BBVC fin can) is extended onto the Adapter as a red line just below the Ground Handling Strap. We'll provide a better view of this reference line when we get to the later finishing stages.

Armed with this information, let's dive in and construct our Adapter.

Adapter Construction

We'll begin with the booster end of the Adapter assembly. Since the booster is based on ST-20 tubing, we'll use a standard HTC-20 coupler for the booster mating section of the adapter; in this coupler we'll also house the staging timer and its battery.

A timer sled is fashioned from a piece of 1/16″ thick ply, using a pair of 1/8″ launch lugs as sled mounts.

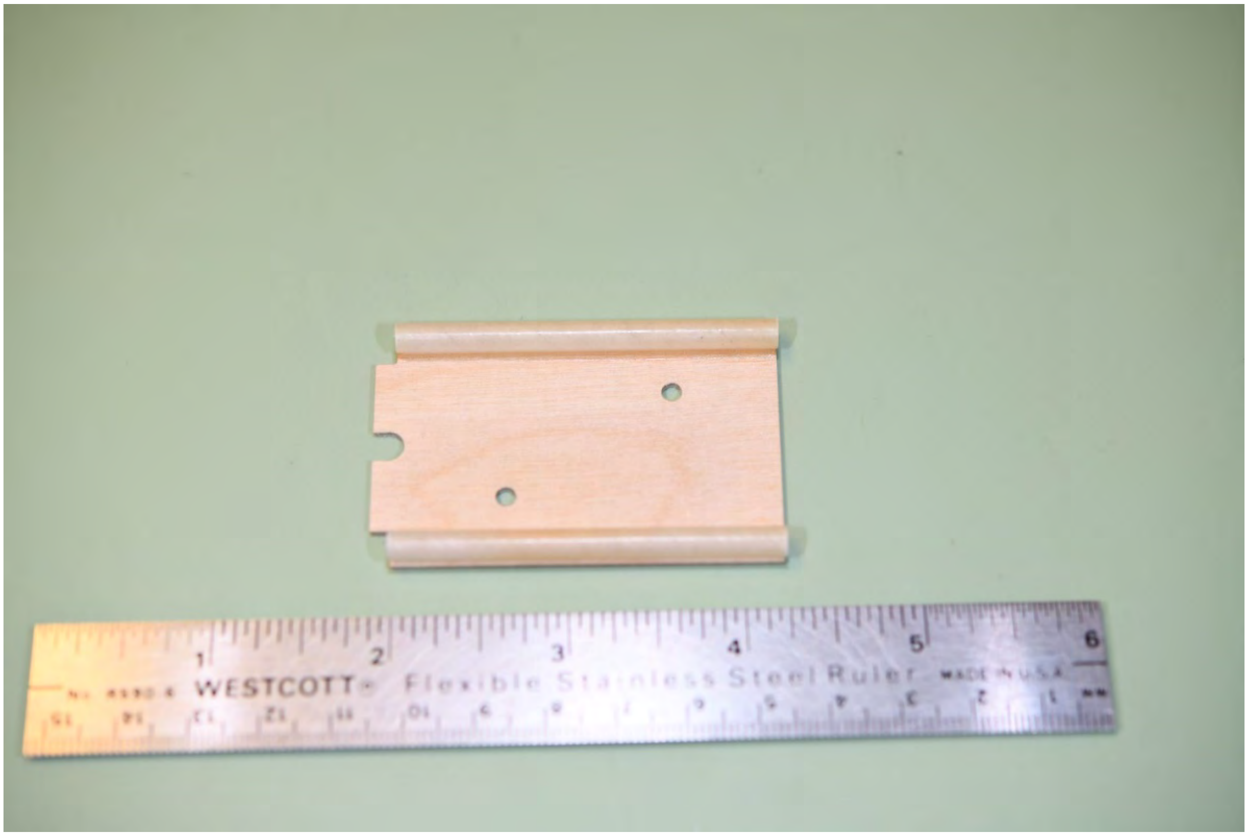

Photo 40: Timer Sled

As is our practice, we'll deploy a PerfectFlite MiniTimer-4 as our staging timer; the timer mounts to the sled with a pair of 4-40 machine screws and standoffs. The backside of the sled is fitted with a pair of 3/32" thick balsa spacers to elevate the battery above the timer mounting hardware. Some thin Velcro® strips are added to secure the battery in place.

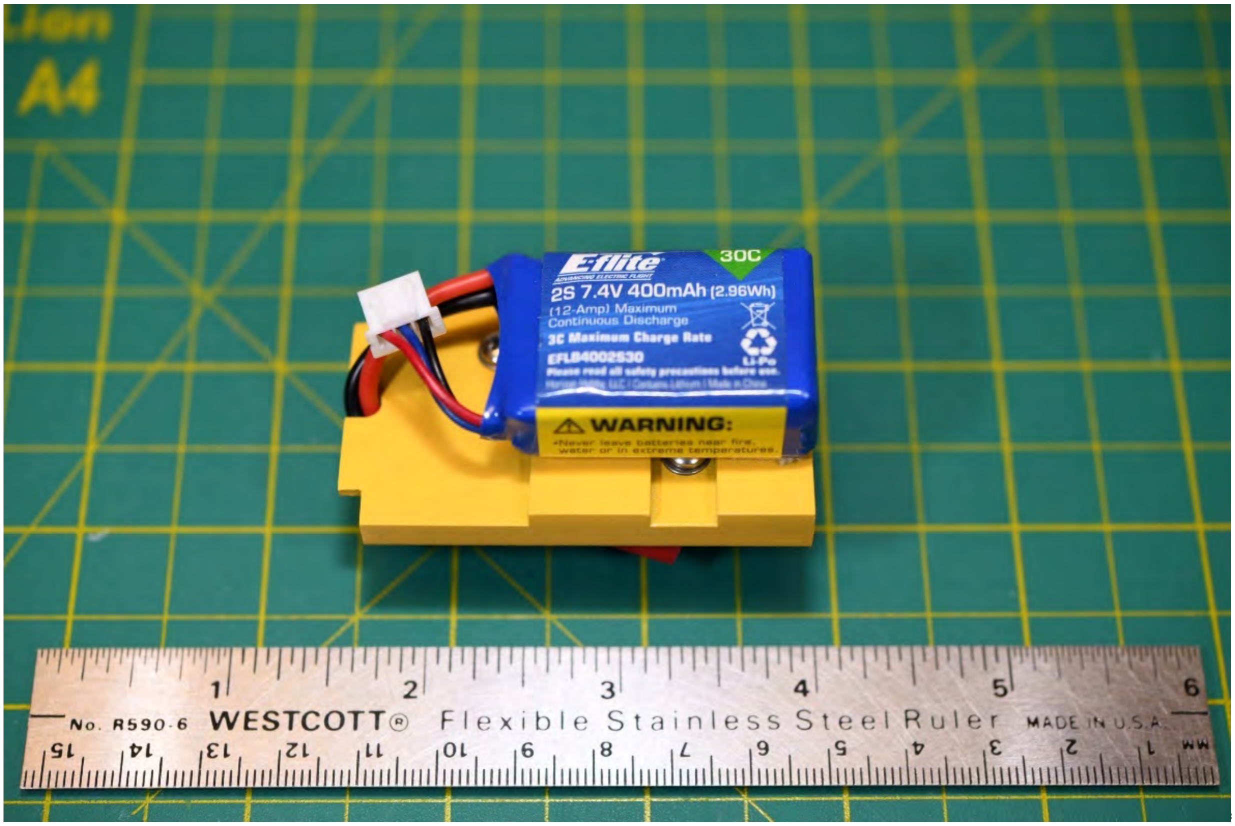

Photo 41: Battery Side

The timer and battery are wired to two two-pin Deans connectors; the aft connector is used as the on/off switch (a simple shorting plug is used for this), and the forward connector is used to connect the igniter extension leads to the sustainer motor. A 400 mAhr LiPo battery provides the staging ignition source, connected to the timer wiring by means of a two-pin JST connector.

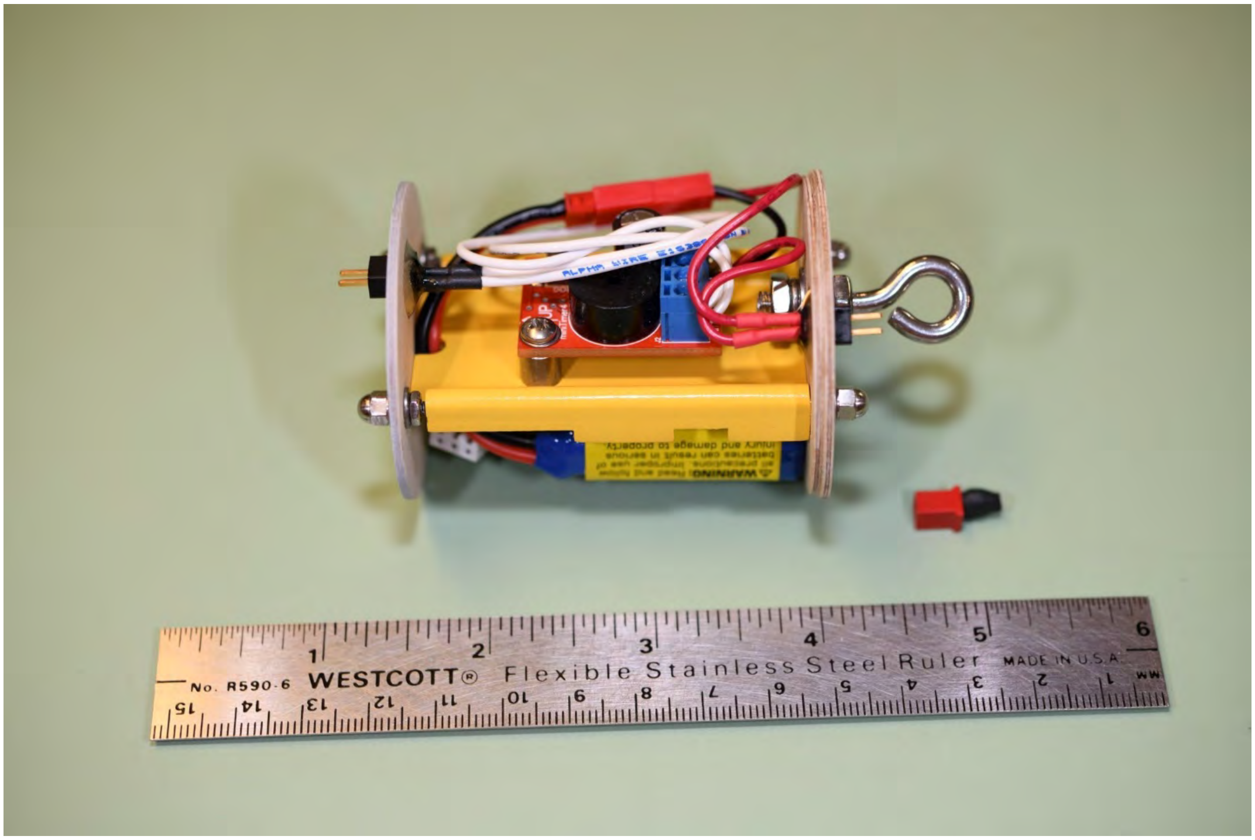

Photo 42: Staging Timer Assembly

The sled is accessible from the aft end of the coupler, and is secured in place by a pair of 2-56 all-thread rods and associated hardware. The length of the coupler is sized so that the sled is captured between the forward and aft bulkheads once the hardware is tightened; the arrangement forms a rigid package that ensures timing is initiated when launch G-forces are detected at liftoff.

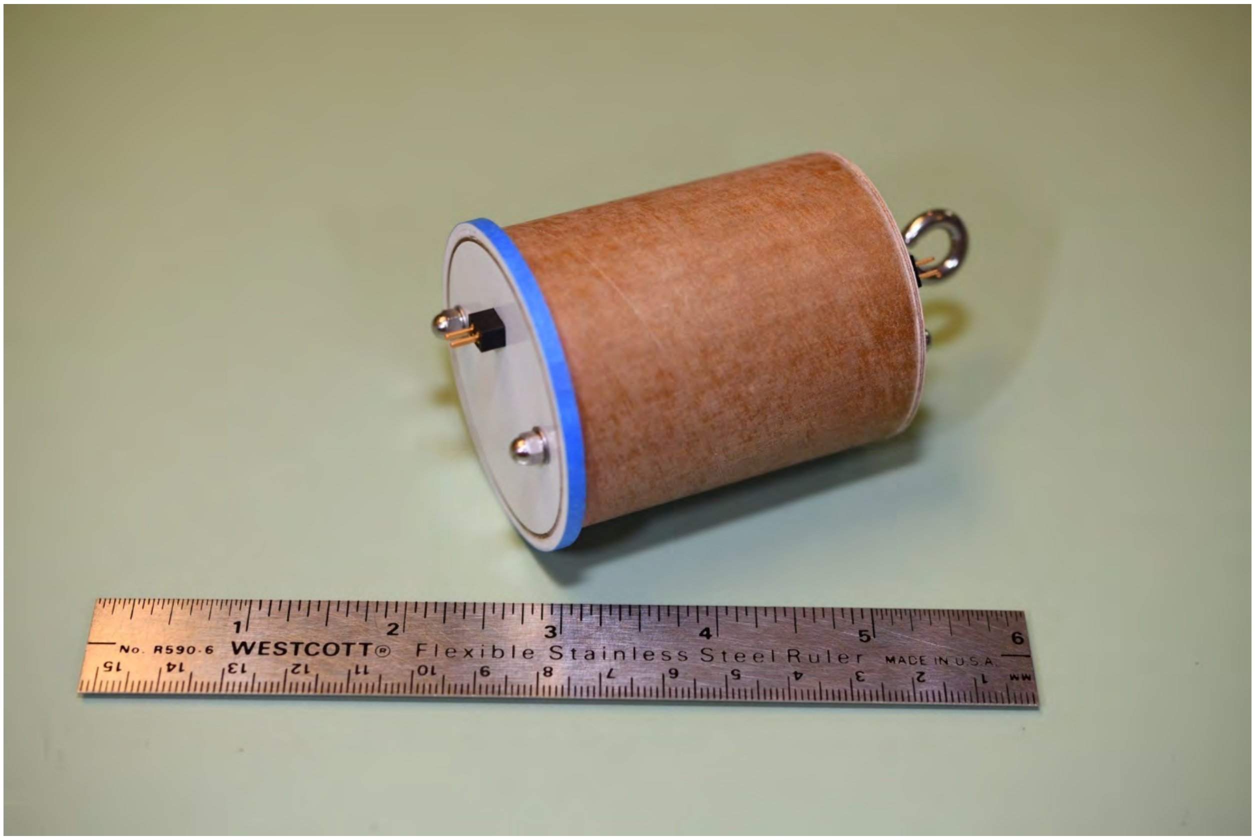

Photo 43: Completed Coupler/Staging Timer Assembly

With the booster coupler assembly complete, we can now craft the Interstage Adapter shell and Sustainer mating coupler. The following photo provides a clearer view of the prototype shell.

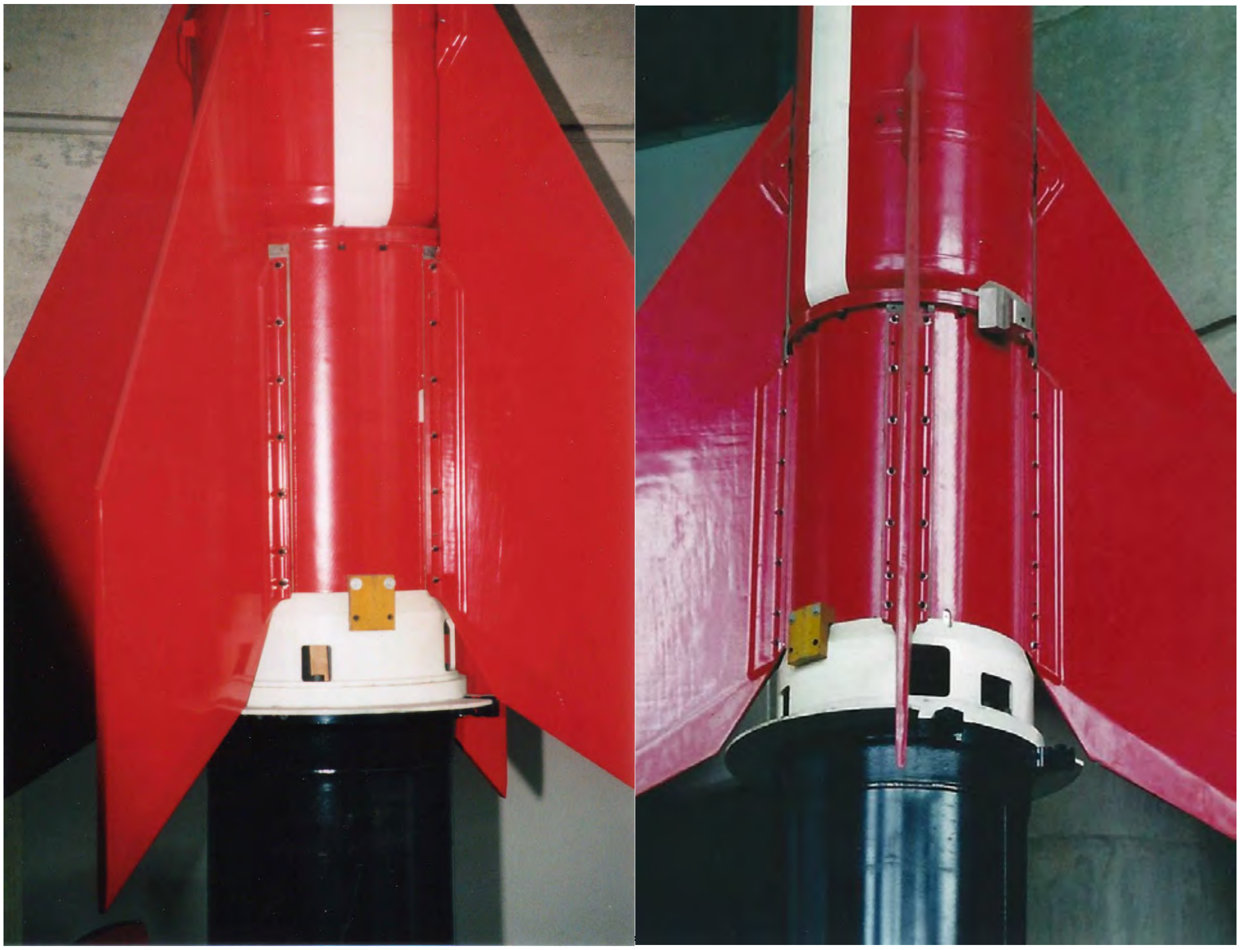

Photo 44: Interstage Adapter

Photos by Paul Lubertowicz

We'll fashion our Adapter shell from a scale length of BT-70, with several strips of 0.125" wide Styrene wrapped round the aft end to form the Riding Ring.

A prominent feature of the Adapter is the set of Nike Arming Doors seen in the photo above, and while we don't present all of the relevant photos here, there are a total of five such doors spaced round the Adapter, comprising two tall doors and three short doors. We'll prepare a wrap in CAD to mark the location of these doors on the Adapter's shell.

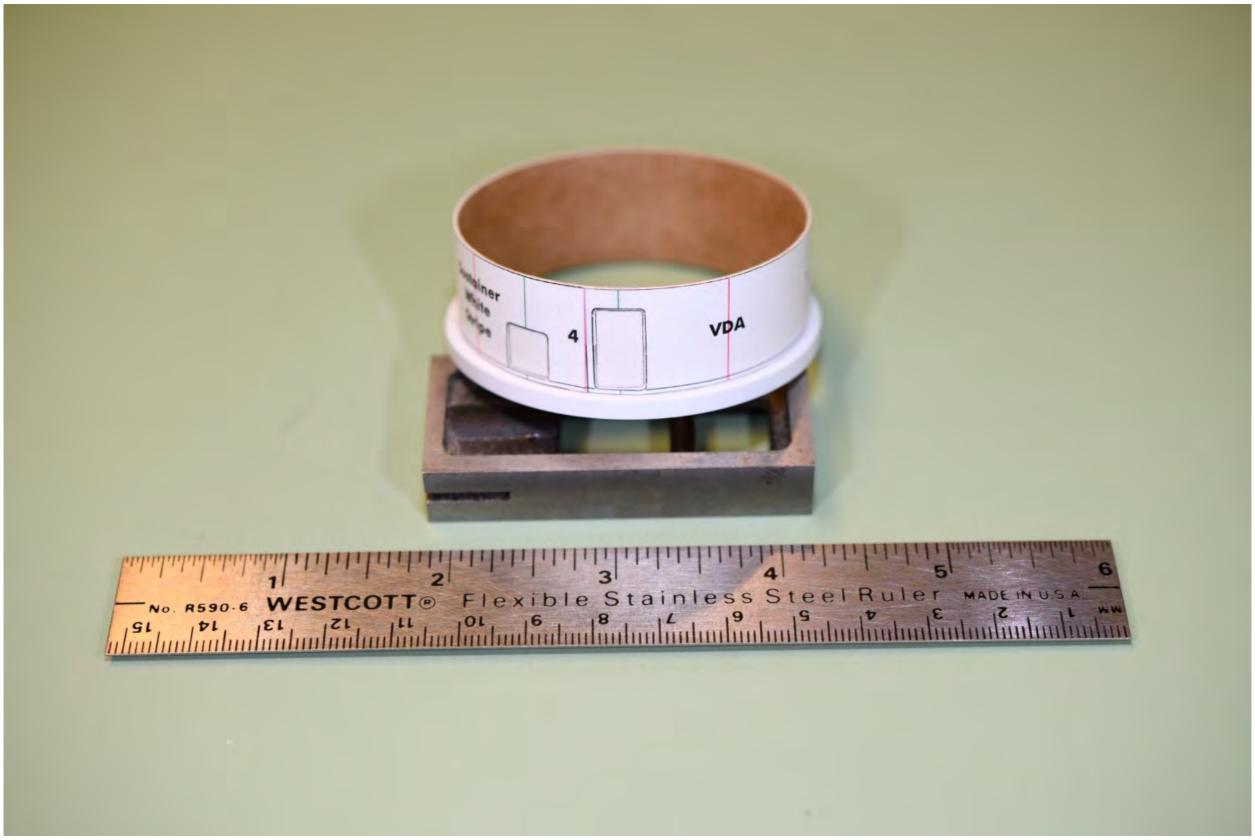

Photo 45: Nike Arming Door Location Wrap

The doors are then carefully cut with a fresh, sharp blade.

