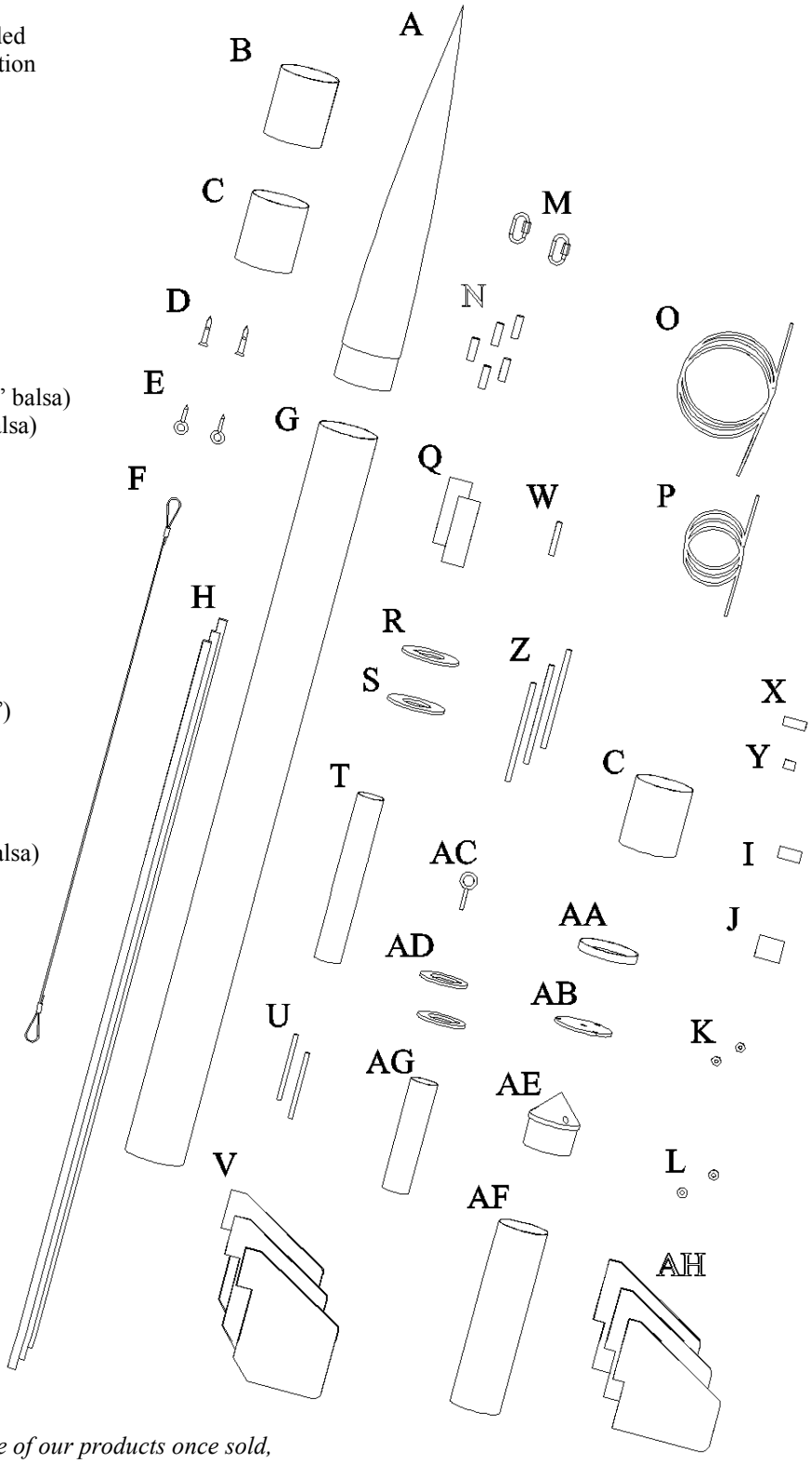
cosmodrome rocketry

1:6 AEROBEE HI

This kit is capable of use with high thrust motors. It is therefore strongly recommended that epoxy be used throughout the construction of this kit.