The sustainer coupler portion of the adapter is a length of HTC-20, fitted to the Adapter shell with a centering ring built up from strips of 0.125" wide Styrene. The forward chamfered transition is a 3D-printed part provided by Mike Nowak of Galactic Manufacturing, and once set in place we can prep the shell assembly for priming. The following photo gives us a glimpse of the assembly setting with a trial fit:

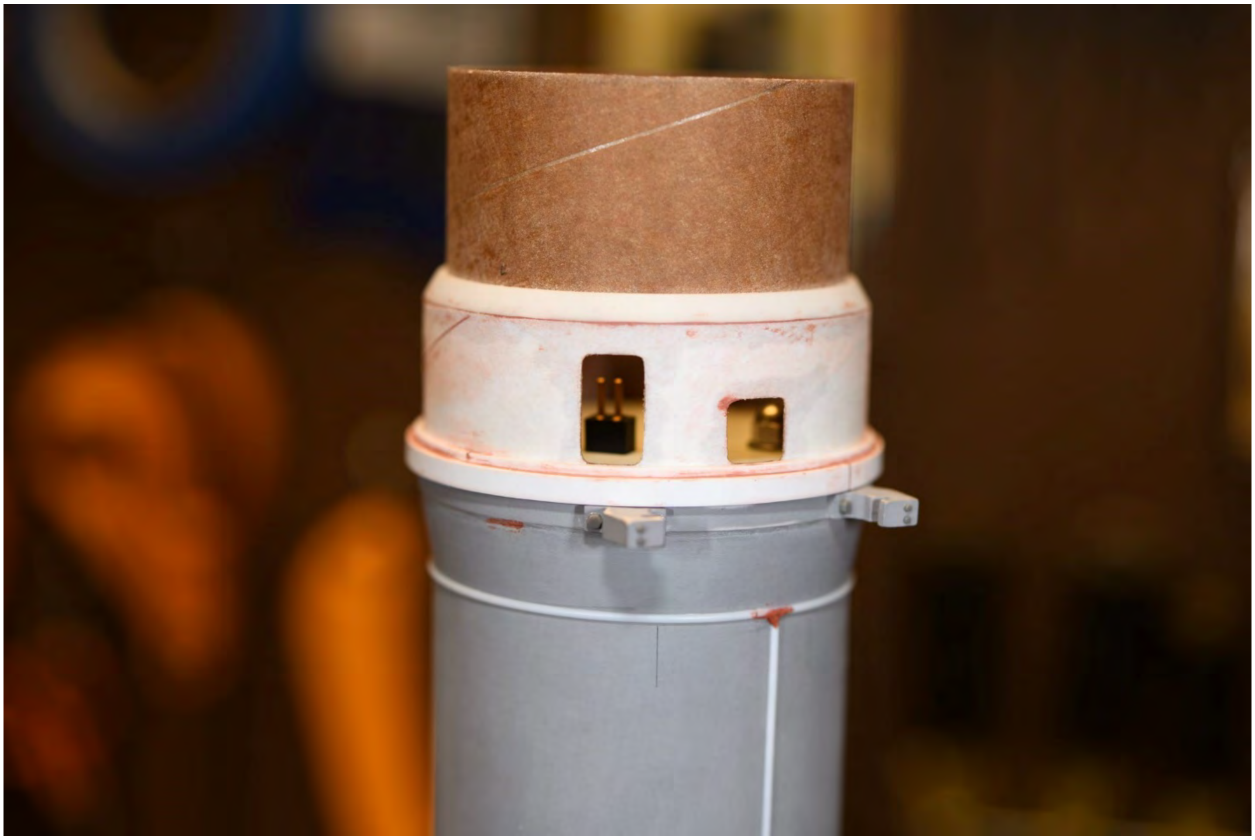

Photo 46: Adapter Trial Fit

Next, we'll fully prime the shell assembly and then prepare a pair of Drag Ring segments from 0.030" thick Styrene. With the Interstage Adapter Assembly temporarily and correctly oriented in the booster, the Drag Ring segments are set in place with Tamiya Extra Thin cement. The shell assembly is now ready for the Paint Shop, where it receives several coats of Dupli-Color Polar/Arctic White lacquer.

Markings

In our earlier Photo 39 we drew attention to the Vehicle Datum Axis (VDA) line. On the Sustainer, this line and accompanying text is marked in white; here, on the Interstage Adapter, the line is continued onto the assembly with a red line, and with red text, as the following prototype photo shows.

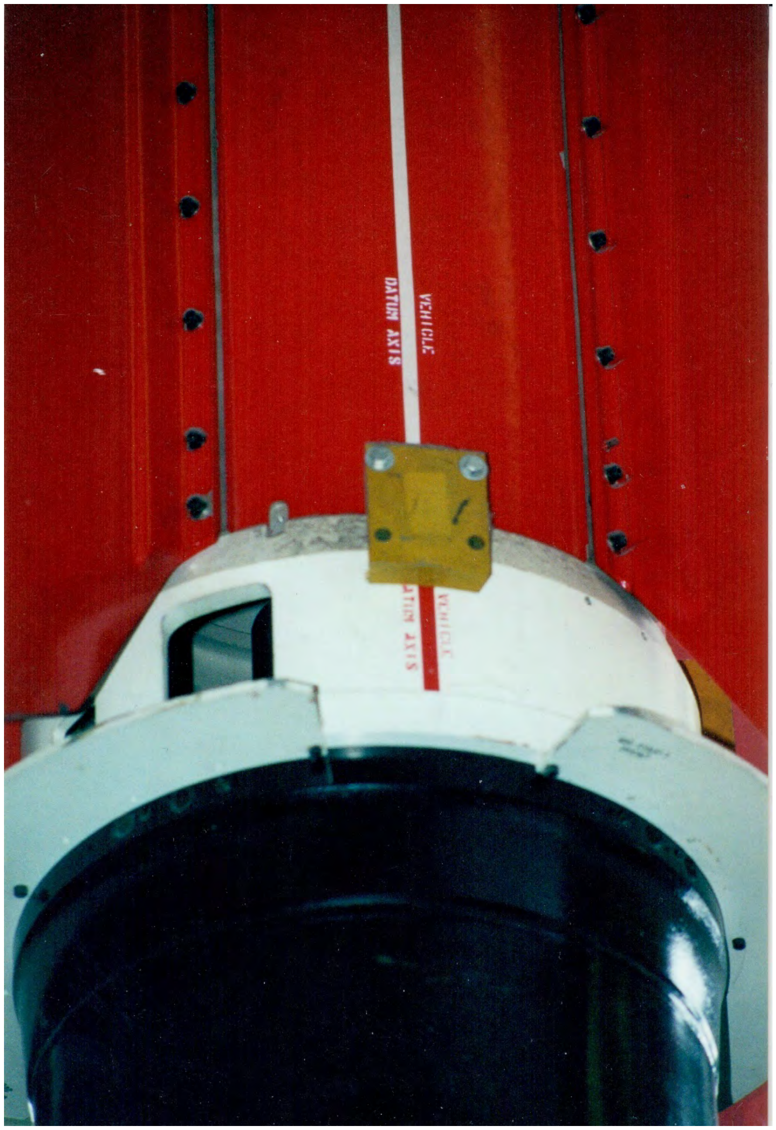

Photo 47: Vehicle Datum Axis

Photo by Paul Lubertowicz

For the model's Adapter, the Vehicle Datum Axis line was cut from a sheet of Expert's Choice #015 Insignia Red decal film; the associated text was prepared in MicroSoft Word, and printed onto Expert's Choice laser decal film by means of an HP LaserJet color printer.

The prototype Drag Ring segments have their part number stenciled on their underside, as can be seen in the lower left of the following photo.

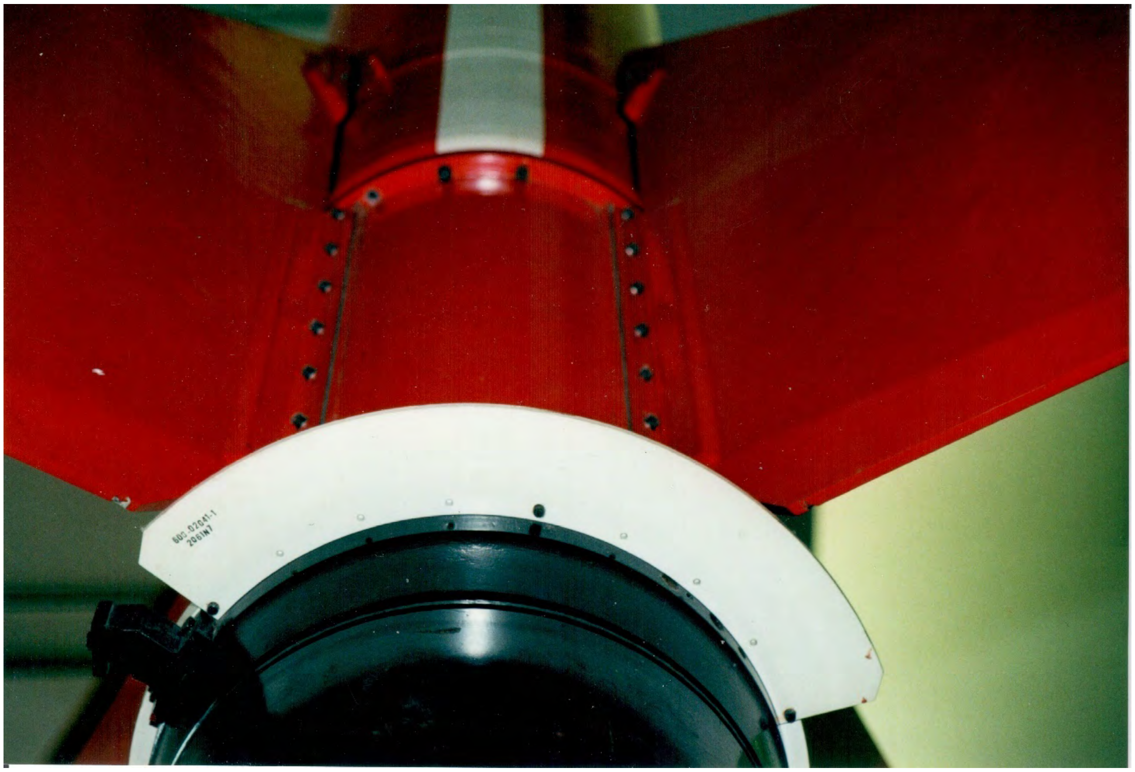

Photo 48: Drag Ring Part Number

Photo by Paul Lubertowicz

Accordingly, this marking was prepared in Word, and placed on the assembly. We also found the Drag Ring underside to be a convenient place to locate our Team name and number.

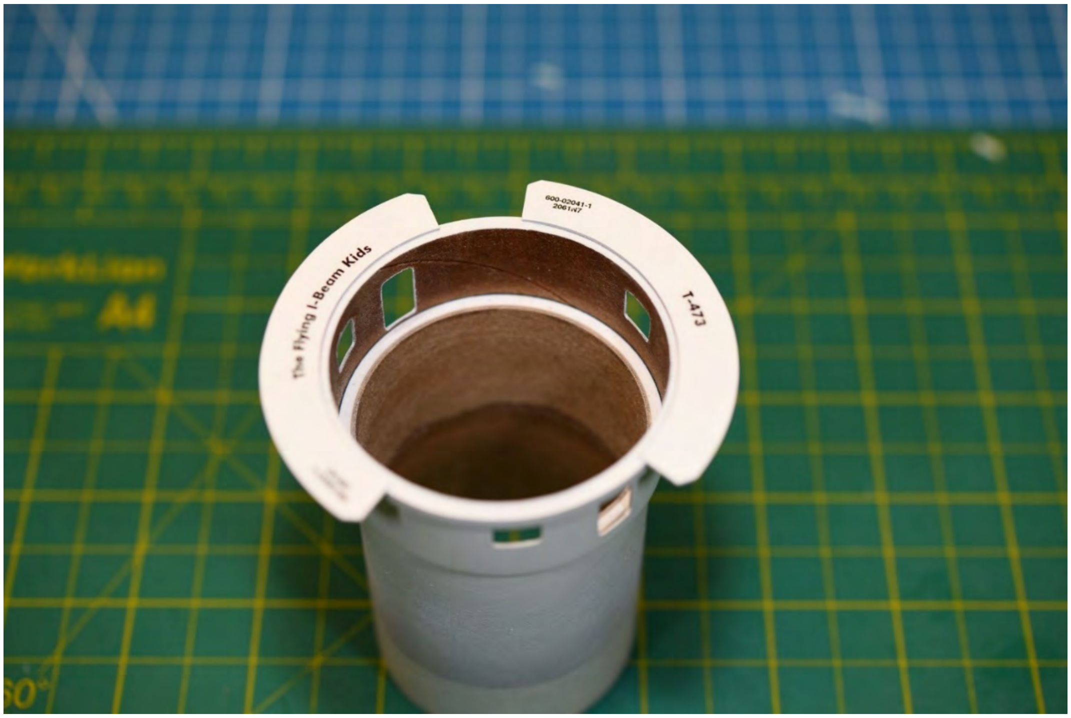

Photo 49: Drag Ring Text

Once the decals were dry, the assembly was over-sprayed with Tamiya TS-13 Clear to secure the markings. Our Adapter shell is now ready for final installation.

Final Assembly

The Adapter shell can now be permanently mated to the timer assembly with a thin film of epoxy. As tempting as it is to leave the Nike Arming Doors open, my prior flying experience with all of those open arming doors showed that too much exhaust pressure could be vented when the upper stage motor ignites, which can lead to various delayed stage separation issues. To mitigate this risk, we'll drop in a port block, fashioned from a length of airframe tubing, and resized to fit inside the HTC-20 coupler. The aft end is painted flat black, and when set in place the part provides some visual depth to the doors while preventing exhaust pressure venting.

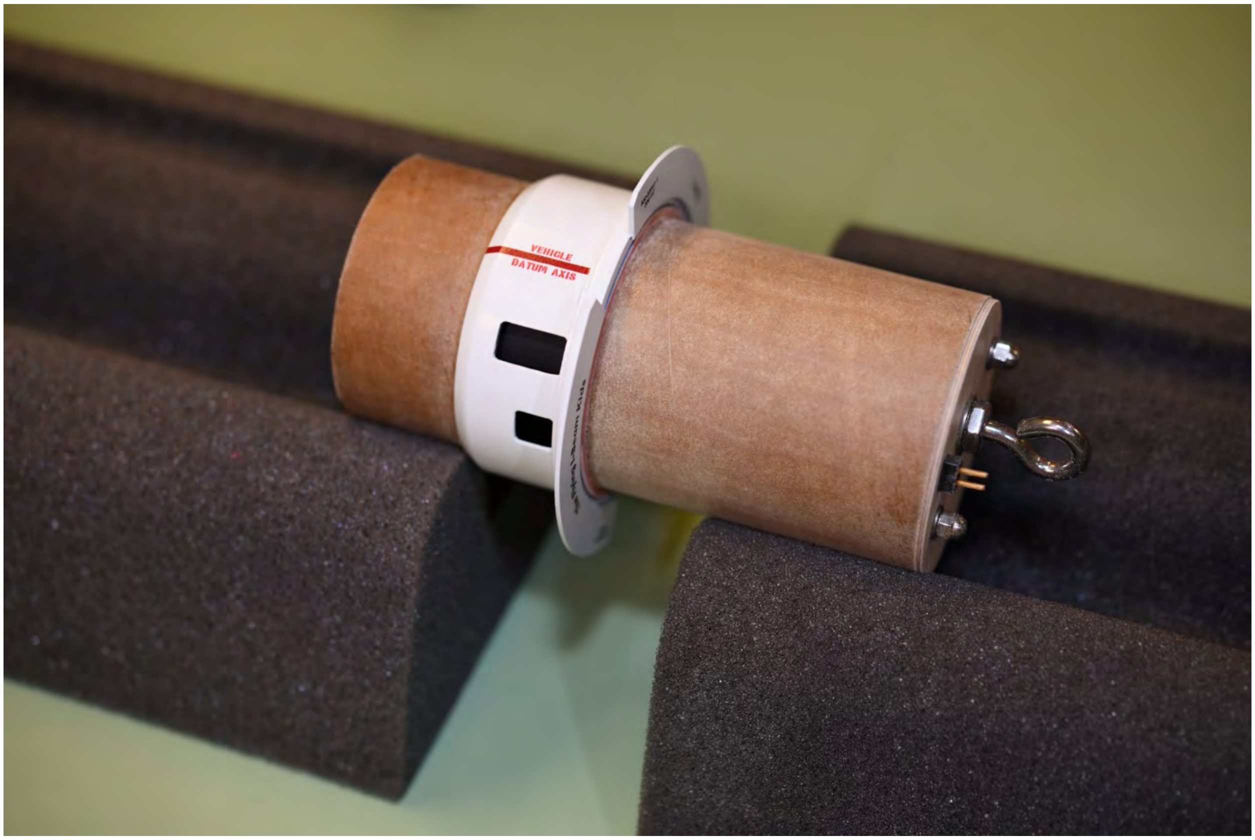

Photo 50: Completed Adapter and Timer Assembly

With this, our Interstage Adapter Assembly is complete.

The Black Brant VC Sustainer

As our earlier Photo 1 shows, when viewed from a distance the Sustainer appears to be not much more than a long, rather straightforward, four-fins-and-a-nose-cone rocket. However, close examination reveals significant airframe detail that we'll want to capture in our build.

Of particular interest is the aft end of the Sustainer motor case, and how it mates to the fin can/tail assembly of the vehicle, as shown in the following prototype photo.

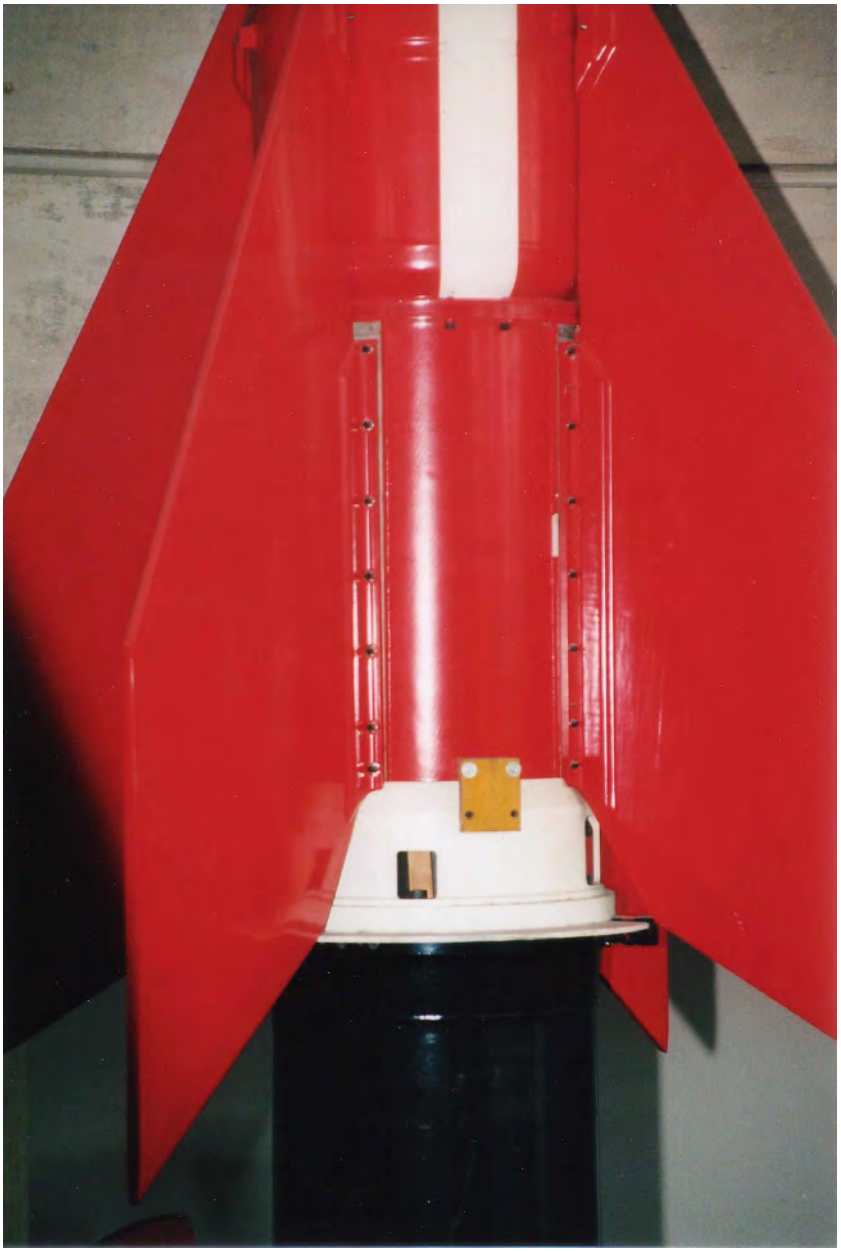

Photo 51: BBVC Tail Assembly

Photo by Paul Lubertowicz

Looking at the end of the white airframe stripe in Photo 51, we can see the exposed rounded aft end of the motor case. We can also see a prominent weld joining the end to the case cylinder. A Spacer Ring separates the motor case from the fin can, the assembly bolted together by a set of socket head machine screws. The following prototype photo provides a view looking down on the assembly.

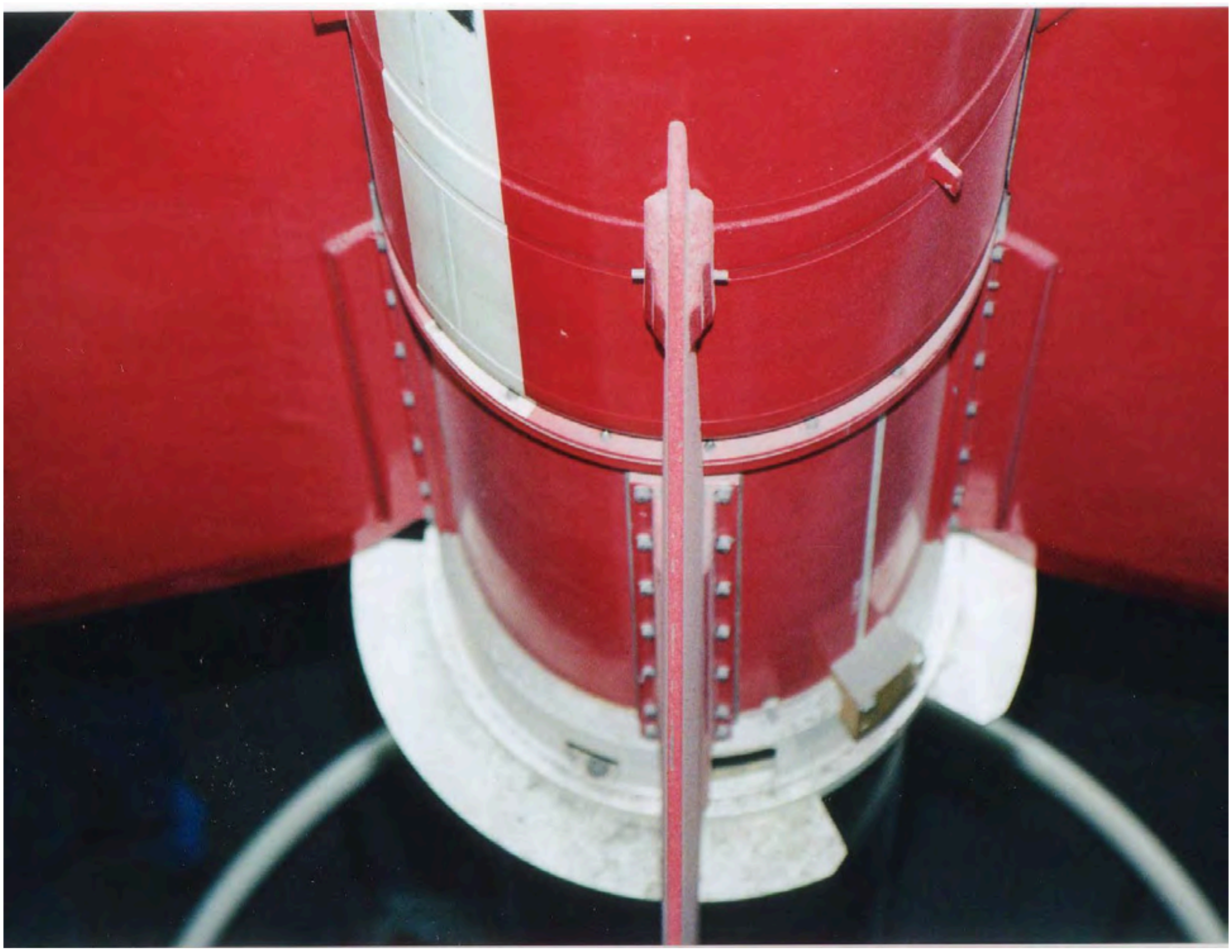

Photo 52: BBVC Motor Case/Fin Can Joint

Photo by Paul Lubertowicz

Comparing these photos of the prototype round to the General Arrangement drawing provided in our earlier Figure 6, we can see that the actual motor case end/fin can interface is different than the representation at Station 185.47 in the drawing.