Parts List

A	1	Sustainer nose cone
B	1	Payload body tube (2.63” x 2.6”)
C	2	Coupler (2.56” x 3”)
D	2	Screw eye anchors
E	2	Screw eyes
F	1	Shock cord mount
G	1	Sustainer body tube (2.63” x 33.4”)
H	3	Conduits (1/4” x 3/8” x 31” balsa)
I	1	Sustainer forward detail (1/16” x 1/2” x 1” balsa)
J	1	Sustainer aft detail (1/16” x 1 1/8” x 1” balsa)
K	2	Engine retainer washers
L	2	Engine retainer nuts
M	2	Quick links
N	5	Launch lugs
O	1	Sustainer shock cord (12’)
P	1	Booster shock cord (3’)
Q	2	Engine retainer stand offs
R	1	Sustainer forward centering ring
S	1	Sustainer aft centering ring
T	1	Sustainer motor mount tube (29mm x 7.5”)
U	2	Engine retainers
V	3	Sustainer fins
W	1	Short dowel (1/4” x 1 1/2”)
X	1	Booster detail (1/16” x 3/8” x 1” balsa)
Y	1	Booster guide detail (1/8” x 3/8” x 1/2” balsa)
Z	3	Struts (1/4” x 4 1/2”)
AA	1	Inter stage body tube (2.63” x 3/8”)
AB	1	Bulkhead
AC	1	Eyebolt
AD	2	Booster centering rings
AE	1	Booster nose cone
AF	1	Booster body tube (2.24” x 8.26”)
AG	1	Booster motor mount tube (29mm x 5”)
AH	3	Booster fins
AI	1	Sustainer parachute (24”, not shown)
AJ	1	Booster parachute (18”, not shown)
AK	1	Decals (not shown)



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NOTE: As no booster motors capable of being used in this kit exist, an electronic stager must be used. Consideration of the size and operation of the stager chosen should be given before beginning construction of this kit.

SUSTAINER

1. Draw a line down the side of the sustainer motor mount tube and mark the line 1/2" from one end and 1 3/8" and 1 1/2" from the other end. Insert one end of the shock cord mount into the two holes in the forward centering ring. Slide the centering ring onto the motor mount tube. Position the centering ring onto the 1/2" mark on the tube. Epoxy the centering ring and shock cord mount to the tube.

Fig 1

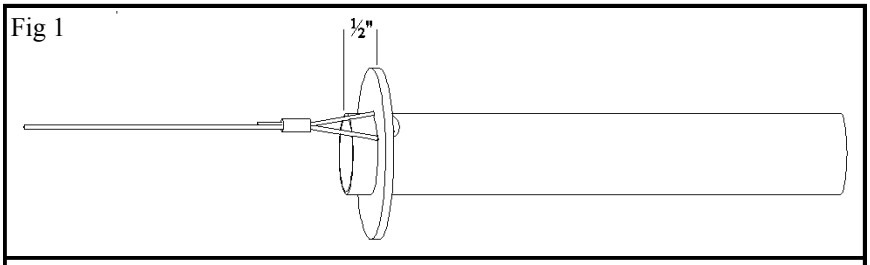
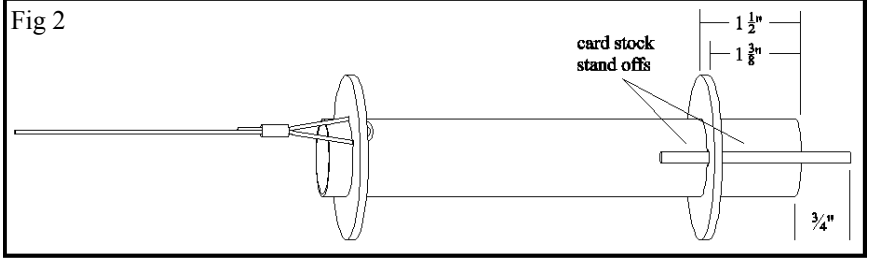