The fin can fairs the motor's nozzle area and provides the mounting base for the fins. Figure 8 provides a section view of this area of the vehicle, which details the features of the tail assembly.

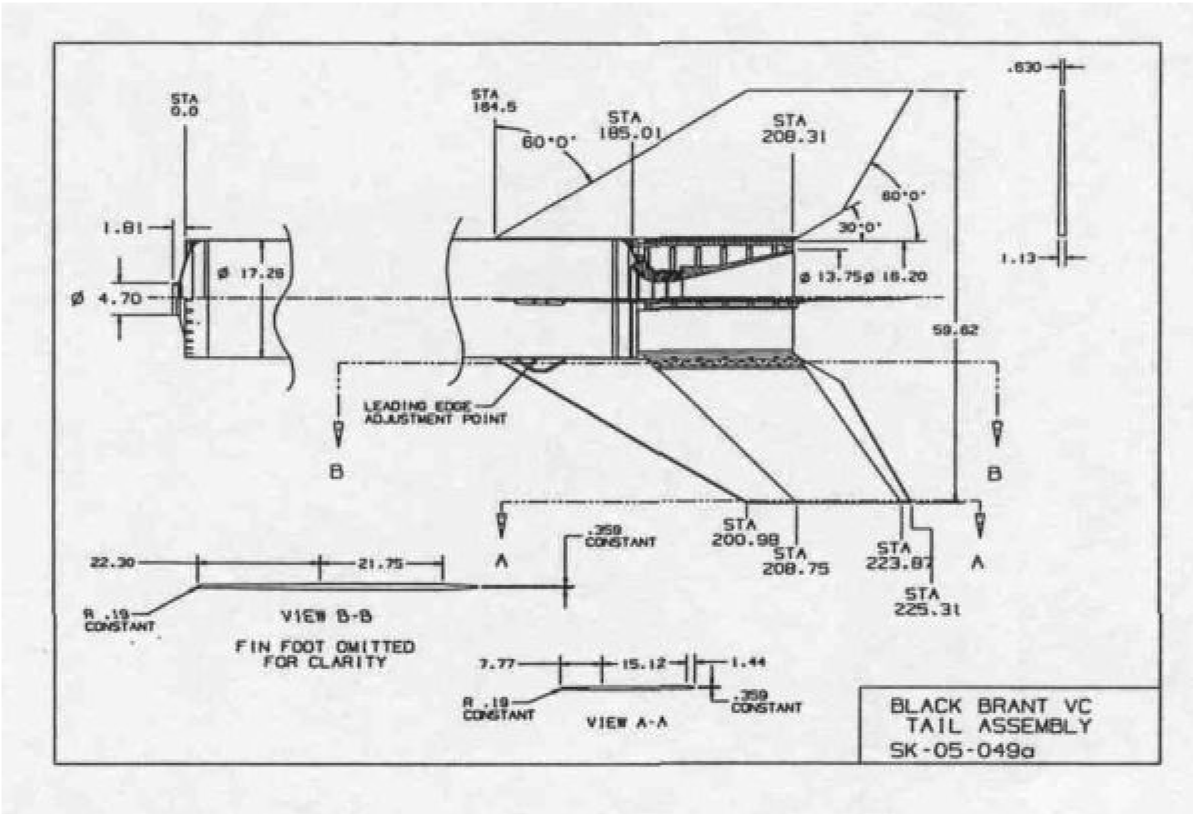

Figure 8: BBVC Tail Assembly

Construction

As the drawing shows, the fin can has an OD of 16.20", a diameter that complicates our build. At our scale factor this dimension returns a value of 2.081", a size not available in commercially available tubes. So just as we did for the booster, we'll base the sustainer fin can on a length of ST-20, but we'll add a scale-length wrapper, derived from a length of BT-70, to the aft end, bringing the model's fin can OD to the required size.

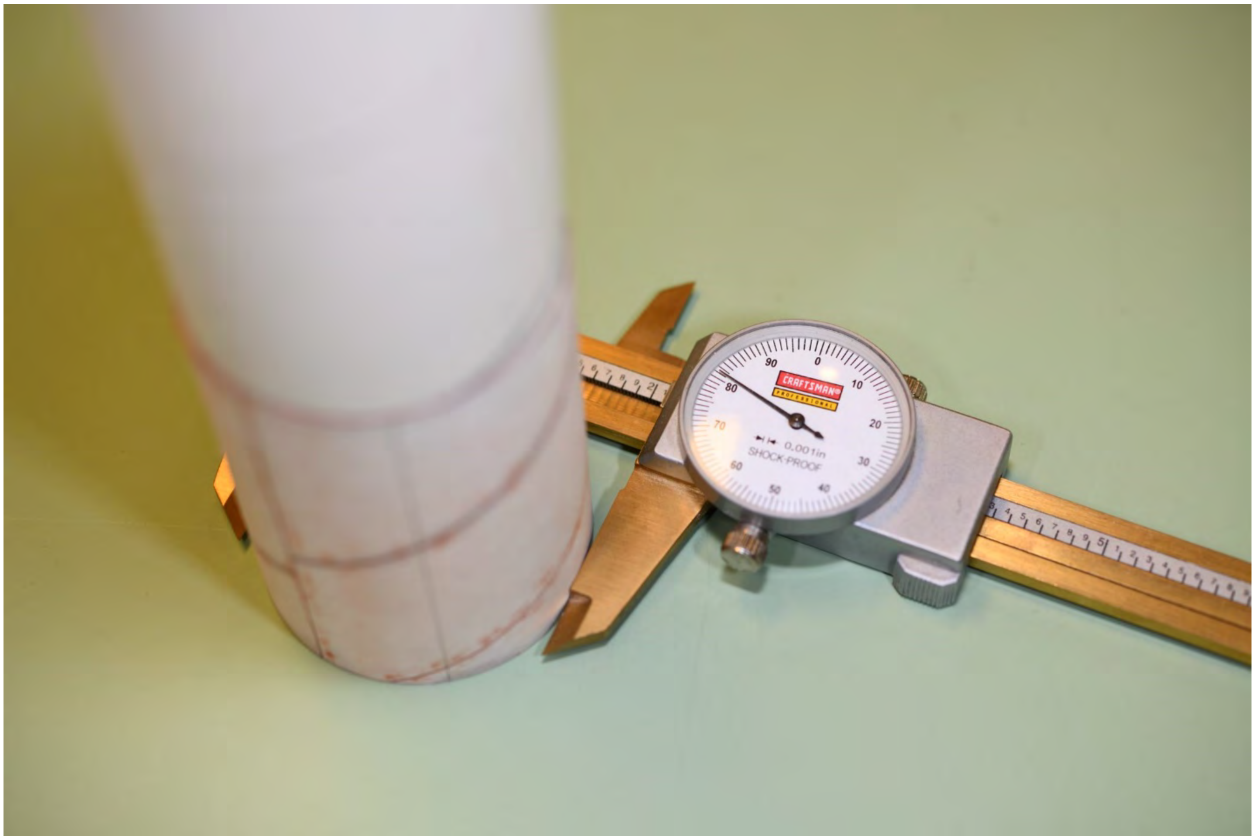

Photo 53: Fin Can OD

The 29 mm motor mount is built next, making sure the two aft centering rings are properly spaced to capture the TTW tabs on the fins.

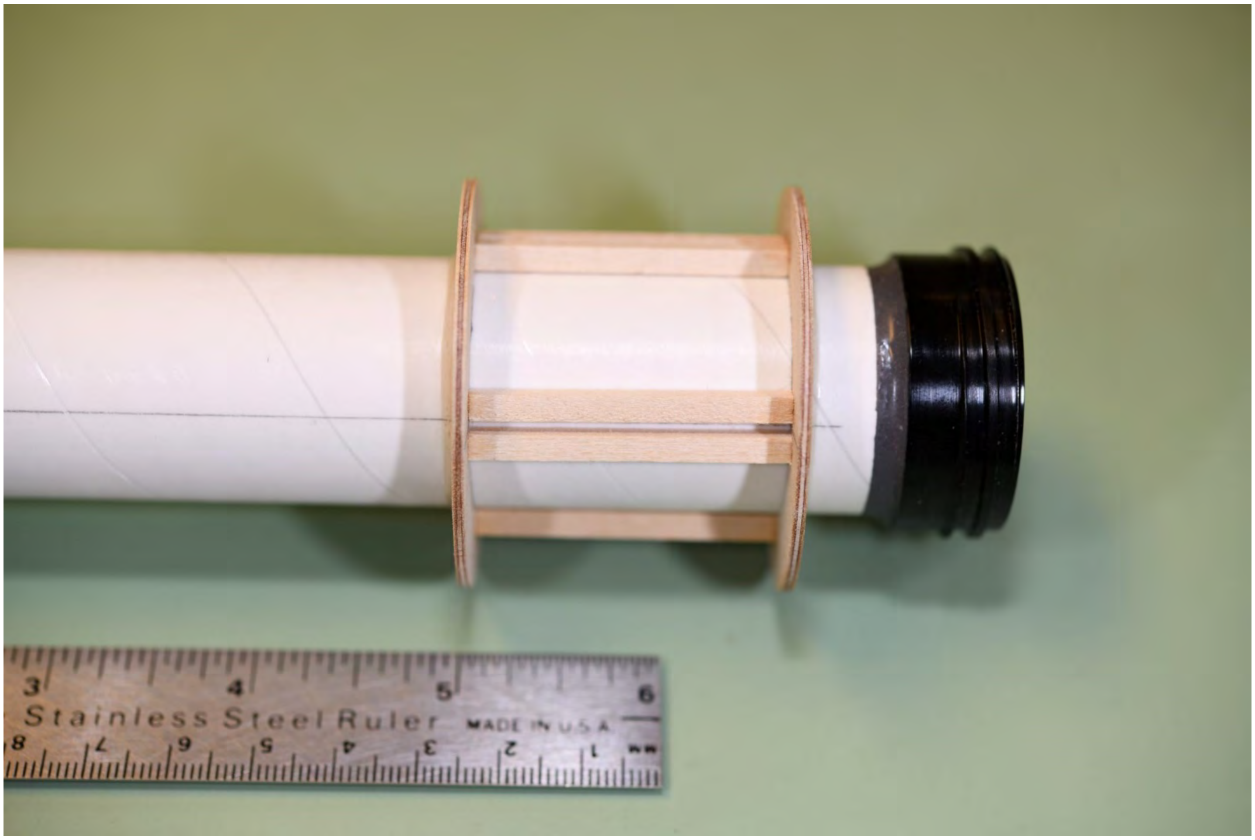

Photo 54: Motor Mount with Fin Tab Wells

One will note the strips of basswood placed at the fin locations on the MMT; these are spaced to create a well to capture the TTW tab of each fin.

Next, the ST-20 fin can tube is slotted for the fins, and a trial fin fit is made to validate alignment. Satisfied with the fit, the MMT is epoxied in place.

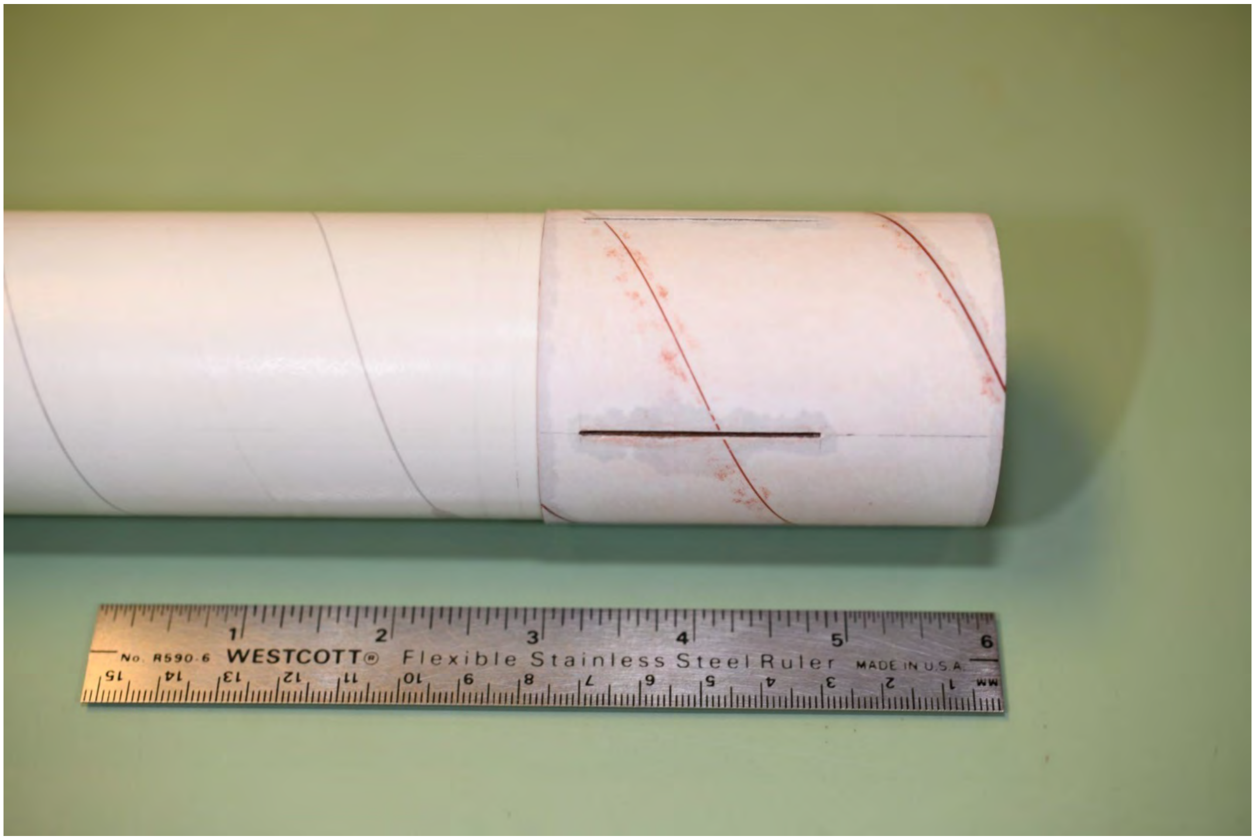

Photo 55: Fin Tab Slots

The Spacer Ring Joint is made up of a 0.030" Styrene ring representing the mating flange on the fin-can, a 1/16" ply ring representing the Spacer Ring itself, and then a further 0.030" Styrene ring representing the motor case mating flange.

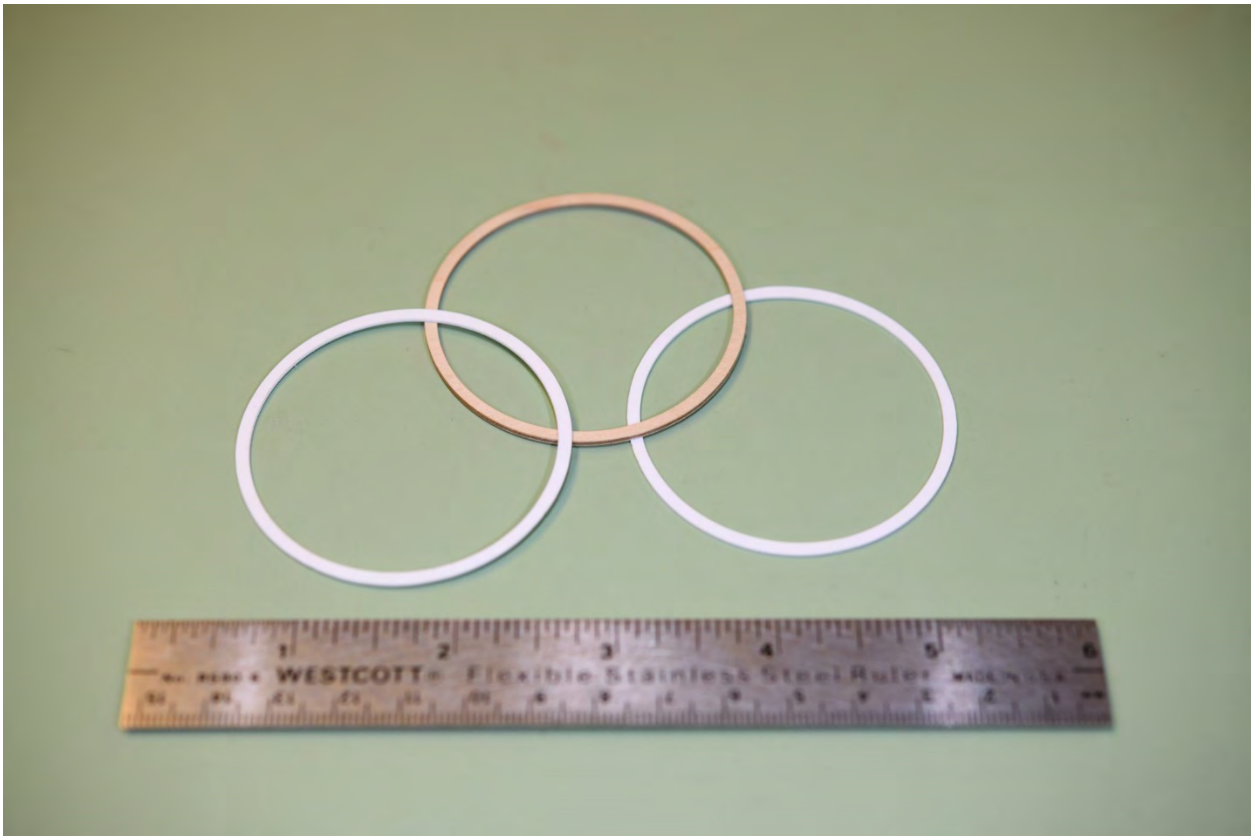

Photo 56: Spacer Joint Rings

These parts are then placed on the model, butting up against the fin can wrapper; a dash of CA fixes them in place.

The rounded motor case end goes on next. On the original NARAM 56 model I had turned the motor case end on my drill press from ¼" thick balsa sheet, using a purpose-built mandrel. While the part was workable, I wasn't satisfied with its precision. This time I opted for a 3D printed part – so I designed the part in CAD and then Mike Nowak of Galactic Manufacturing was kind enough to print the part for me. Mike's part fit perfectly, the resin printing providing a smooth surface ready for final finishing.

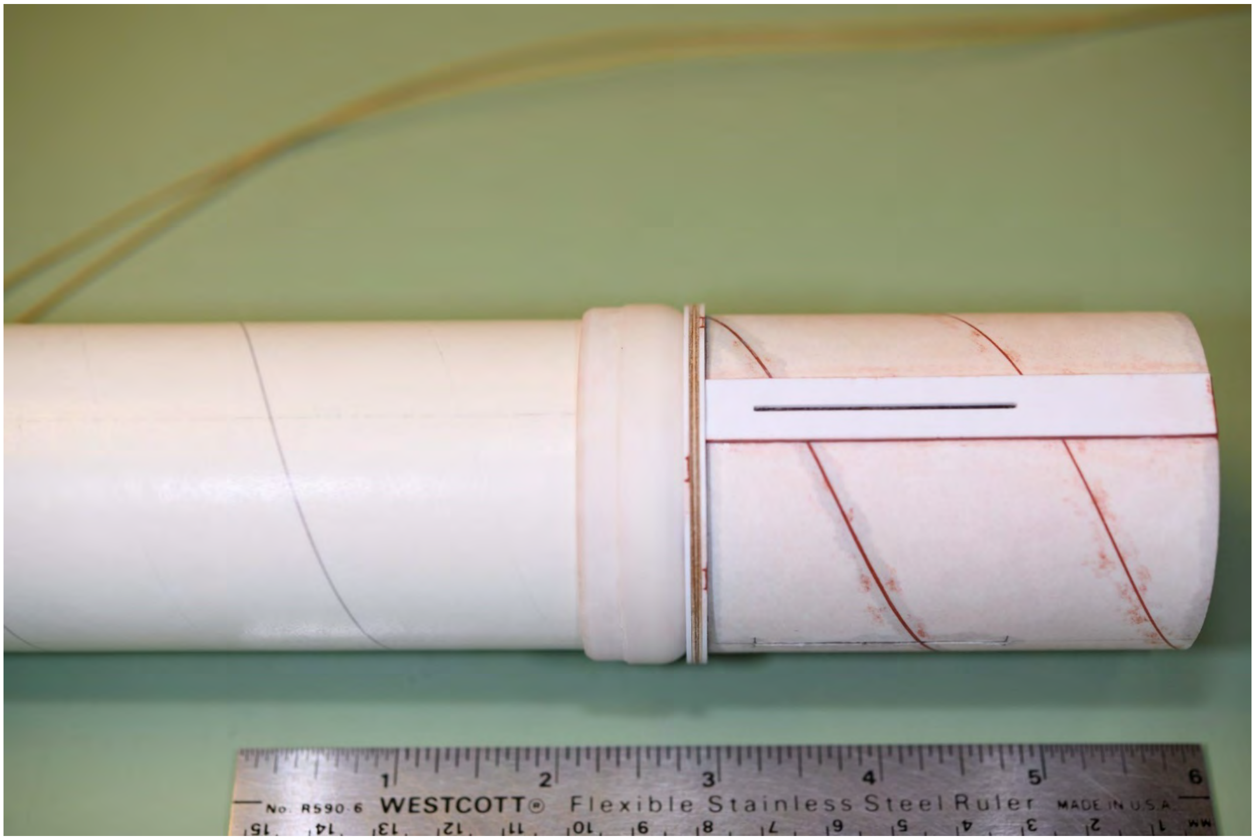

Photo 57: MMT/Fin Can Assembly

The photo shows that I've also begun to place the Styrene plates that represent the milled fin can surfaces the fin mounting flanges are mated to. Finally, a forward centering ring is added to the MMT assembly, built up from strips of 0.020"x 0.125" Styrene. The composite MMT/fin can assembly is then seated in the sustainer airframe.