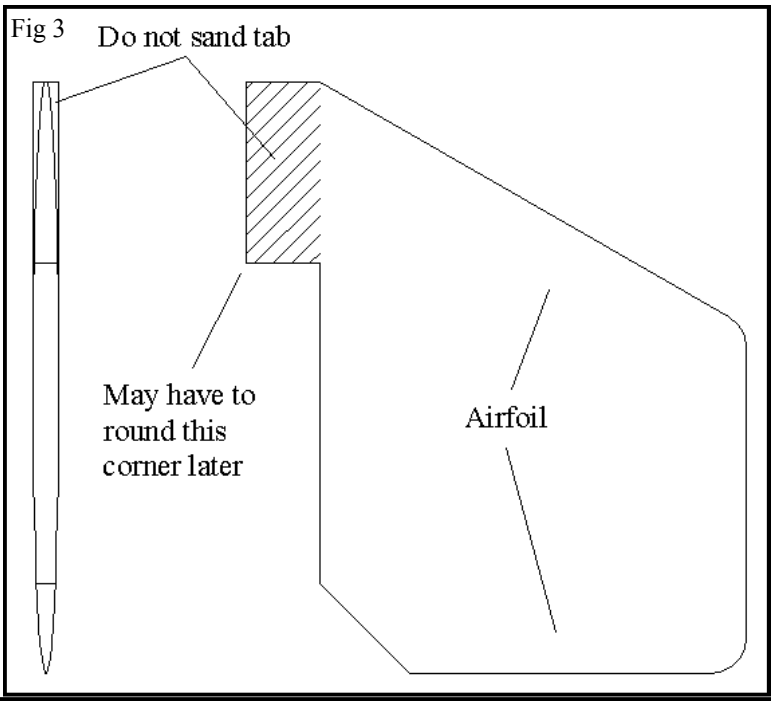
Fig 2



2. Slide the aft centering ring onto the tube until it is between the 1 3/8" and 1 1/2" marks so that the hole in the centering ring is lined up with the line on the motor mount tube. Without getting epoxy near the hole, epoxy the centering ring into place. Cut out two pieces of card stock, 1/8" x 1 1/4" and 1/8" x 1/2". Slide the engine retainer through the hole in the centering ring so that 3/4" extends past the end of the tube. Note: One end of the engine retainer is cut (painted), one is not (unpainted), position the uncut end aft and it will be easier to thread the nut on. Insert the two pieces of card stock between the tube and the engine retainer. Note: The card stock simply creates a space between the engine retainer and tube to allow for some reload cases enough clearance to fit. Epoxy the engine retainer to the tube, making sure that it is even with the line on the tube. Be careful not to get epoxy on the threads of the engine retainer that extend past the tube.

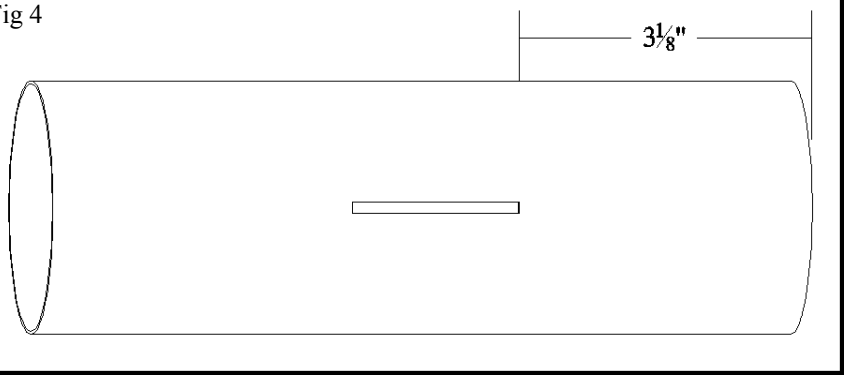
3. Sand the leading and trailing edges of the sustainer fins to an airfoil shape. If possible, do not sand the fin tabs, the less material removed from the fin tab the stronger it will be. The lower corner of the fin tab may have to be rounded in a later step so that it does not get in the way of the epoxy fillet on the motor mount tube.