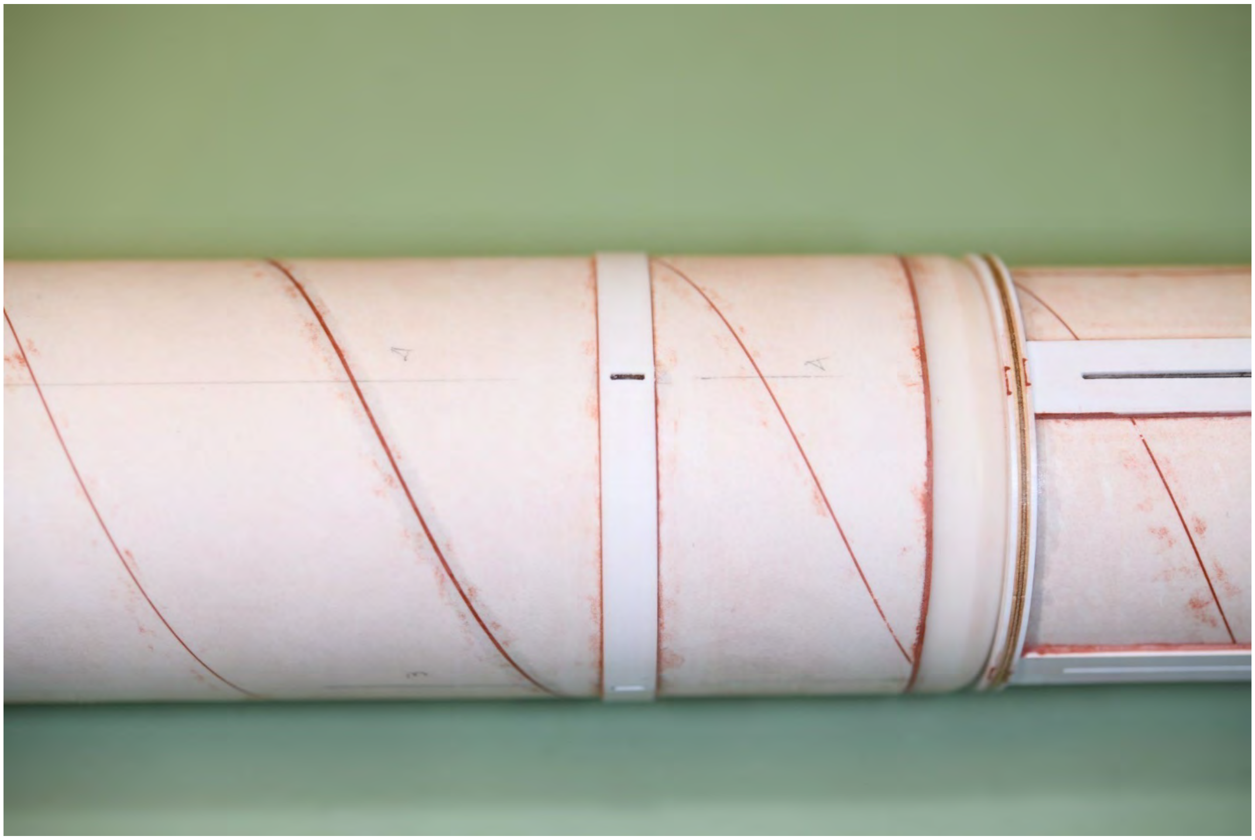

Photo 58: MMT/Fin Can Installed

As the photo shows, the forward fin mounting band (the Leading Edge Adjustment Point band) has also been placed and slotted for the fins. We still need to add the motor case welds, and we'll do that after the airframe is fully primed.

Sustainer Motor Case Welds

Our earlier Photos 51 and 52 provide evidence of some sustainer motor case welds. We'll reference several additional prototype photos to further clarify this detail, beginning with the aft motor case end.

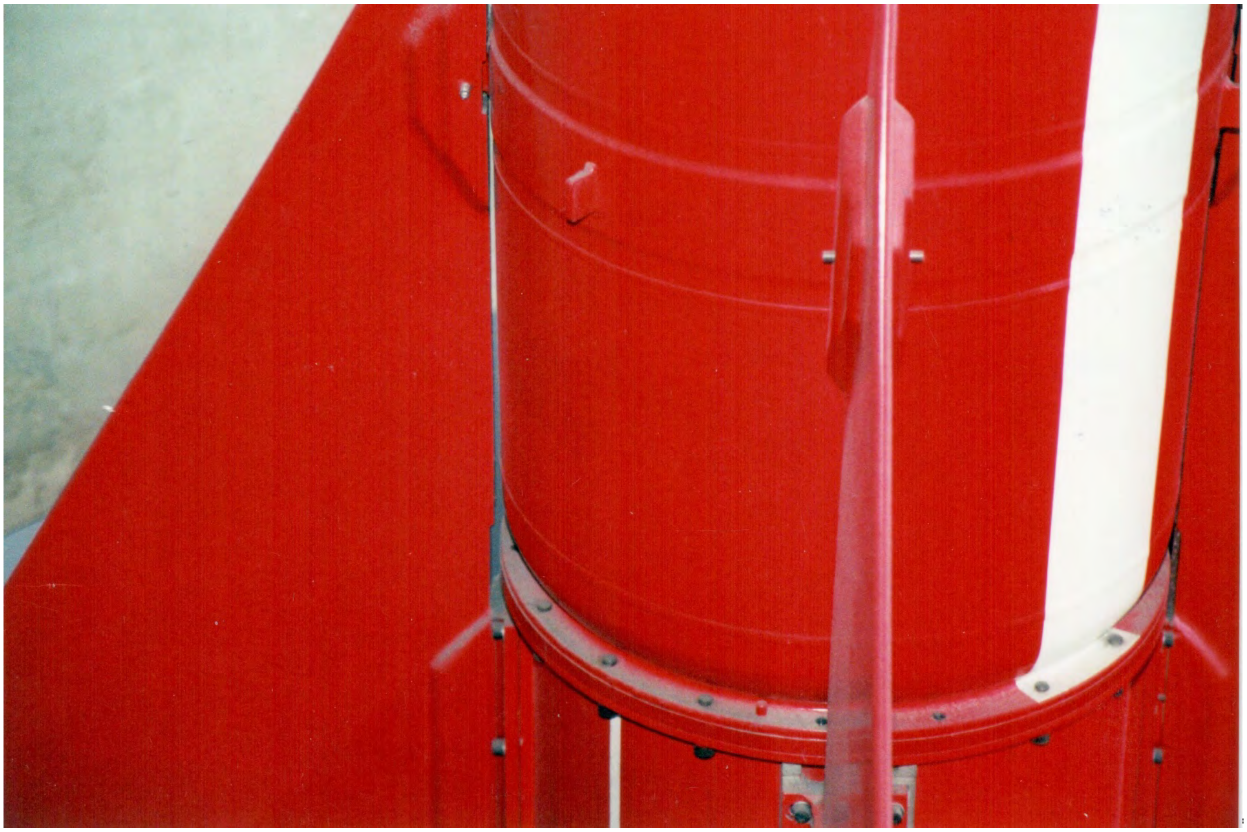

Photo 59: Aft Case Welds

Photo by Paul Lubertowicz

The next photo shows evidence of a longitudinal case weld, starting just above the LEAP band. Note how this weld is continued below the LEAP band, down to the aft motor case weld.

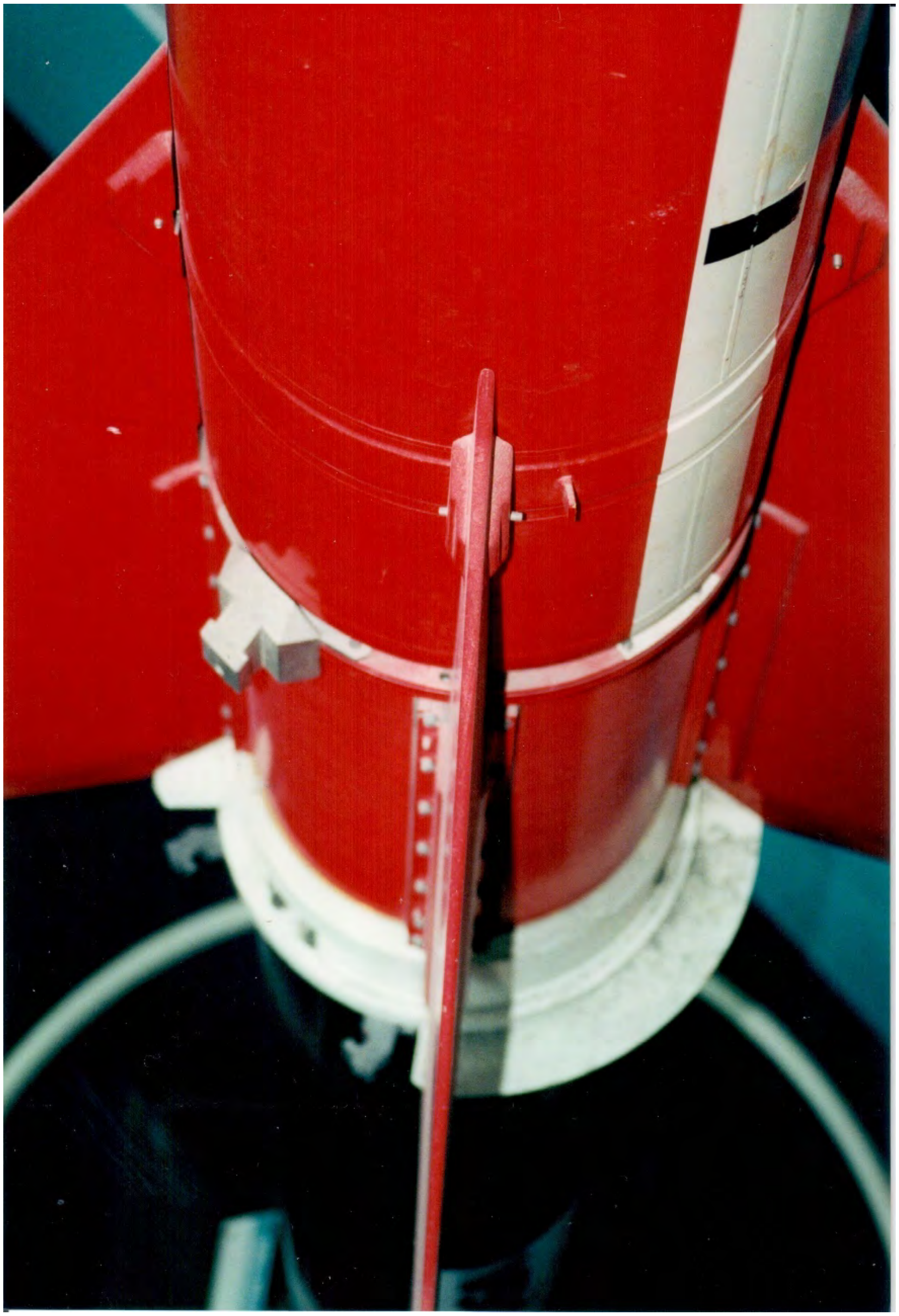

Photo 60: Aft Case Welds

Photo by Paul Lubertowicz

The next photo shows a weld in progress – we can see the longitudinal weld running to the left from the welder's hand; the welder is busy zapping what appears to be a mid-case circumferential weld.

Photo 61: BBVC Case Welds

Photo courtesy of Marc McReynolds

The following photo provides a view of a finished mid-case weld:

Photo 62: BBVC Mid-Case Weld

Photo courtesy of Marc McReynolds

Perhaps a more interesting aspect about these case welds is how the longitudinal case weld flips 180 degrees (i.e.: to the other side of the motor case) on the forward section of the motor case, above the mid-case circumferential weld. While the previous photo suggests this (note the long straight line/streak to the left of the mid-case weld, no line/streak to the right), I've not yet encountered a close and clear photo that definitively shows this. However, we can make this deduction by comparing our earlier Photo 60 to the following photo:

Photo 63: Forward Case Weld

Photo by Paul Lubertowicz

In Photo 63 we can see clear evidence of a forward circumferential case weld, but we do not find evidence of the longitudinal weld that began at the aft end of the motor case, as shown in Photo 60. Somewhere along the line it vanished from this side of the round. Just to be clear, the white stripe is the same stripe in both photos.

Therefore, we can be reasonably sure there are two longitudinal case welds, an aft and forward weld, 180 degrees opposed, separated by a mid-case circumferential weld.

Finally, the LEAP band weld – we can see evidence of this weld on the white portion of the LEAP band in the following photo; note the absence of a longitudinal case weld on this white stripe, this stripe being the one opposite to the stripe in Photo 60, above.

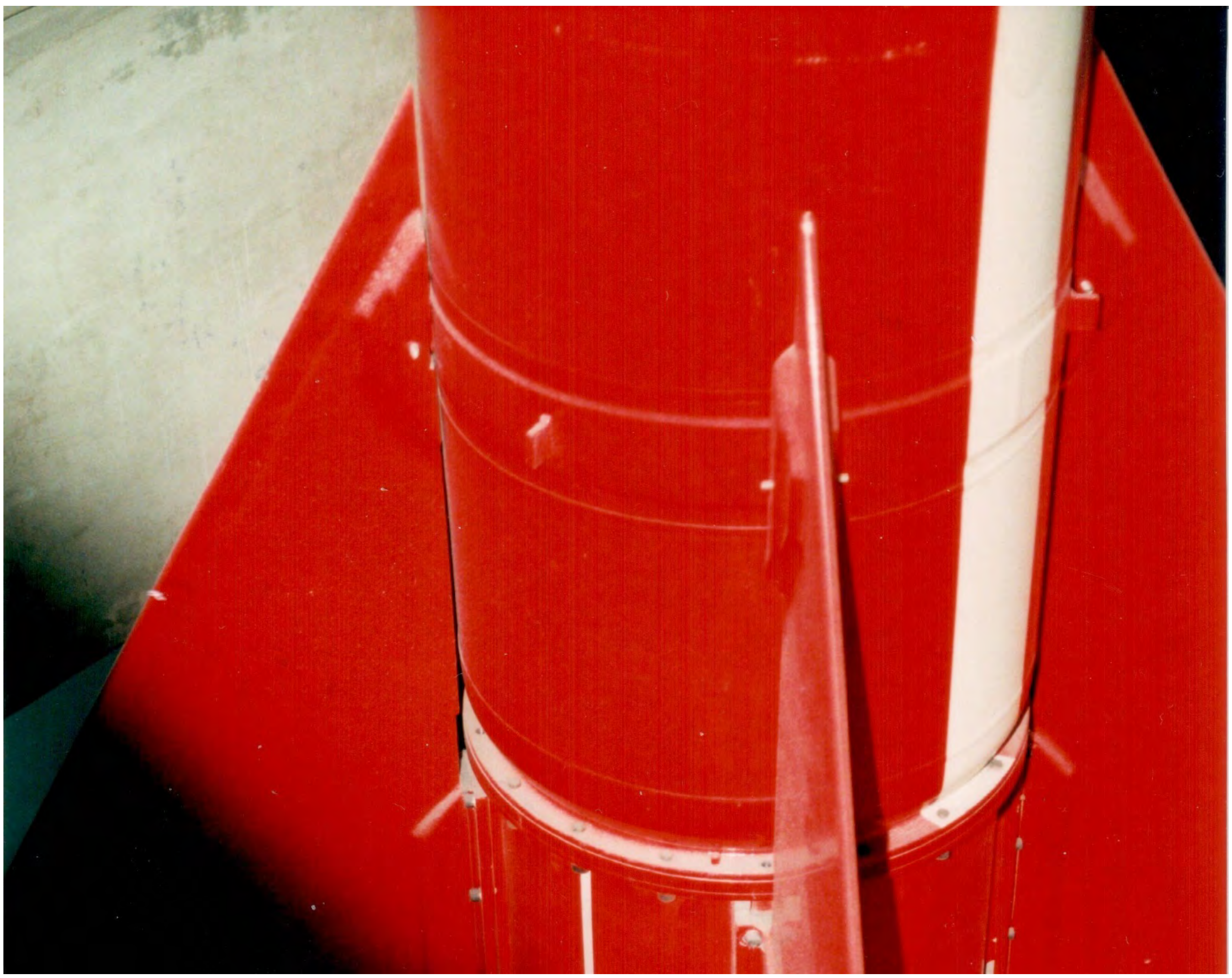

Photo 64: LEAP Band Weld

Photo by Paul Lubertowicz

Let's place these welds on the model now, using some narrow strips of Styrene.

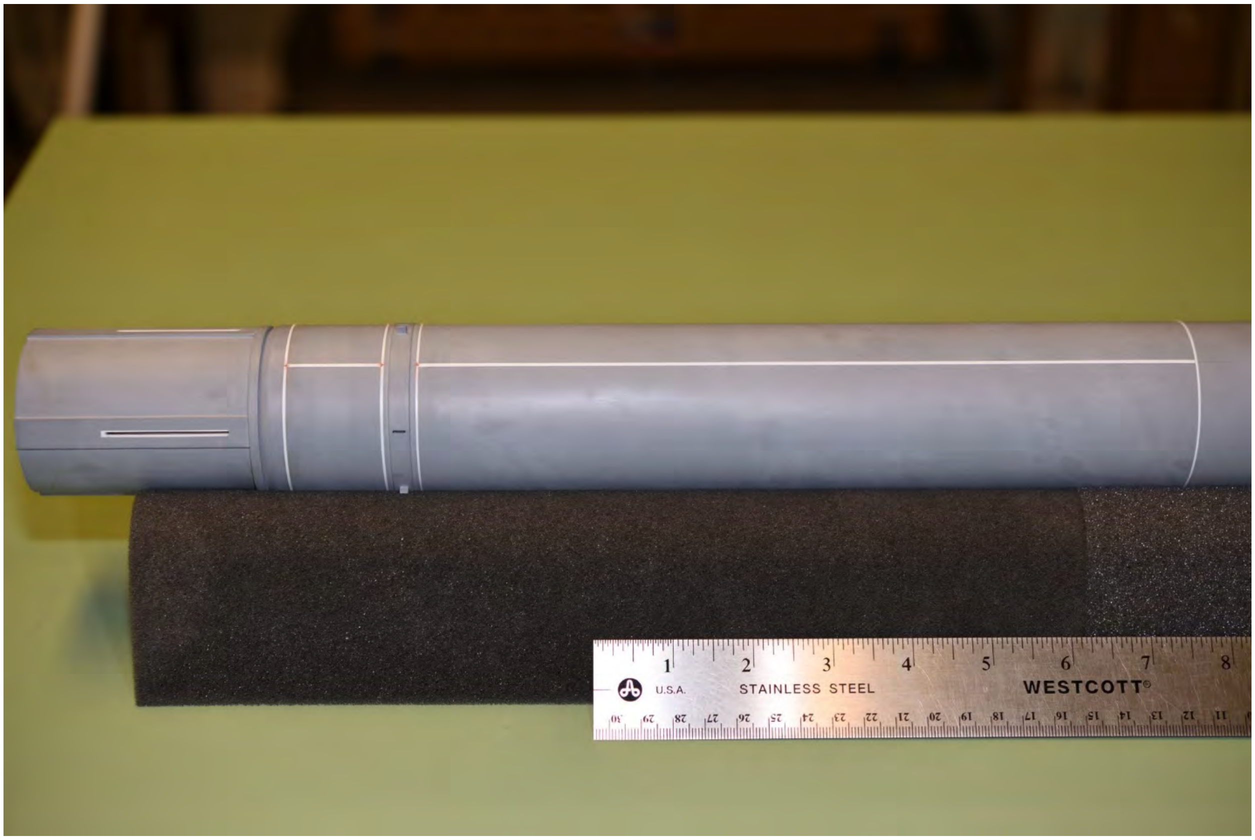

Photo 65: Case Welds

With the case welds in place, we can now finish priming the airframe with Rustoleum Automotive Primer. But before we move on to the Sustainer color coats, we must first fabricate the aft launch rail lug that's mounted at the motor case/fin can joint.

Aft Launch Rail Lug

The prototype aft launch rail lug is milled from a solid piece of metal, and is fitted with an integral mounting flange that fastens to the screws that mate the fin can and motor case together.

Photo 66: Aft Launch Rail Lug

Photo by Paul Lubertowicz

The next two photos round out our view of the overall shape of the lug.