Fig 3



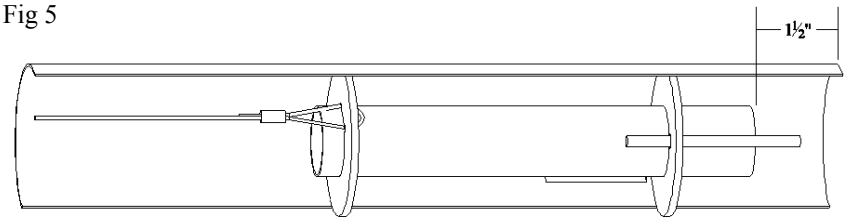
4. Using the body tube marking guide, mark the body tube at the fin, lug and detail lines. Extend the fin and detail lines all the way up the tube. Extend the lug line 20" up the tube. Mark the fin lines 3 1/8" from the aft end of the tube. Place a fin on the tube so that the aft end of the fin tab is centered on a fin line and even with the 3 1/8" mark. Make sure that the forward end of the fin tab is centered on the fin line. Draw a line completely around the fin tab. Using an X-acto knife, cut out a slot for the fin tab by cutting on the inside of the outline. Carefully enlarge the slot, if necessary, until the fin tab fits snuggly. Repeat for the other fins.

Fig 4



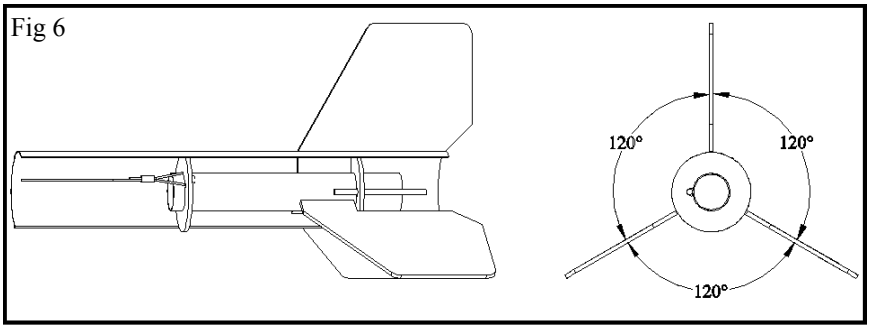
5. Apply a ring of epoxy to the inside of the body tube just forward of the fin slots. Push the motor mount assembly into the body tube until the aft end of the motor mount tube is 1 1/2" past the aft end of the body tube. Make sure the engine retainer is between two fin slots. Stand the assembly upright so that the epoxy can settle on the forward centering ring. Let the epoxy cure. Turn the assembly over and epoxy the aft centering ring to the body tube. Do not get epoxy on the inside of the body tube between the aft centering ring and the aft end of the tube. If this happens, it will be necessary to sand it away to allow the booster coupler to fit properly.

Fig 5



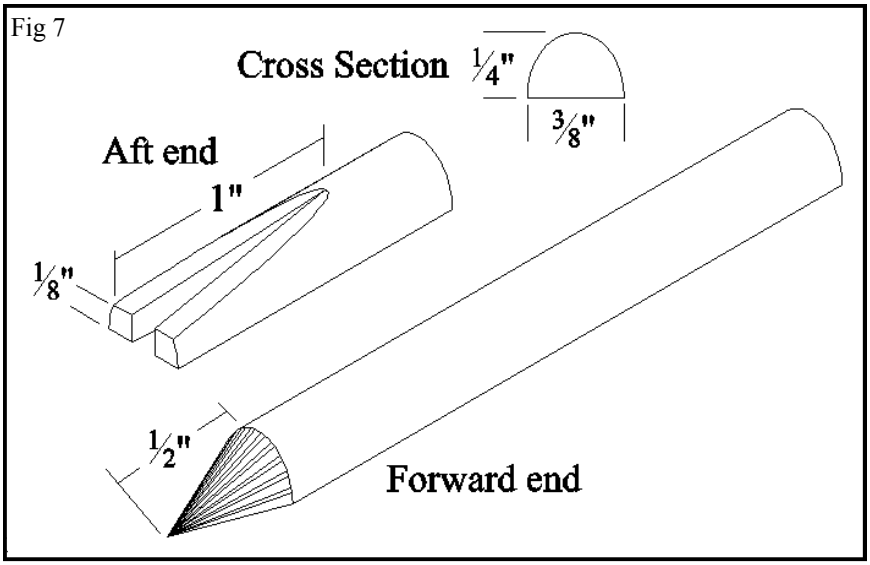
6. Test fit a fin into a slot and check to make sure the fin rests flat on the motor mount tube. If not, sand away the bottom corner of the tab to avoid hitting the epoxy fillet on the motor mount tube. Apply epoxy to the motor mount tube through one of the fin slots. Also apply epoxy to the root edge of one fin. Insert the fin into the slot. Make sure that the fin is perpendicular to the body tube. Let the epoxy cure. Repeat for the other two fins, making sure that they are equally spaced around the body tube. Fillet each fin.

Fig 6



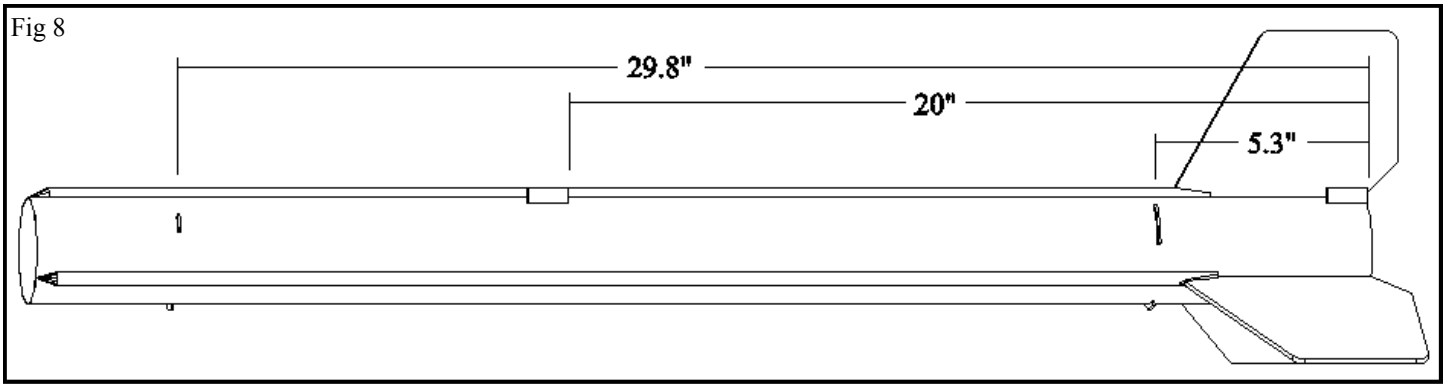
7. Sand the conduits to the cross section as shown in figure 7. Sand the aft end flat as shown in figure 7. Cut out a notch for the fin. The aft 1" of the conduit should just fit around the fin. Epoxy the conduits on the fin lines so that the aft 1" fits around the fin. Cut off the forward end of the conduits so that they are even with the forward end of the body tube. Sand the forward 1/2" of the conduits as shown in figure 7.

Fig 7



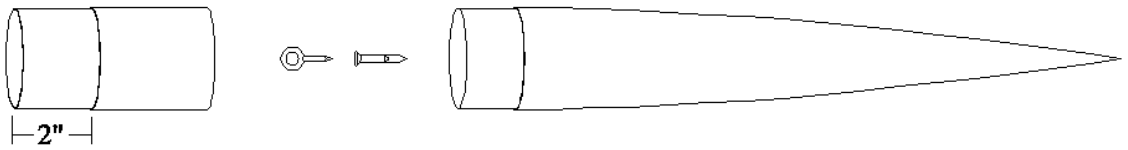
8. Epoxy the launch lugs to the body tube, on the lug line. Place one of the lugs even with the aft end of the body tube and the other 20" from the aft end. Using a 1/4" launch rod, align the lugs so that the rod slides easily through them. Using the 1/16" x 1/2" x 1" balsa, cut out (3) 1/16" x 1/2" x 1/8" pieces (forward details). Using the 1/16" x 1 1/8" x 1" balsa, cut out (3) 1/16" x 1 1/8" x 1/8" pieces (aft details). Cut these pieces out so that the grain is perpendicular to the cut as they will wrap around the body tube (see the full size patterns on the last page). Epoxy the forward details, centered on the details lines, 29.8" from the aft end of the body tube. Epoxy the aft details, centered on the detail lines, 5.3" from the aft end of the body tube. If the balsa will not bent enough to fit on the body tube, soak them in water for a few minutes, form around the body tube, let dry.