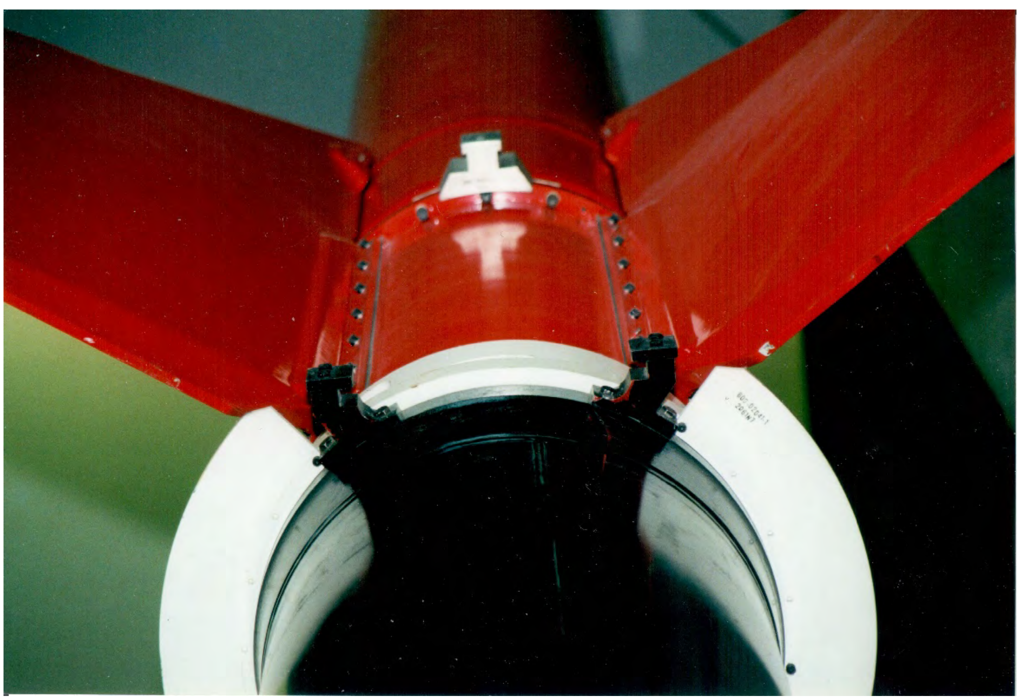

Photo 67: Lug Aft View

Photo by Paul Lubertowicz

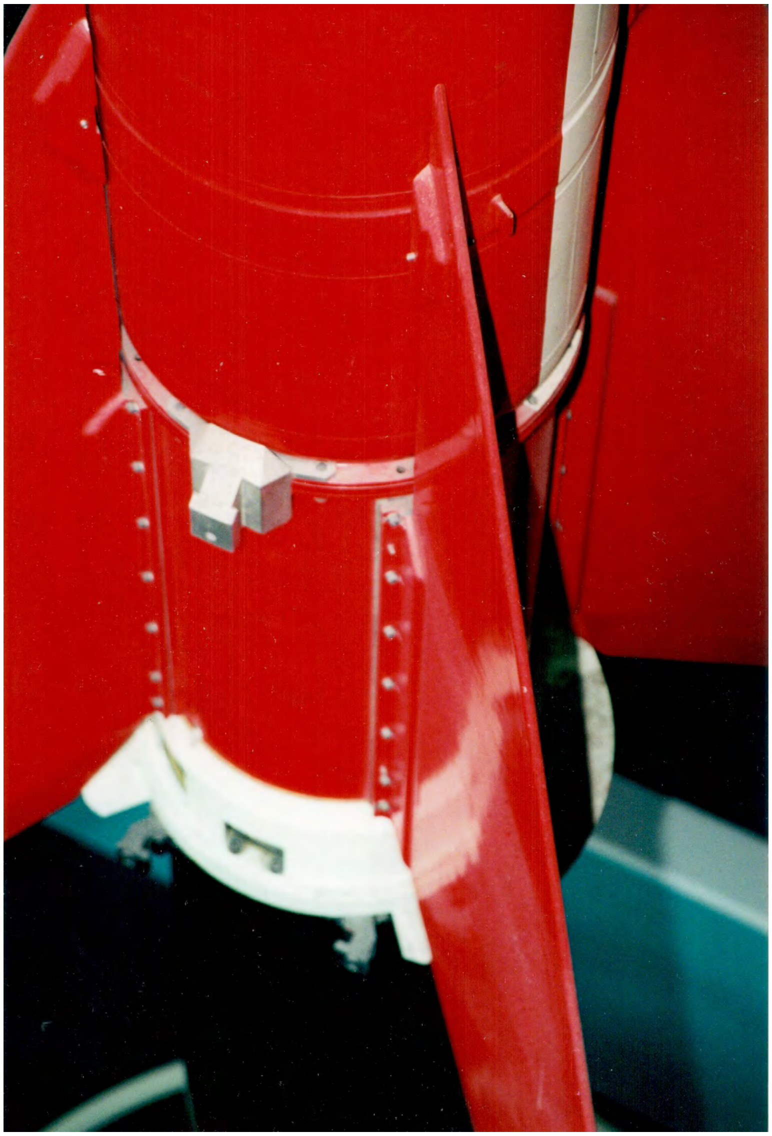

Photo 68: Lug Top View

Photo by Paul Lubertowicz

We'll fabricate this shape by gluing together a stack of sheet Styrene pieces of various widths and thicknesses, and then from this blank cut and sand the composite part to final shape. A curved Styrene mounting flange is added to the underside, per the prototype. The part will be mounted to the motor case joint ring with a length of 0.040" Styrene rod once the Sustainer is fully painted.

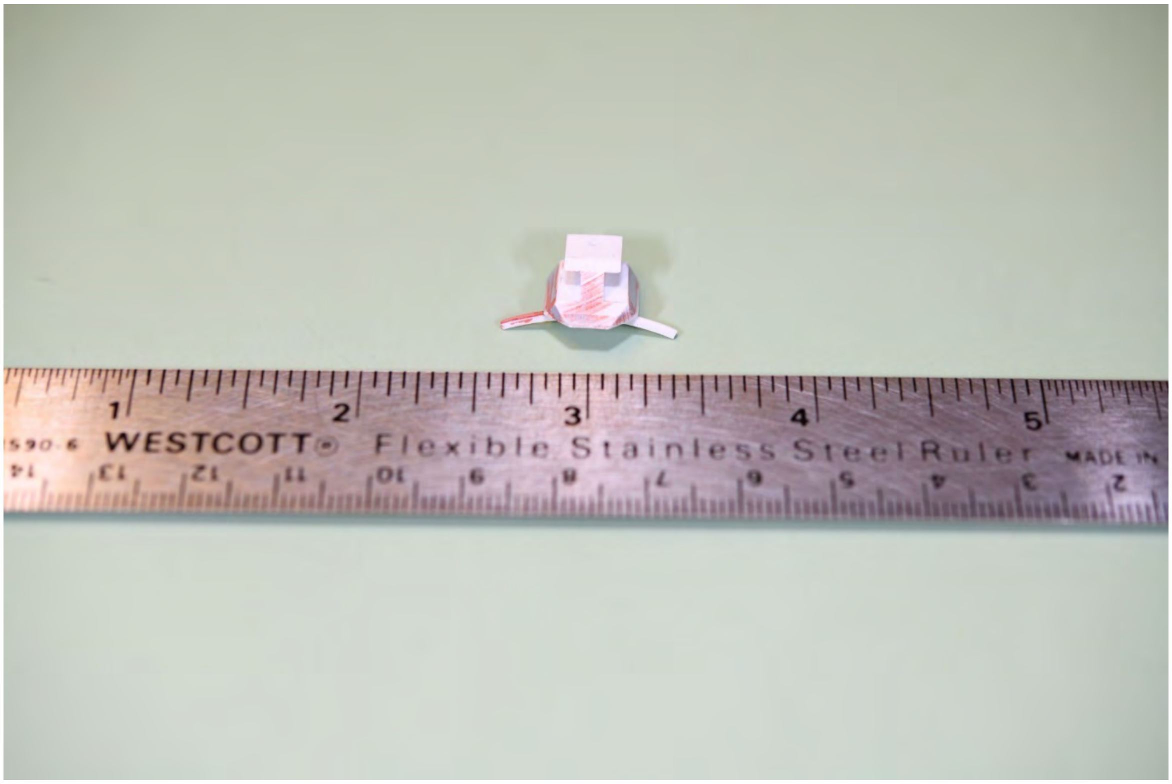

Photo 69: Aft Lug

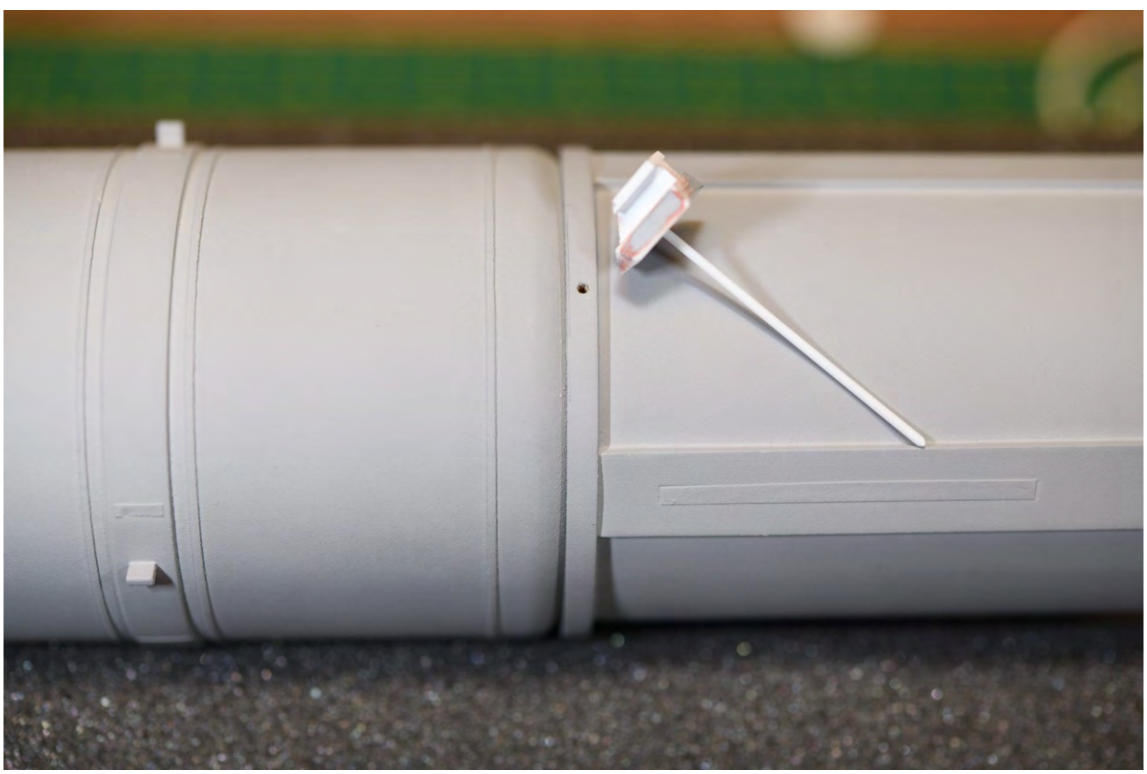

Photo 70: Aft Lug Location

The lug was primed with GSI's Mr. Finishing Surfacer 1500 Black Primer, and once dry sprayed with Tamiya AS-12 Bare Metal Silver, and then set aside to cure.

Sustainer Airframe Paint and Finish

Satisfied with the final primer finish, the Sustainer airframe was sprayed with several coats of Dupli-Color Perfect Match Polar/Arctic White lacquer; once cured, the two white stripe areas were masked with Tamiya tape and the Sustainer was sprayed with Dupli-Color Perfect Match Flash Red.

The markings were applied next. The NIKE-BLACK BRANT VC text was prepared as a dry transfer marking, as was the Bristol 'b' logo; these were carefully burnished down, taking special care at those locations where the markings were overlaid on the airframe weld lines.

Photo 71: Black Brant Text

The Vehicle Datum Axis line was cut from MicroScale's TF-1 White decal film and applied with MIG Ultra Decal Set; the white VDA text was prepared in MicroSoft Word and printed on Expert's Choice laser decal film with an Alps MD-5000 printer.

Photo 72: Vehicle Datum Axis

The text decal was set in place with MIG Ultra Decal Set, and snuggled down with MIG Ultra Decal Fix. Once dry, the airframe was clear-coated with Rustoleum Crystal Clear Enamel. With this our Black Brant VC Sustainer airframe is complete.

Sustainer Fins

Our earlier Figure 8 provides a good overview of the Black Brant VC fin, but for an accurate build we'll pull in some data from Bristol's fin assembly drawing 600-00100. This drawing provides detailed dimensions for the fin, as well as dimensions for the fin foot used to mount the fin, and for the Leading Edge Adjustment Point.

Construction

Just as was done for the booster fins, we'll base each Sustainer fin on a 1/32" ply core, each core created from a pair of 1/64" ply blanks, each warp-free core then sanded down to meet the required thickness.

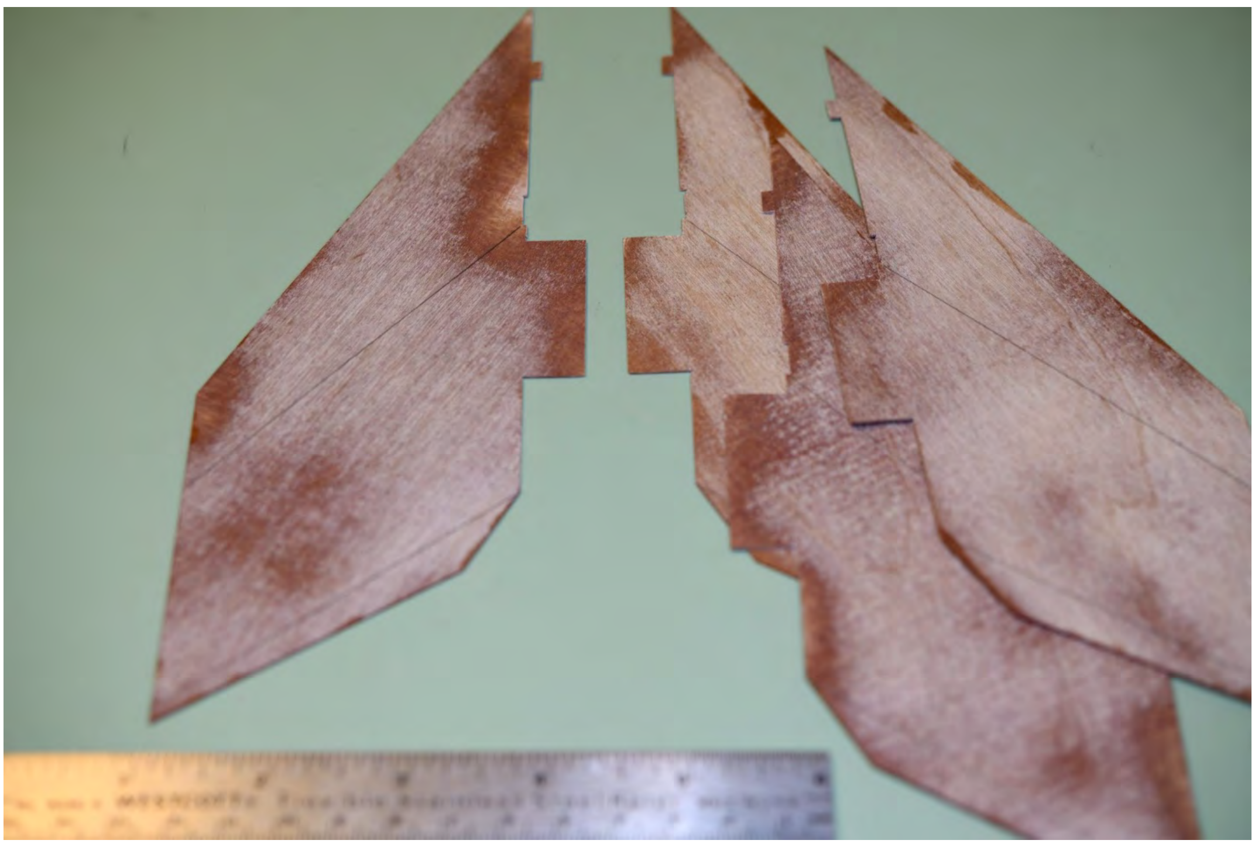

Photo 73: Sustainer Fin Cores

The leading and trailing edges were each fitted with a length of 0.035" Styrene rod; these rods provide the rounded edges as seen on the prototype fins, and as they're Styrene, they'll provide the perfect welding surface for when the Styrene fin skin edges are cemented closed. The Styrene rods were fixed in place with contact cement.

As seen in Figure 8 and in the prototype photos, the sustainer fins are distinguished by a thin, root-to-tip tapered profile, compounded by three distinct planar wedges. It's a complex compound surface to be crafted here, and attempting to hand-sand all of these features into a single balsa slab at this scale factor can cause one to test the limits of the English language, and can leave us with less than desirable results. So we'll sidestep these sanding and language issues, instead focusing our effort on crafting an accurate wedge for just the central tapered plane.

A pair of sanding jigs (left and right side) was prepared to shape the balsa sheets that would form the center tapered wedges of the fins.

Photo 74: Tapered Center Wedge

Once shaped and sanded, the sections were glued in place with epoxy, which provided the necessary time to properly position each part on the fin core. The forward root edges were fitted with balsa strips, sanded to shape to support the root edge of the fin skins.

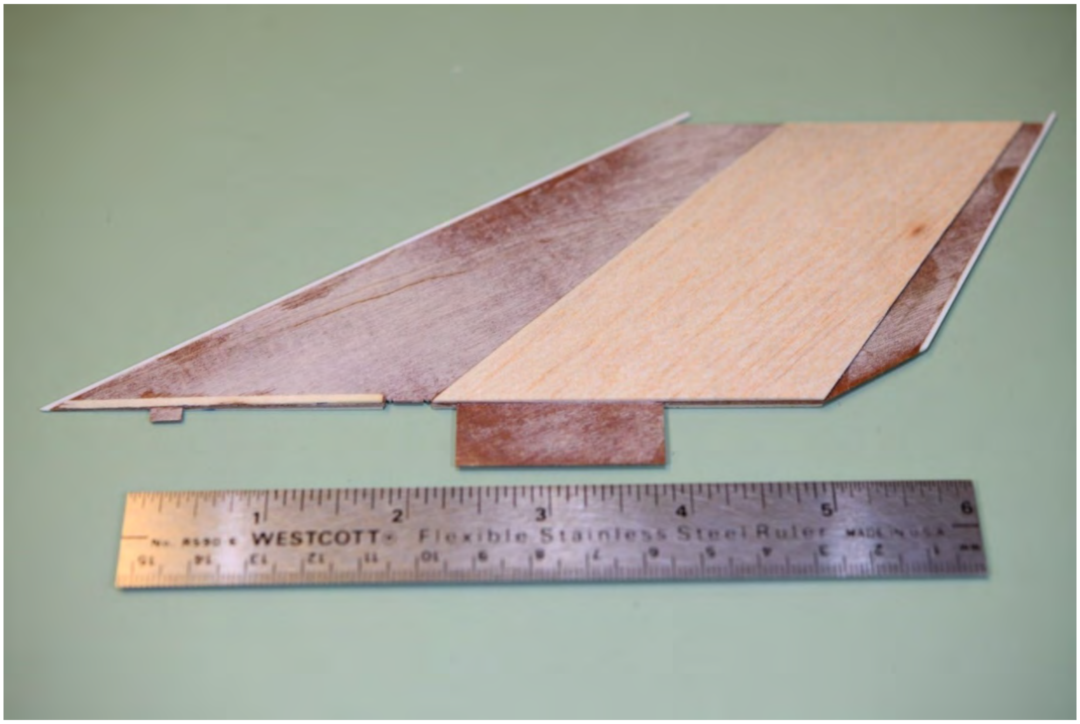

Photo 75: Completed Fin Core

A pair of fin skins was crafted from 0.010" Styrene sheet, each skin glued in place with medium CA. The skin edges were then closed on the Leading and Trailing edges with Tamiya Extra Thin Cement.

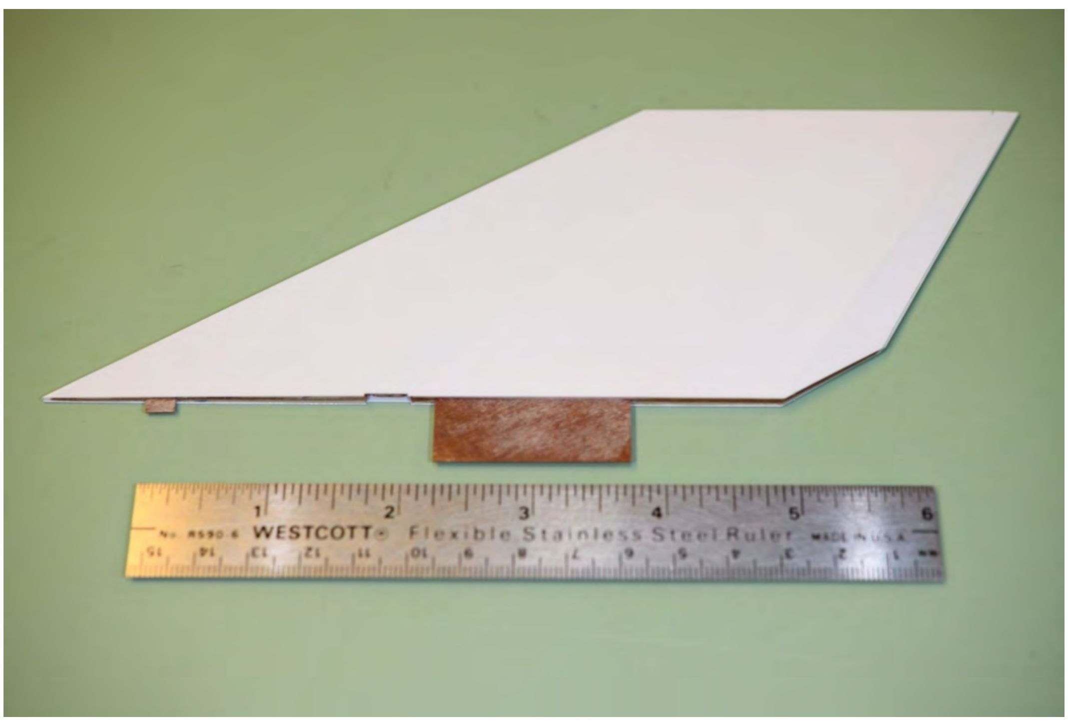

Photo 76: Skinned Fin

To enhance the durability of the thin fin tips, the open area of each tip was filled with a mix of epoxy and micro-balloons. The same mixture was used to fill the root void in the Trailing Edge, near the nozzle section.

Photo 77: Filled Fin Tip

The result is a subtle, lightweight, but stiff, compound fin, ready for detailing.

Fin Foot

The fin foot is a milled part that captures the main root of the fin, and is used to mount the fin to the fin can. Bristol drawing 600-00100 provides both a side and cross-section view of the part, reproduced here in the following figures.