Fig 8



9. Thread a small screw eye into an anchor and remove. Apply a small amount of epoxy to the inside of the anchor and re-install the screw eye. Let the epoxy cure. Thread the screw eye/ anchor into the base of the sustainer nose cone and remove. Fill in the hole with epoxy and reinsert the screw eye/anchor. (OPTIONAL: If you are building the "NRL-42" version you will need to add the payload section. Epoxy the payload coupler into the payload section so that 2" of the coupler is exposed. Epoxy the other end of the payload section to the nose cone.)

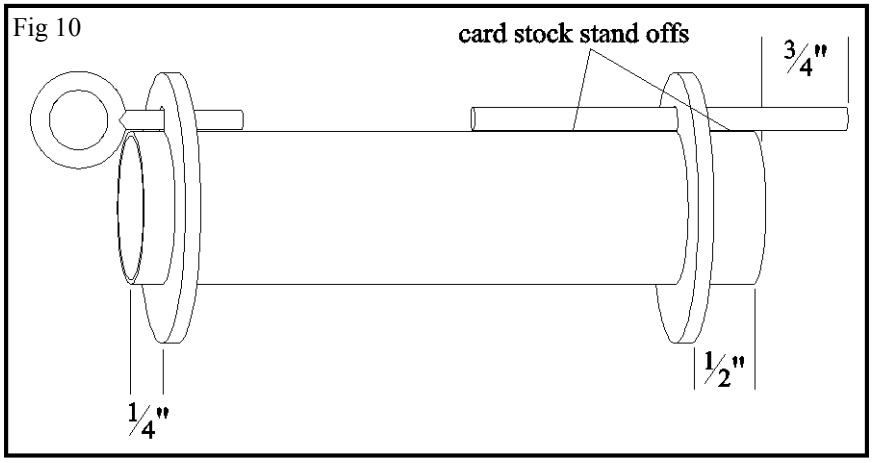
Fig 9



BOOSTER

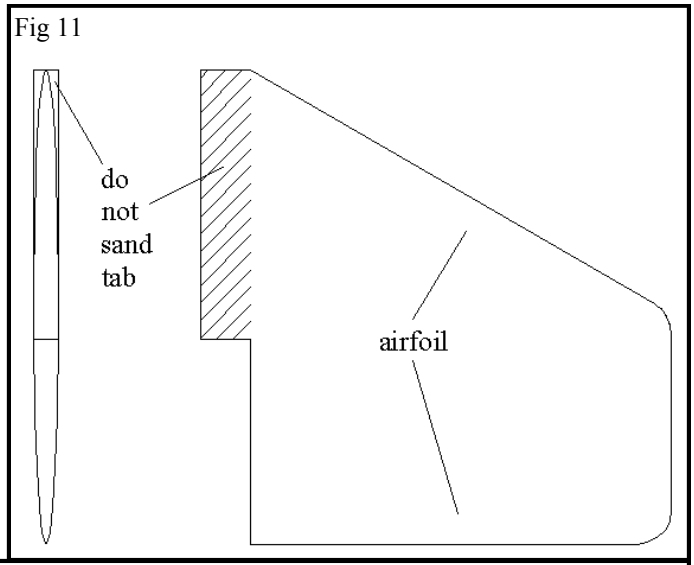
10. Mark the booster motor mount tube 1/4" from one end and 1/2" from the other. Draw a line down the side of the tube. Slide the forward centering ring onto the tube to the 1/4" mark. Line up the cut out in the ring with the line on the tube. Slide the aft centering ring onto the tube to the 1/2" mark. Line up the cut out in the ring with the line on the tube. Epoxy both sides of the centering rings to the tube. Do not get epoxy into the cut outs in the centering rings. Cut out two pieces of card stock, 1/8" x 1 1/2" and 1/8" x 1/2". Epoxy the card stock to the motor tube over the line, the 1/2" piece aft of the aft ring and the 1 1/2" piece forward of the aft ring. Note: The card stock simply creates a space between the engine retainer and tube to allow for some reload cases enough clearance to fit. Epoxy the motor retainer to the card stock, on the line, so that 3/4" extends past the tube. Note: One end of the engine retainer is cut (painted), one is not (unpainted), position the uncut end aft and it will be easier to thread the nut on. Epoxy the small eye bolt in the cut out in the forward centering ring. Position the eye bolt so that the eye is perpendicular to the tube.