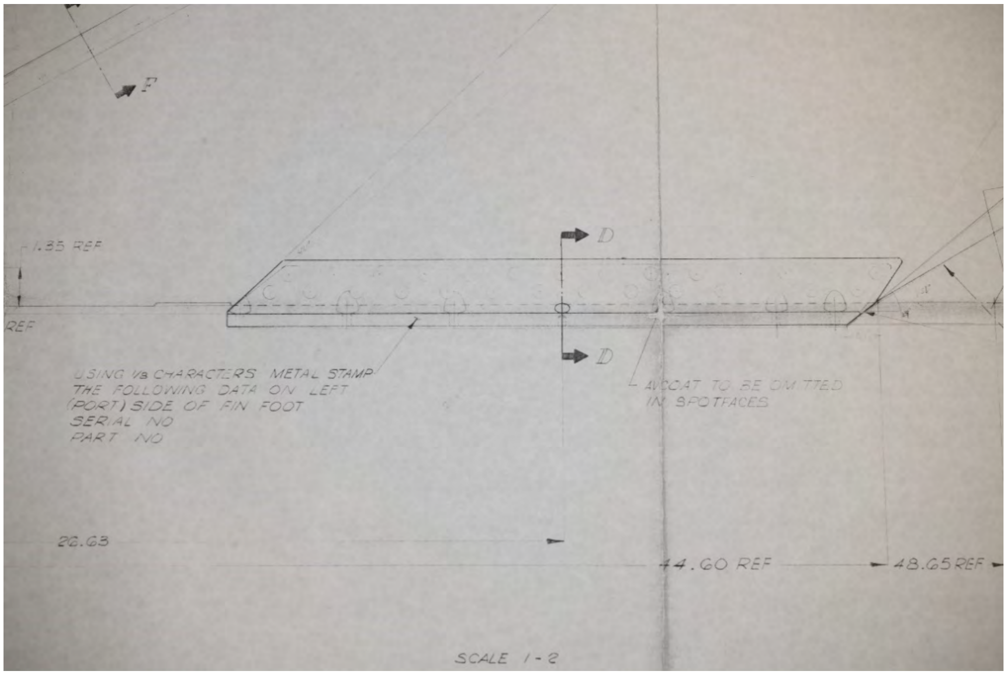

Figure 9: Fin Foot Side View

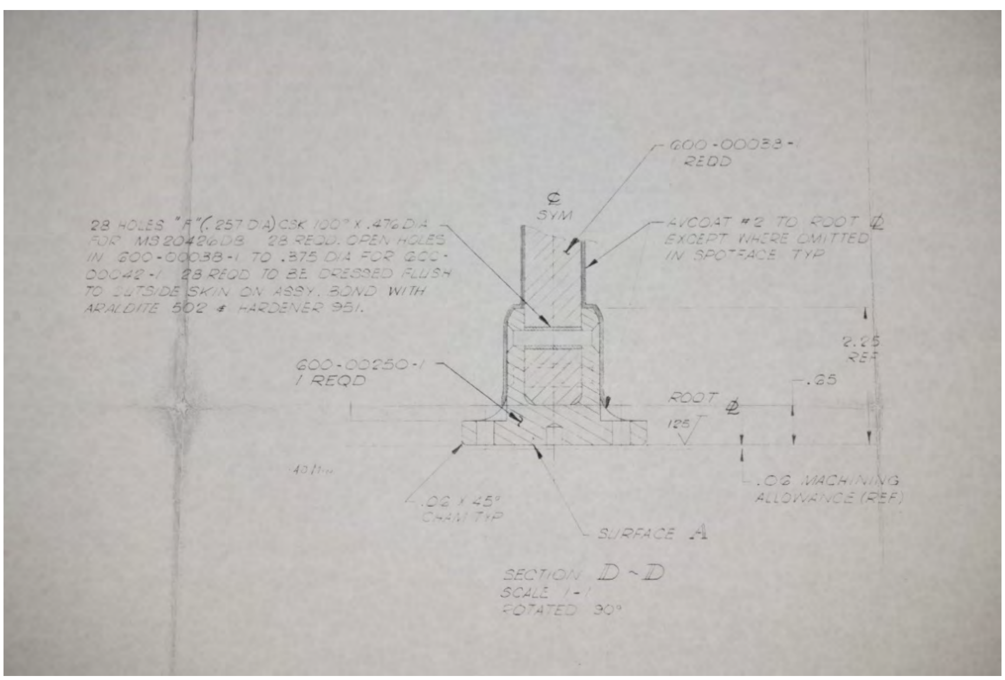

Figure 10: Fin Foot Cross Section

It's apparent from the cross-section view that the foot forms a trough that the fin root sits in, there being some material that fills the space between the root of the fin and the mounting flange. We'll represent that filler material on our fins with a pair of 0.030" Styrene strips, tacked in place with Tamiya Extra Thin Cement.

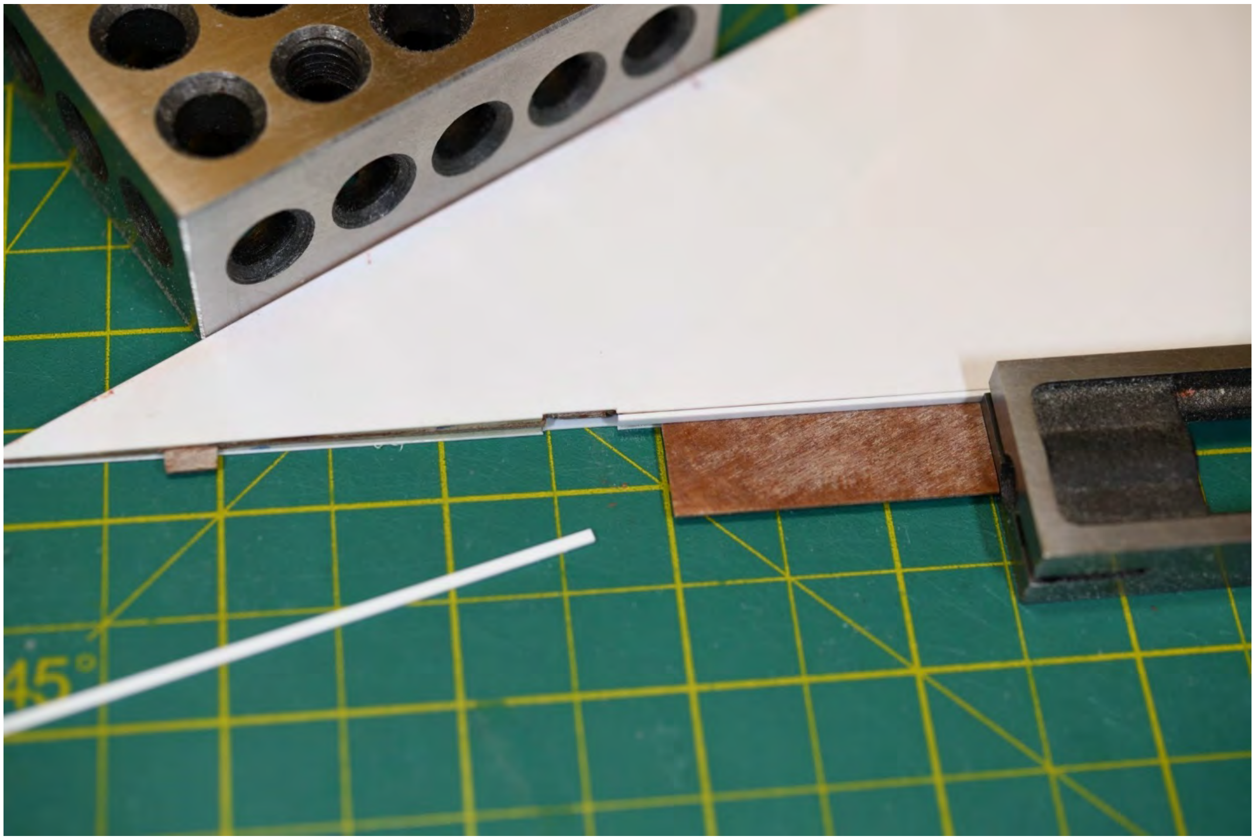

Photo 78: Root Filler Strip

The Styrene plate representing the fin flange is placed next, but before we do, we need to mark the location of the fin fasteners on the plate. This is done with the aid of a location jig and a 0.8 mm diameter drill bit.

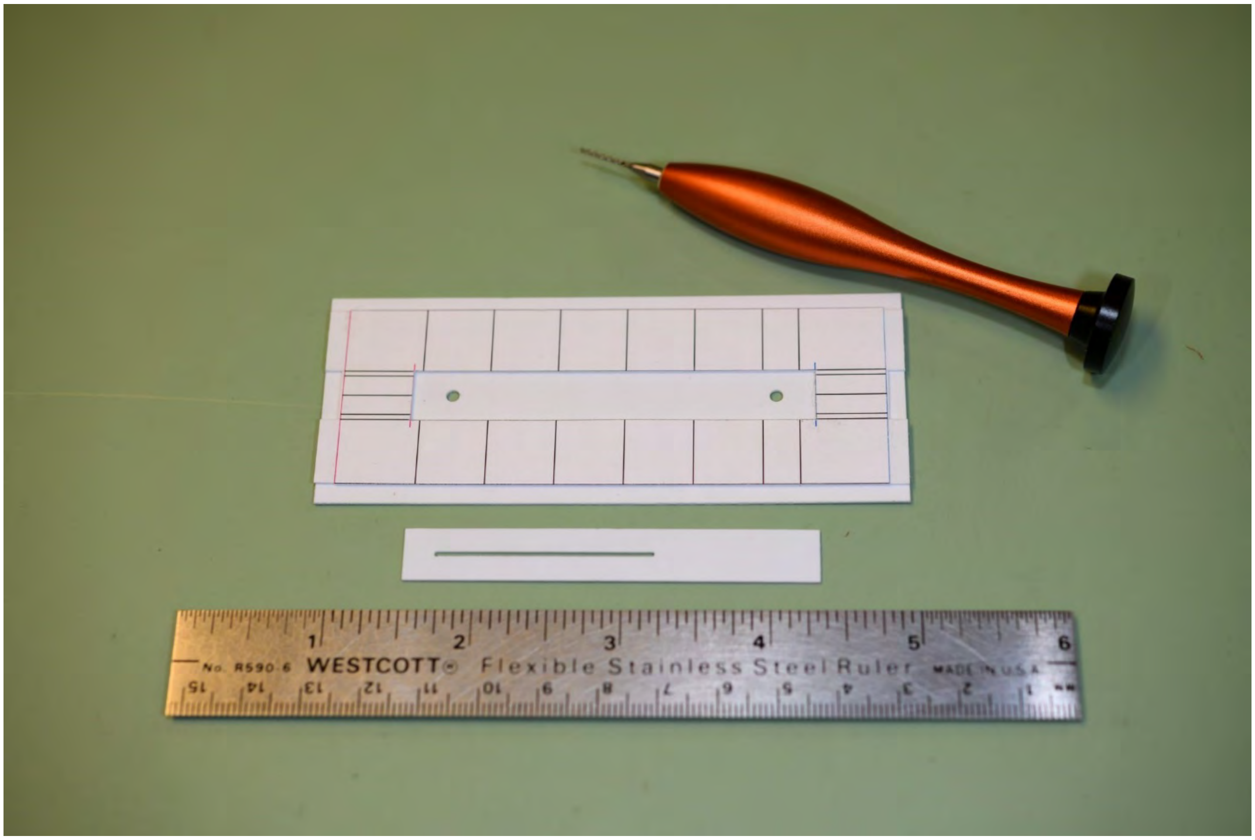

Photo 79: Fin Plate Drilling Jig

The drill bit is turned just a few times to create a depression in the Styrene plate; these marks will still be visible after the fins are painted, helping us locate the placement of the fin fasteners at that stage.

The fin plates are then glued to the underside of the fin root. Next, the fin foot side plates are crafted from 0.030″ x 0.25″ Styrene strips, and are tacked in place with Tamiya Extra Thin Cement.

Photo 80: Fin Foot Side Plate

Following this, we add a very narrow, tight fillet between the fin flange and the foot sides, mirroring the fillet present on the prototype fin foot, as seen in our earlier Figure 10. We're now ready to place the Leading Edge Adjustment Points. But first, we have to make them.

The Leading Edge Adjustment Point

The Leading Edge Adjustment Point (LEAP) is a prominent feature on the sustainer fins, its purpose being to permit adjustment of the fin's cant angle, thereby setting the vehicle's roll rate during flight. In the upper left-of-center portion of the following photo we can see the LEAP near the leading edge of the left fin; the fin in the center of the photo provides a top, edge-on view of a pair of these parts.

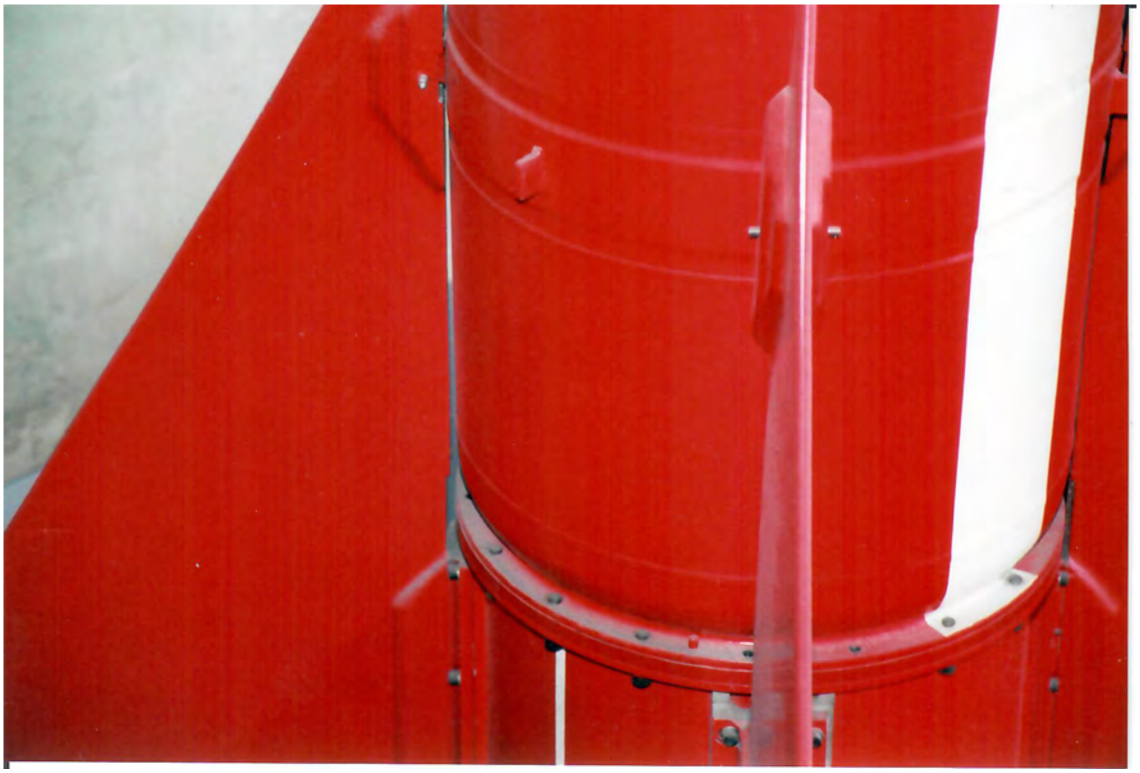

Photo 81: Leading Edge Adjustment Point (LEAP)

Photo by Paul Lubertowicz

Bristol drawing 600-00100 provides dimensions for the part, and the relevant section of that drawing is provided below.

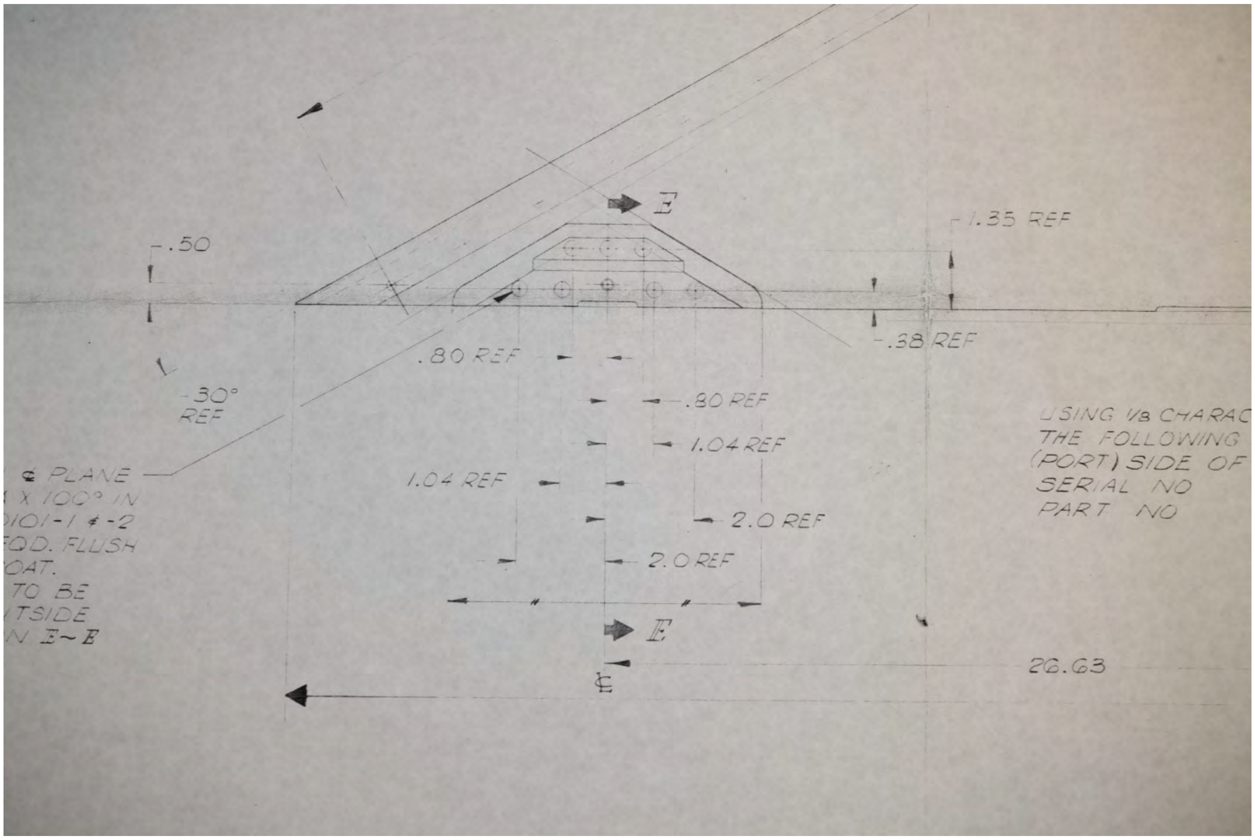

Figure 11: Leading Edge Adjustment Point

Bristol Drawing 600-00100

For the model, we'll shape a master part from two strips of 0.030" thick Styrene, which is then fitted into a Styrene molding box from which we'll cast a master silicone rubber mold. We need a total of eight Adjustment Points, and casting from a common master ensures all eight parts will be identical.

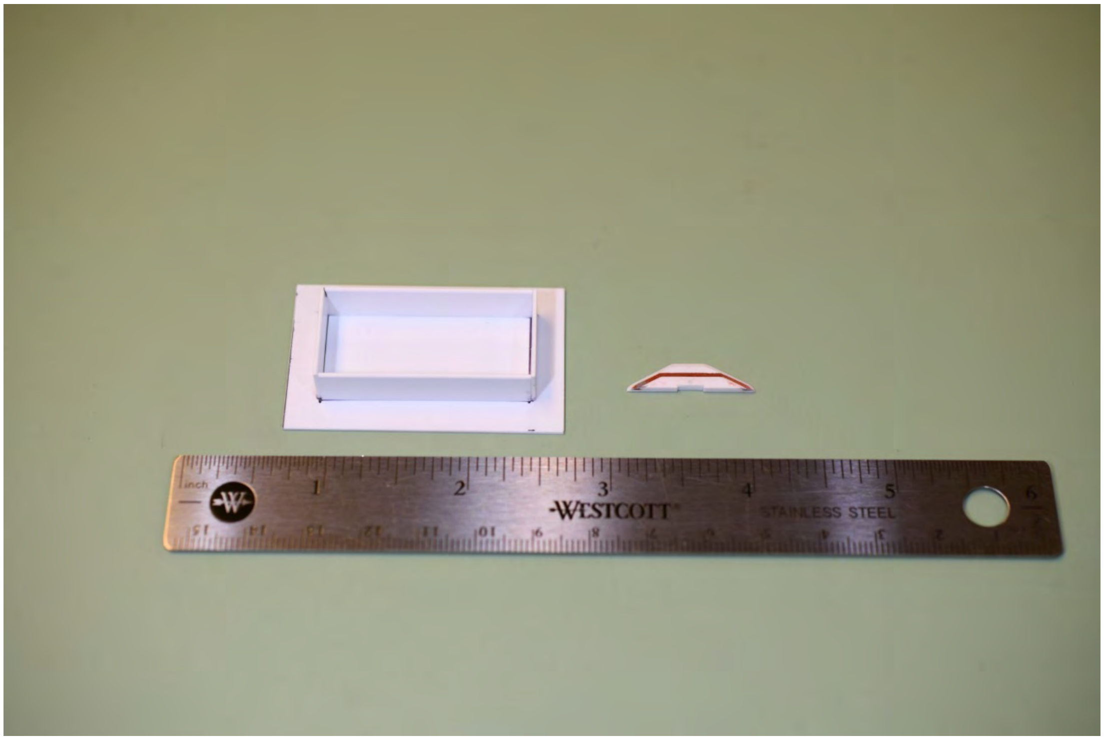

Photo 82: Mold Box & LEAP Master

After some resin casting and a little flash clean up, we arrive at eight LEAPs for the fin set.

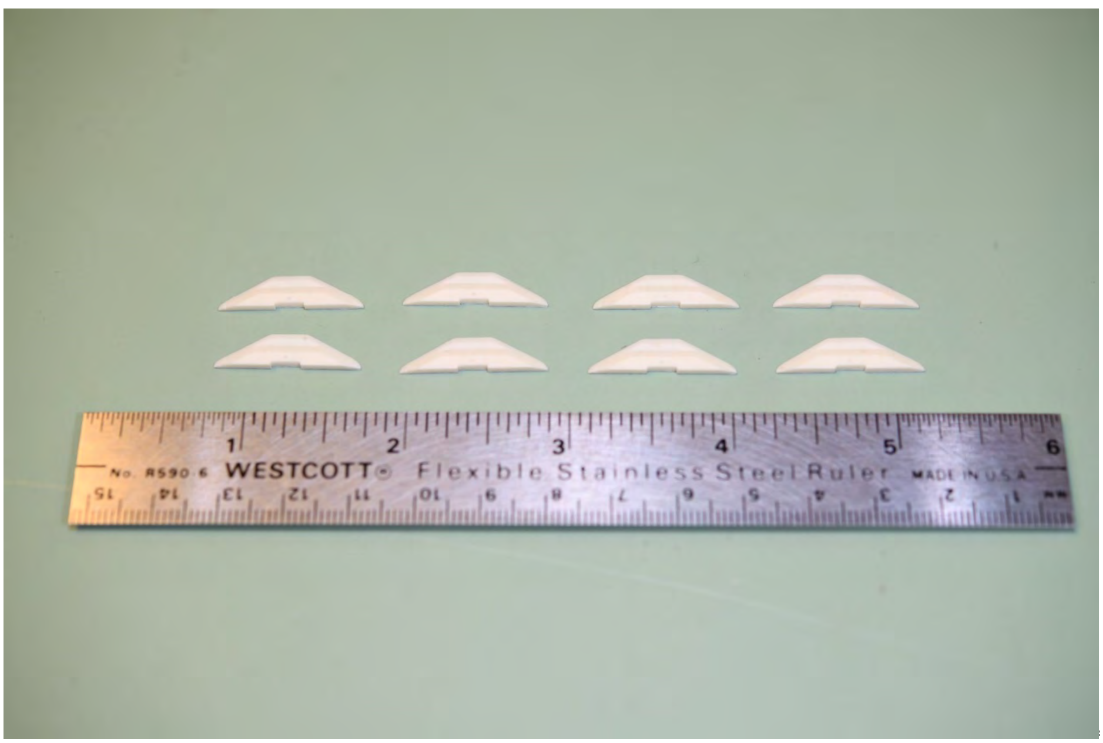

Photo 83: LEAP Castings

A dry fit gives us a view of their placement:

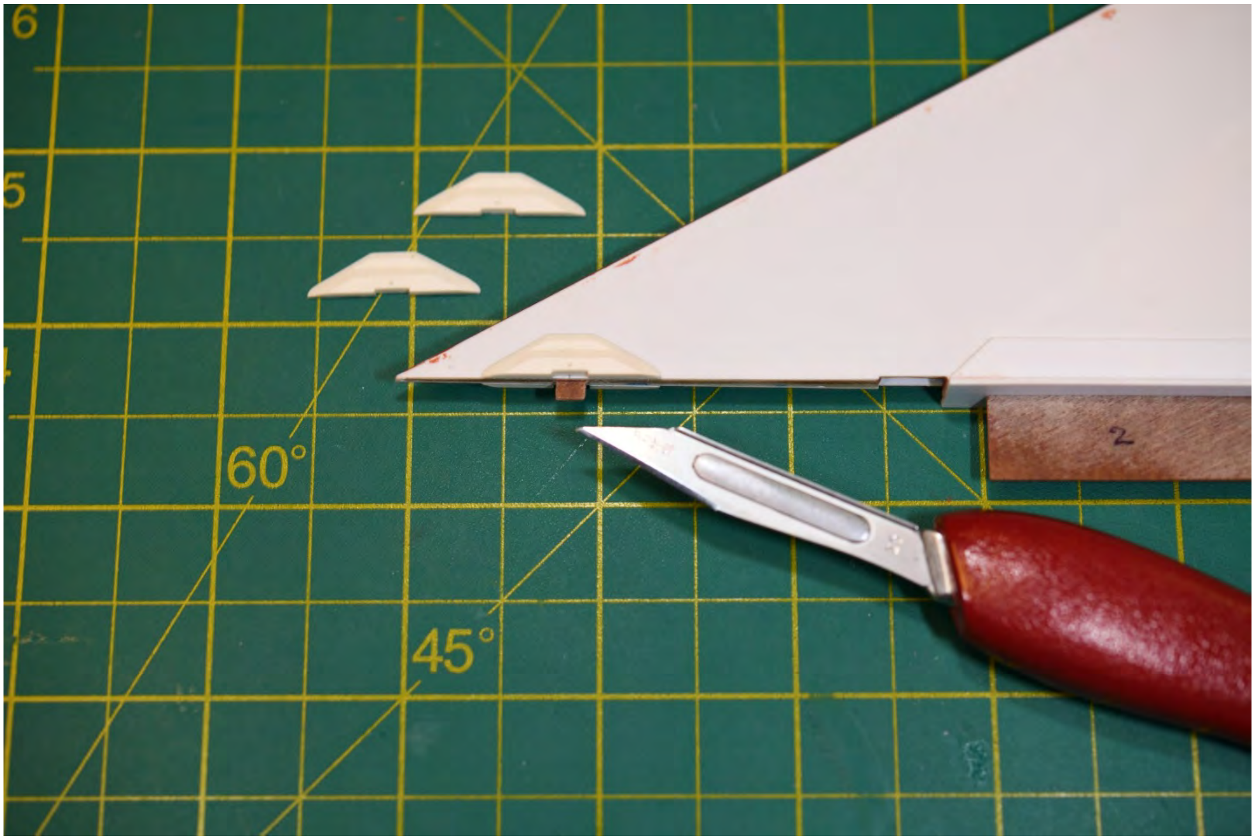

Photo 84: LEAP Trial Fit

Satisfied with the LEAPs we can cement them in place with a dot of Medium CA.

Our earlier Photo 81 also provides a view of the LEAP adjustment screws; we'll drill each LEAP with a #65 drill bit, and once the fins are fully painted and finished, we'll cut short lengths of 0.030" Styrene rod, painted with Model Master #1790 Chrome Silver, and fix these in place with a tiny dot of MIG Ultra Glue.

We can now try a trial fin fit, and once a satisfactory fit is confirmed, the sustainer fins can head off to the Paint Shop for some primer.

Sustainer Fin Paint

Each fin was primed with Rustoleum Automotive Primer, and once cured, sprayed with Dupli-Color Perfect Match Polar/Artic White to provide a bright neutral base for the final color. The fins were then sprayed with Dupli-Color Perfect Match Flash Red.

The fins were finished with an overcoat of Rustoleum Crystal Clear. The fin flange fasteners are scale size socket head bolt heads, painted with Testors Model Master #1749 Flat Black, and set in place with a tiny dot of MIG Ultra Glue. We opted for a nonsolvent-based adhesive for this final step to obviate any chance of marring the finish while placing the fasteners.

Photo 85: Finished Fin Installed

With the last fin installed, our Black Brant VC Sustainer is now complete.

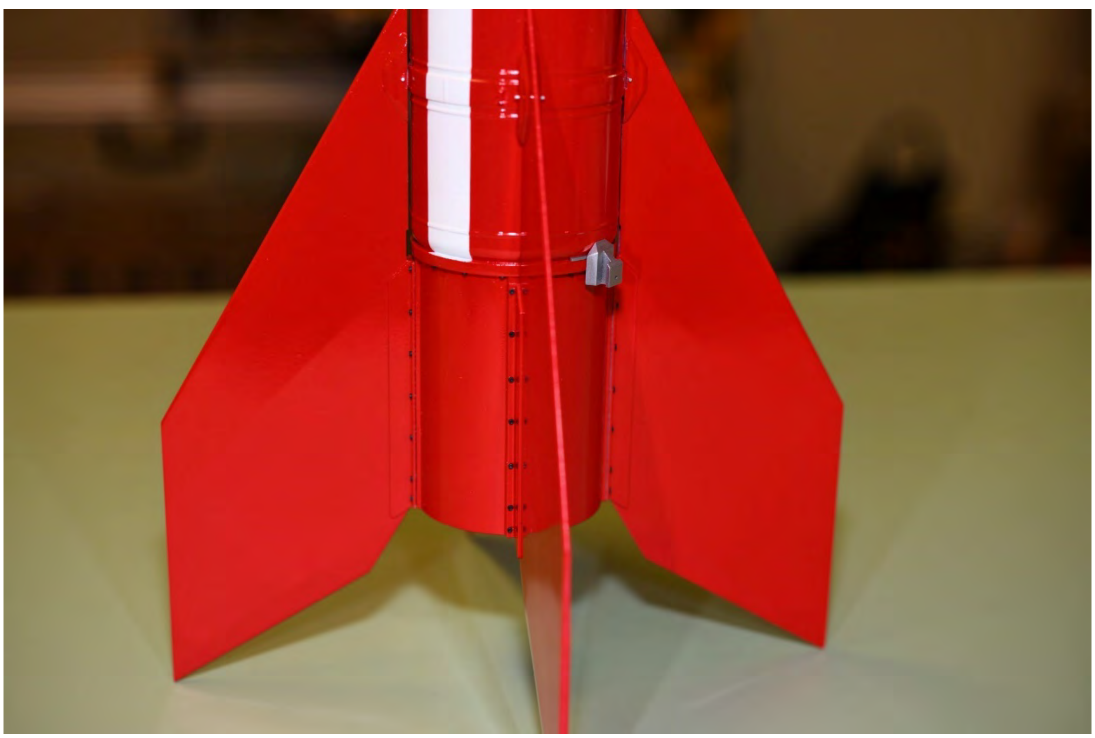

Photo 86: Fins Installed

Payload and Nose Cone

When I was constructing my original BBVIII model, the only photograph of the payload section available to me at the time was the Tim Harincar photo featured in the ROTW 2002 Supplement. That photo appears in this article way back at the beginning as our Photo 1, and for convenience, we'll reintroduce the photo here:

Photo 87: BBVIII Upper Stage

Photo by Tim Harincar

That photo suggests the payload section has a portion painted a tan or beige color; by itself not a remarkable observation, as over the years many of us have seen photos of all sorts of Black Brant V variants sporting all sorts of payload colors and mission widgets. However, since Bristol's General Arrangement drawing 600-02025 offered little to the contrary, I did my best to interpret that section from the photo, and with some beige paint replicated the colored band on the model. But my interpretation couldn't possibly have been more wrong.

Paul Lubertowicz's photo collection makes it clear the beige colored band has nothing to do with the payload section. Instead, that beige band is part of a clamp and brace system used to secure the prototype to the building's support column.

Photo 88: Science Center Safety Clamp

Photo by Paul Lubertowicz

Unfortunately, that clamp also obscures the joint between the red section (the Igniter Housing) and the white section (the Instrumentation section), so we can't precisely determine the manner of fastener that was used to mate these two sections. More on this point in a moment.

To better understand this section of the round, let's review a few more of Paul's photos, starting with a view of the joint area between the motor case and the Igniter Housing.

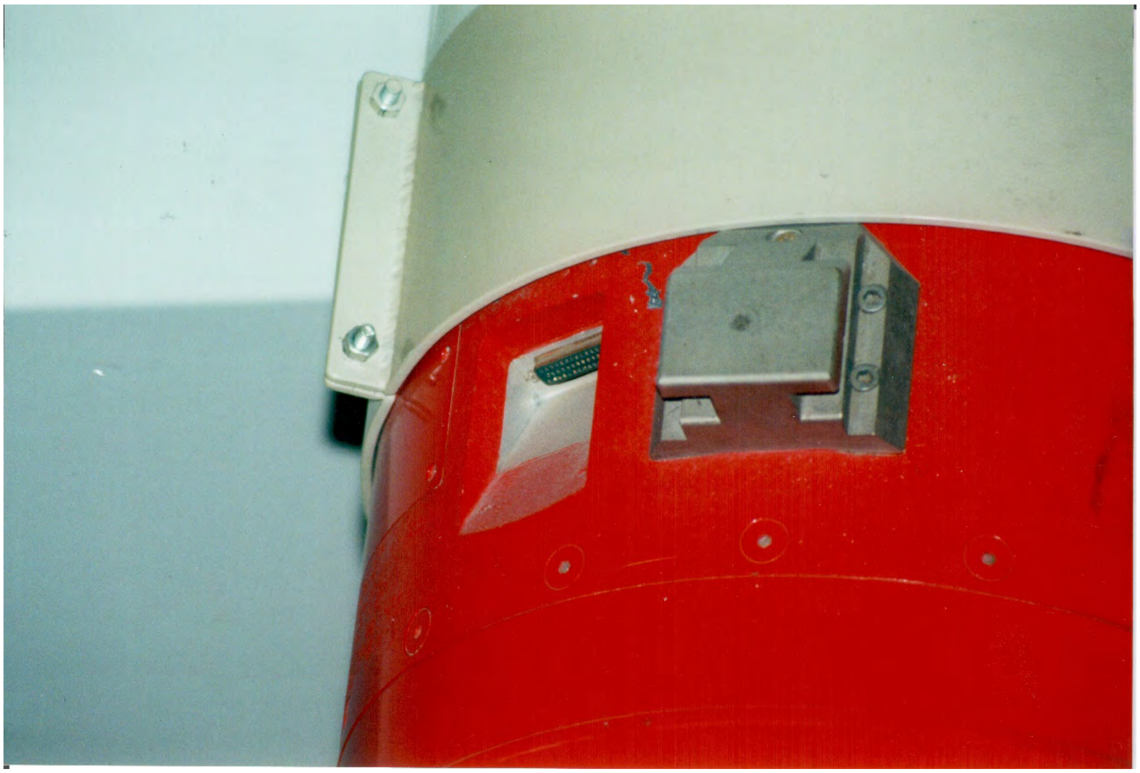

Photo 89: Igniter Housing/Motor Case Joint

Photo by Paul Lubertowicz

In Photo 89, one can see a small access panel on the far left, fastened in place with four round head screws. To the right of the panel is the umbilical port; prominent in that port is a Cannon DD50S 50 pin D-Type connector. And then further right is the forward launch rail lug. One should note that the base of this lug is different than the base of the aft lug.

Looking more closely, one can just make out the large diameter flat head socket screws used to join the Igniter Housing to the motor. Those screws are UNBRAKO 3/8"-24UNF countersunk socket head screws, and there are sixteen of them spaced about the circumference of the joint.

The next photo provides a view of the Instrumentation Section.

Photo 90: Instrumentation Section

On this section we can see two flush mounted access panels. Then just above is the nose cone, and the very visible inset screws that join the nose to the Instrumentation section. And as mentioned previously, the wall mounting clamp obscures the joint between the Igniter Housing and the Instrumentation section, so we can't be sure what fasteners were used to make that joint.

Photos of other BBVC rounds show a variety of joint arrangements for the various modules that can comprise the payload section – some use the milled, angled insets such as we see here between the Instrumentation section and the nose; others use flush-set screws, either of the socket head type or sometimes flat head Phillips screws.

Buried within the data package shared by Taras Tataryn is a blueprint of a BBVC payload section that's very similar to the section found on the St. Louis Science Center round. Unfortunately, that blueprint has sustained some water damage somewhere in its past, and so the drawing number is illegible and can't be referenced. Nevertheless, we'll pull in a detail view from that nameless, numberless print, as it highlights the fasteners used at the Igniter Housing/Instrumentation Section joint for that particular Payload version.

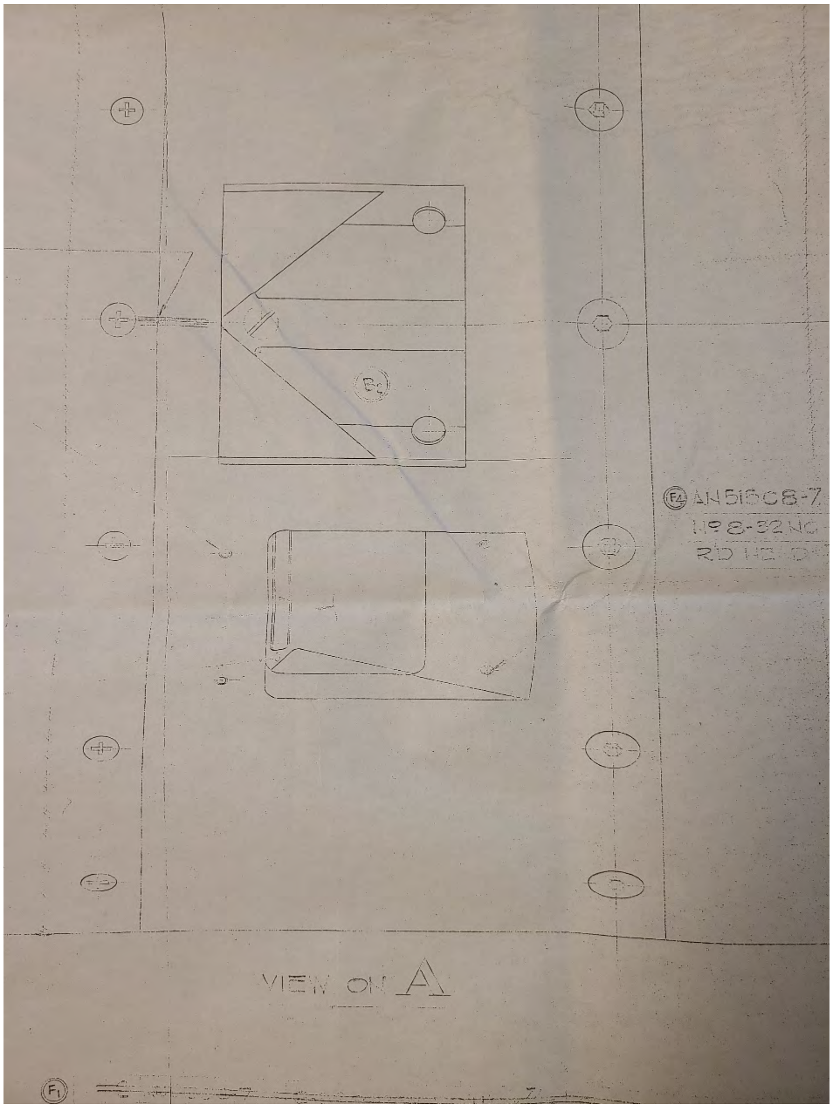

Figure 12: Igniter Housing

In the left of the drawing, we can see the joint between the Igniter Housing and the Instrumentation section, and in this particular payload example the joint is secured by sixteen UNBRAKO ¼"-28UNF flat head Phillips screws, as annotated in the following blueprint note:

Figure 13: Instrumentation/Igniter Housing Joint Fasteners

Returning to our St. Louis Science Center round, and the fact that the joint and fastener type is obscured by the wall mounting clamp, we'll stipulate an arbitrary conclusion to our own twisted confrontation with Schrodinger's Cat, and for our model we'll go with these ¼"-28 flat head Phillips screws as our Instrumentation Section/Igniter Housing joint fastener.

Reference data established, let's construct our payload section.

Igniter Housing

We will base the Payload Section on a JT-70C coupler, as the section must mate with the Sustainer portion of our model. We'll begin with the Igniter Housing, cutting out the port for the umbilical connector.

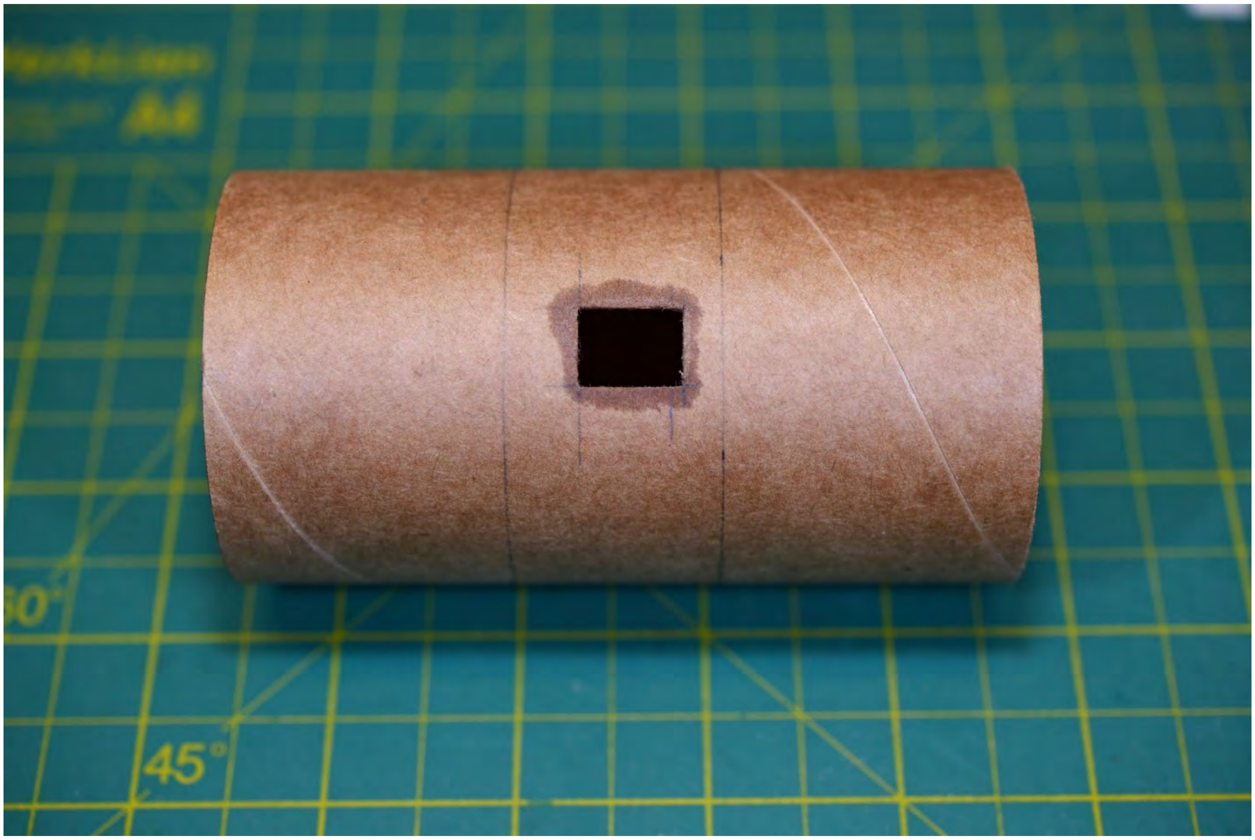

Photo 91: Umbilical Port

To this we'll add a scale length of 0.010" thick sheet Styrene, cutting out the port area once the glue has set. As seen in our earlier Photo 89, the umbilical connector is inset at an angle, and so we'll craft the port accordingly from pieces of 0.010" thick Styrene.

To represent the DD50S Cannon connector, we'll cut the end off of a micro-USB cable; at our scale factor, a micro-USB connector is very close to the required shape and size, and makes for a good facsimile.

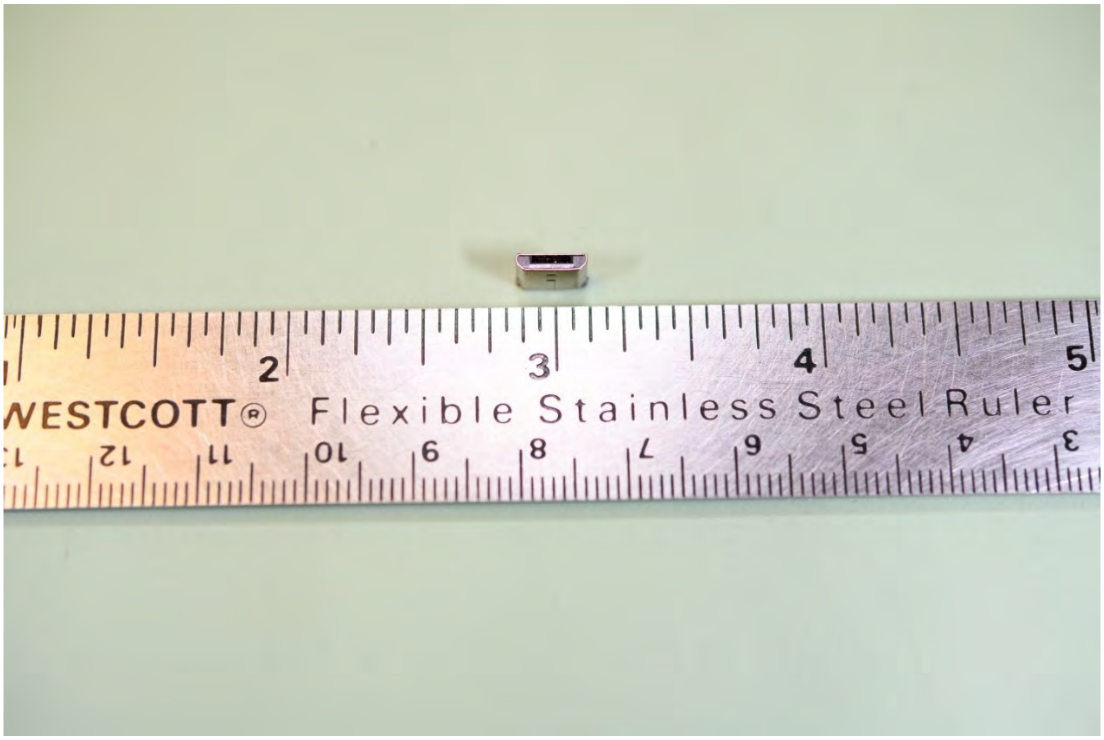

Photo 92: "Cannon" Connector

The port assembly follows:

Photo 93: Umbilical Port Assembly

Before we mount the port assembly, we need to add the outer skin so that the diameter of the Igniter Housing matches the diameter of the airframe. We also need to add our representation of the UNBRAKO socket head fasteners, and so to prepare for this, the outer skin is punched along its lower edge.