Fig 10



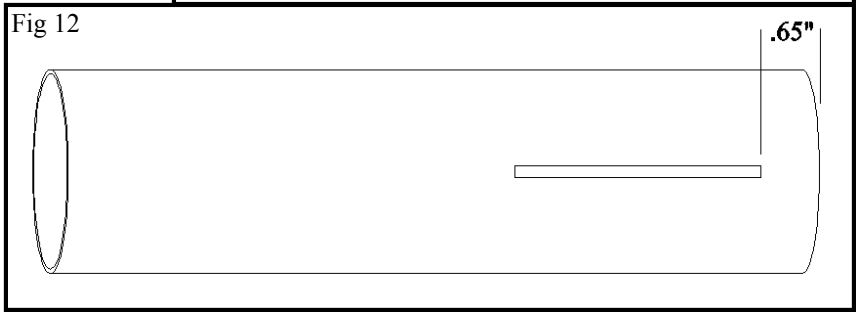
11. Sand the leading and trailing edges of the booster fins to an airfoil shape. If possible, do not sand the fin tabs, the less material removed from the fin tab the stronger it will be.

Fig 11



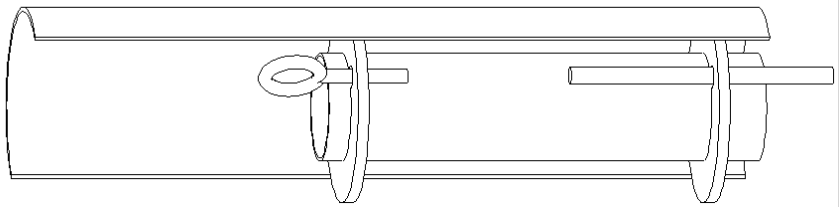
12. Place the booster body tube on the marking guide and mark it at the fin and detail lines. Extend the fin marks 4" up the tube. Extend the detail marks 1" up the tube. Mark the fin lines 0.65" (41/64") from the aft end of the tube. Place a fin on the tube so that the aft end of the tab is centered on a fin line and on the 0.65" mark. Make sure that the forward end of the fin tab is centered on the fin line. Draw a line completely around the fin tab. Using an X-acto knife, cut out a slot for the fin tab by cutting on the inside of the outline. Carefully enlarge the slot, if necessary, until the fin tab fits snuggly. Repeat for the other fins.

Fig 12



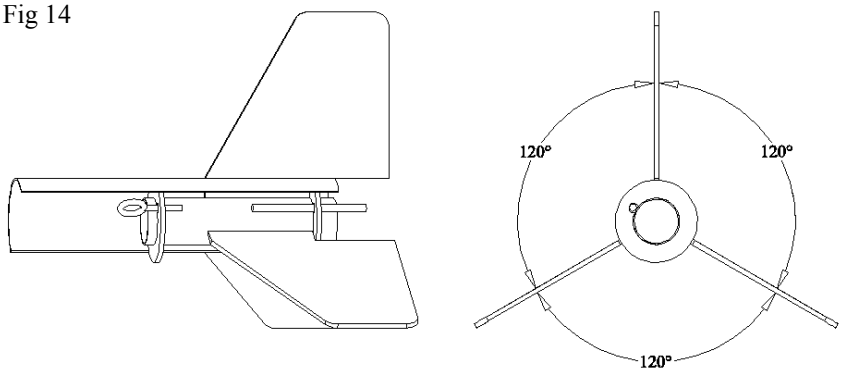
13. Apply a ring of epoxy to the inside of the body tube just forward of the fin slots. Push the motor mount assembly into the body tube until the aft end of the motor mount tube is even with the aft end of the body tube. Make sure the engine retainer is between two fin slots. Stand the assembly upright so that the epoxy can settle on the forward centering ring. Let the epoxy cure. Turn the assembly over and epoxy the aft centering ring to the body tube.