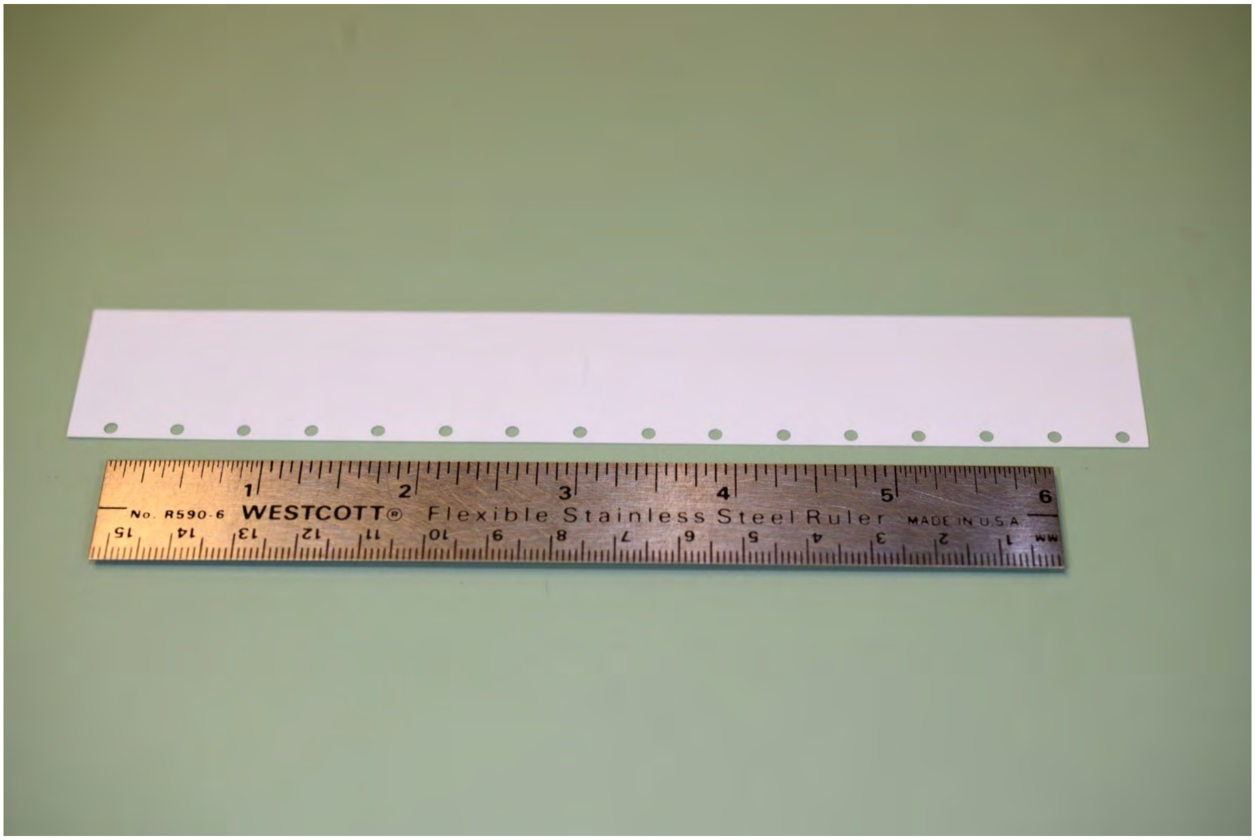

Photo 94: Igniter Housing Outer Skin

Not so visible in the photo is the scribed access panel that's located to the left of the umbilical port.

With some glue the outer skin is applied, the umbilical port area opened, and the connector port assembly is installed and trimmed.

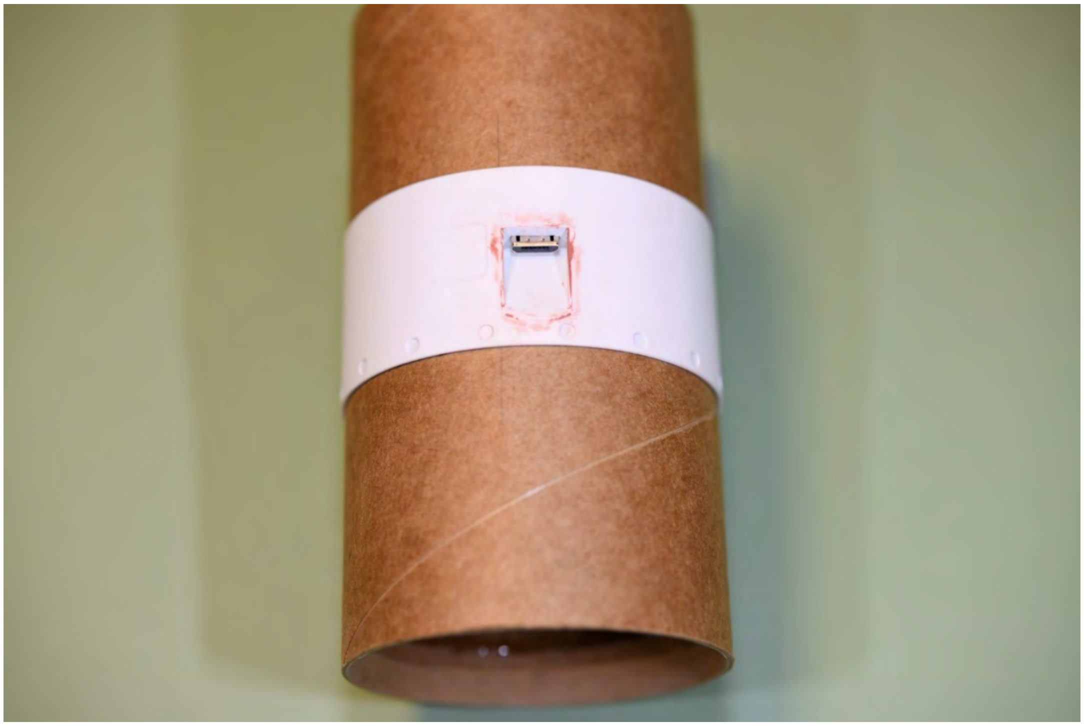

Photo 95: Umbilical Port Installed

To represent the UNBRAKO socket head screws, we'll double-punch some Styrene disks of the appropriate diameter.

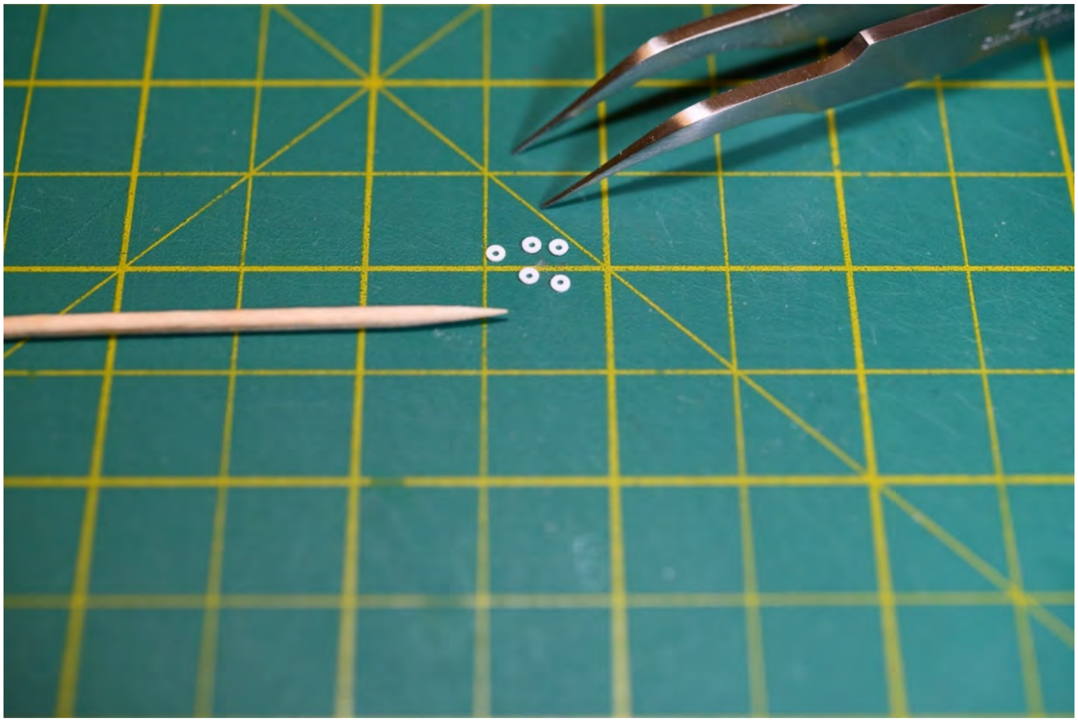

Photo 96: Socket Head Screws

These are installed with careful dashes of Tamiya Extra Thin Cement.

Next, we'll craft up the forward launch rail lug using pieces of Styrene sheet, as we did for the aft launch lug.

Photo 97: Forward Launch Rail Lug

This puts us in position to attempt a trial fit before priming the assembly:

Photo 98: Igniter Housing Trial Fit

With this, it's off to the Paint Shop for some primer and paint.

Igniter Housing Paint

The Igniter Housing was primed with Tamiya Fine Gray Surface Primer, with defects fixed with Tamiya Basic Modeling Putty. The section was then shot with Tamiya TS-26 Pure White, and once cured, sprayed with Dupli-color Perfect Match Flash Red.

The faux Cannon connector was hand-painted with Vallejo Model Color Black, and once dry, a narrow piece of Bare Metal Foil Gold was placed over the shell. The bare metal area of the port was covered with pieces of Bare Metal Foil Aluminum.

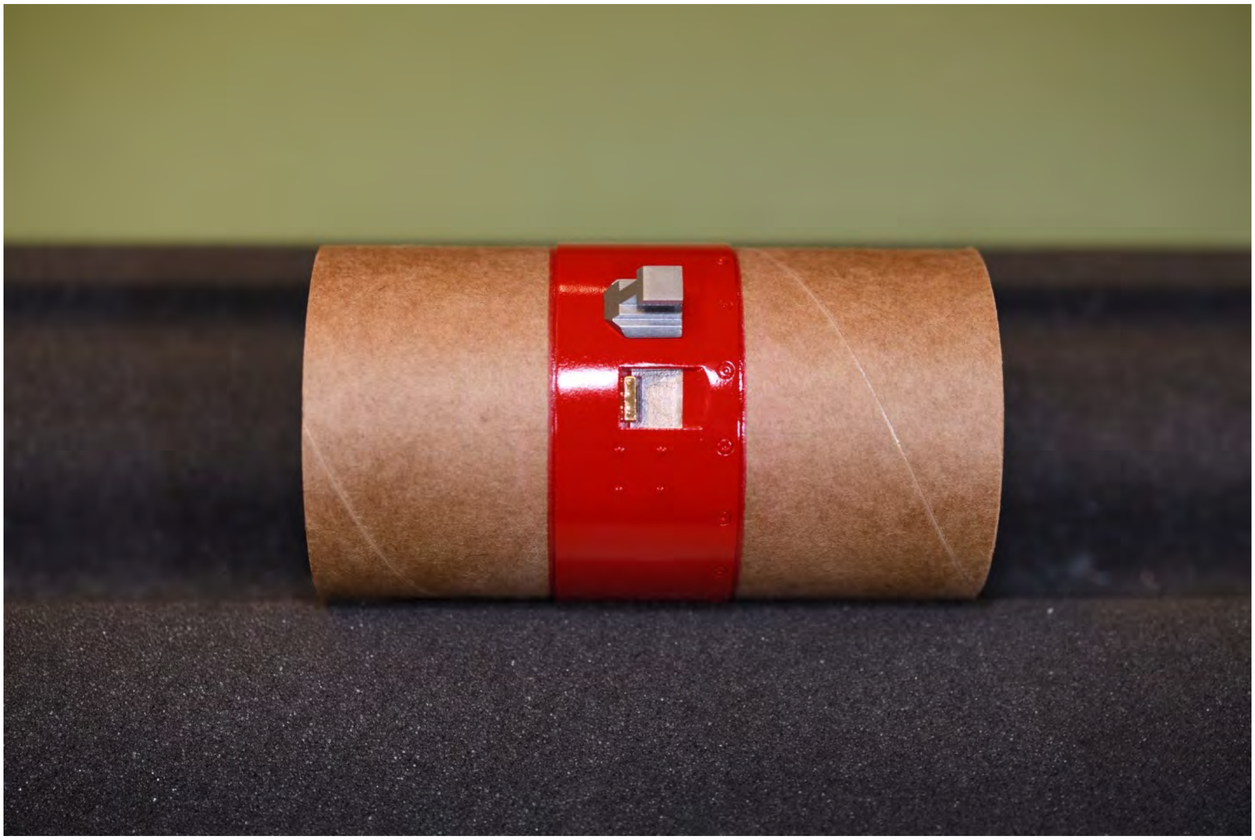

Photo 99: Finished Umbilical Port

The forward launch lug was primed with GSI's Mr. Finishing Surfacer 1500 Black Primer, and then over-sprayed with Tamiya AS-12 Bare Metal Silver. Once dry, the lug was installed, completing the Igniter Housing assembly.

Instrumentation Section

As seen in our earlier Photo 90, the Instrumentation section exhibits a pair of access panels and a circumferential row of joint fasteners. This detail manifests on the outside skin of the section, so we'll reproduce this on a scale length of 0.010" thick sheet Styrene. The Styrene wrap will then be glued to an underlying piece of BT-70 which will nicely slip-fit over the JT-70C coupler we're building the overall payload section on.

Before we do all that, we must first adjust the diameter of the underlying BT-70 tube so that when the Styrene wrap is added, we remain at an overall BT-70 diameter. We accomplish this by first removing the outer paper layer of the BT-70.

Photo 100: Instrumentation Section BT-70 Underlay

All of the white paper layer is removed, and then the stripped tube is saturated with thin CA. Once dry, the stripped tube is carefully sanded to remove any remaining outer paper remnants, all the while checking wall thickness for uniformity. We want the stripped tube to arrive at a wall thickness of about 0.010".

The Styrene wrap is punched for the row of fasteners, the access panels are scribed into the surface, and then the Styrene wrap is glued to the underlying tube. The representative Phillips head screws (punched, scale diameter Styrene disks, with hand-pressed Phillips impressions made with a 000 Phillips screwdriver) are then added with Tamiya Extra Thin Cement.

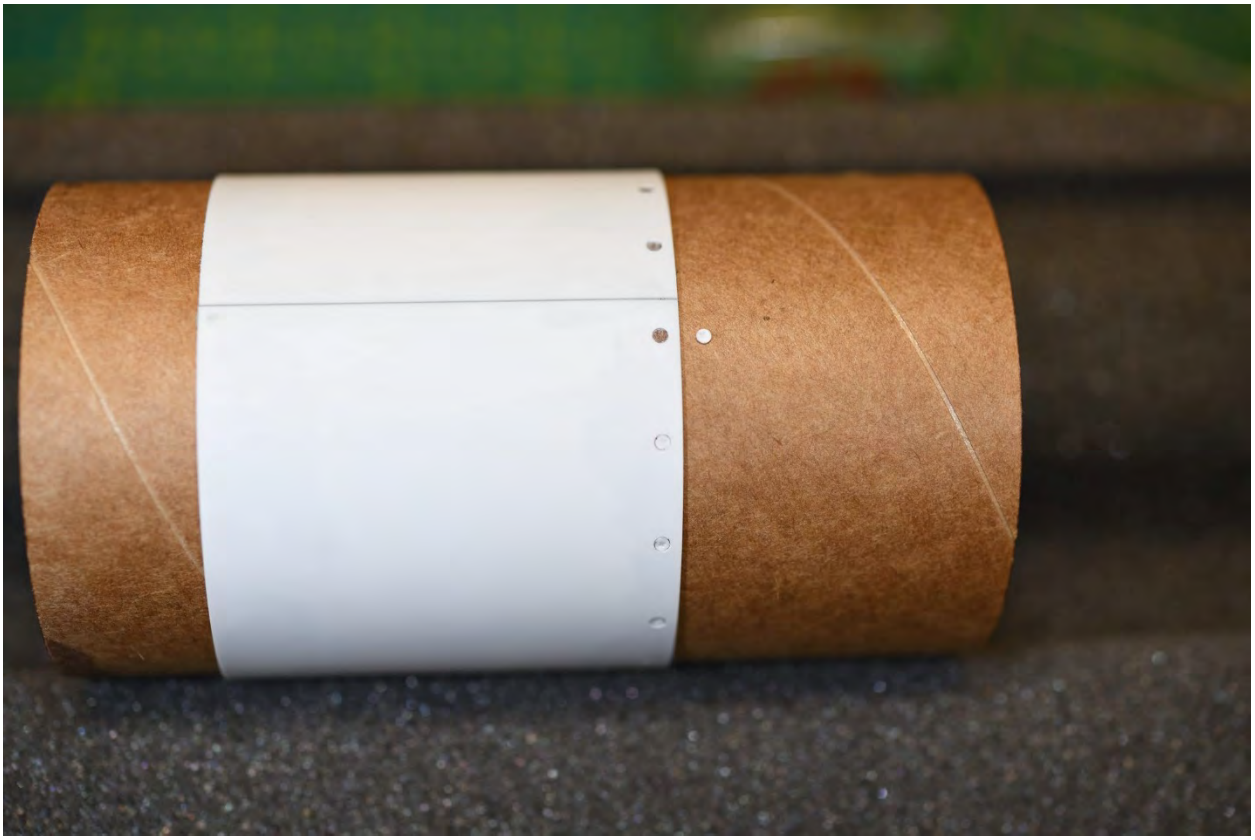

Photo 101: Phillips Joint Fasteners

Note that the section is temporarily supported with a spare coupler while being worked on, due to the fragility of the part. Once the thing is finished and painted, we can try a trial dry fit on the actual payload section.

Photo 102: Payload Section

It seems to be coming along nicely, and one can see that I've added the nose cone as part of the trial dry fit. We'll cover that topic next.

Nose Cone

The nose cone is a two-part, 3D resin-printed assembly produced by Mike Nowak of Galactic Manufacturing. Mike printed the nose in two parts to accommodate the overall length of the nose.

Two parts means a joint, and so a little bit of sanding was needed to arrive at a clean fit. Also, to maintain the nose cone's compound curve, I found that leaving a small gap in the joint helped the fit. With the cleanup finished, the two halves were epoxied together.

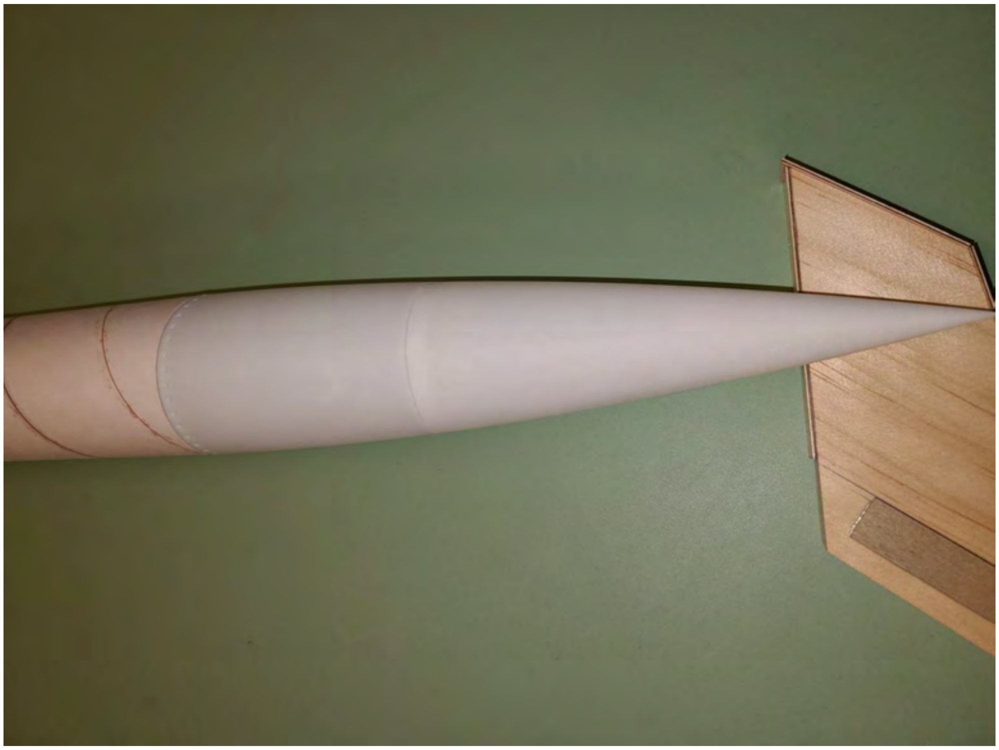

Photo 103: Two-Part Nose Cone

Because the resin material can flex, the joint gap was filled with an epoxy/micro-balloons mix. Because of that potential flexing, just filling the gap with a filler compound could lead to a cracked joint over time, so the epoxy mix was the way to go.

Photo 104: Filled Joint

Surface blemishes were filled with Bondo Glazing and Spot Putty. The very tip on this cone sustained a little damage during shipping, so that defect was rectified with a dab of Apoxie Sculpt, sanded to shape once cured.

Photo 105: Ready for Primer

The nose was then prepared for primer. I used Rustoleum Automotive Primer for the first two coats, with Tamiya Basic Modeling Putty applied as needed to resolve any remaining surface blemishes. Once satisfied with this finish, the nose was sprayed with a couple of coats of Tamiya Gray Fine Surface Primer, and then finally, with GSI's Mr. Finishing Surfacer 1500 Black Primer. I then spent some time and elbow grease wet-sanding and buffing the black primer completely smooth, as metallic paint will reveal any remaining unattended surface blemishes.

Now for the metal paint. For this application I decided to go with AK Interactive's Xtreme Metal Polished Aluminum, airbrushed over the buffed black primer. This stuff is an enamel, and comes airbrush-ready right out of the bottle.

Photo 106: Finished Nose Cone

And there you have it, a finished Black Brant VC nose cone, ready for installation.

Payload Integration

Some glue, and the payload section, plus nose, is assembled. Let's take a look at it on the model.

Photo 107: Payload Section Installed

Black Brant VIII – Final Assembly

We now have all the major subsystems finished, and so it's time to stack the model.

Photo 108: Black Brant VIII Complete

And with this, the build of our new 1/8th size Black Brant VIII is now complete.

Acknowledgements

Developing and building this Black Brant VIII model has been both a challenging and rewarding experience, but it's a project that wouldn't have been possible without the kind support of several good friends.

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