Fig 13



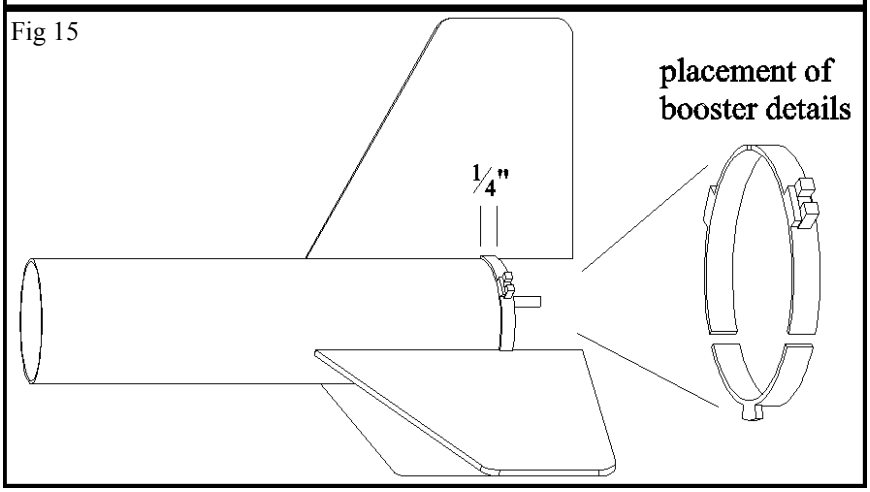
14. Test fit a fin into a slot and check to make sure the fin rests flat on the motor mount tube. If not, sand away the bottom corner of the tab to avoid hitting the epoxy fillet on the motor mount tube. Apply epoxy to the motor mount tube through one of the fin slots. Also apply epoxy to the root edge of one fin. Insert the fin into the slot. Make sure that the fin is perpendicular to the body tube. Let the epoxy cure. Repeat for the other two fins, making sure that they are equally spaced around the body tube. Do not fillet the fins yet.

Fig 14



15. Cut out (3) pieces of card stock 1/4" x 2 1/4". Epoxy these to the aft end of the booster body tube, between the fins. Trim the length as necessary to get the pieces to fit. Using the 1/4" x 3/8" x 1" balsa, cot out (3) 1/16" x 3/8" x 1/8" pieces (booster details). Cut these pieces so that the grain is perpendicular to the cut as they will wrap around the body tube. Epoxy the booster details to the forward end of the booster card stock, centered on the detail lines. Using the guide template, cut out the guide detail from the 1/8" x 3/8" x 1/2" balsa. Epoxy the guide detail just behind one of the booster details. Fillet the fins.

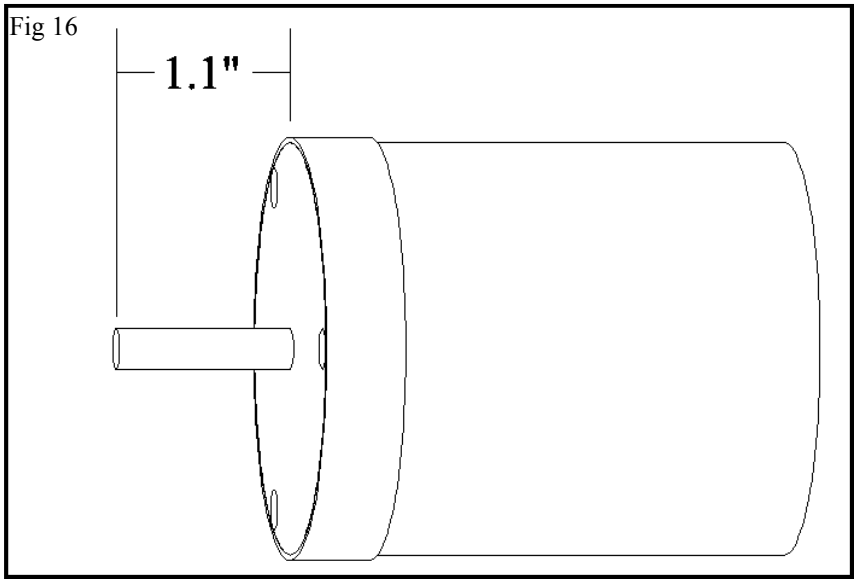
Fig 15



Steps 16 through 20 apply to the inter stage struts. In these steps there is a lot of test fitting and several parts that must be assembled and epoxied at the same time. Only epoxy parts when the instructions say so. These are the most critical steps. If there is any misalignment between the booster and the sustainer the rocket may not fly well.

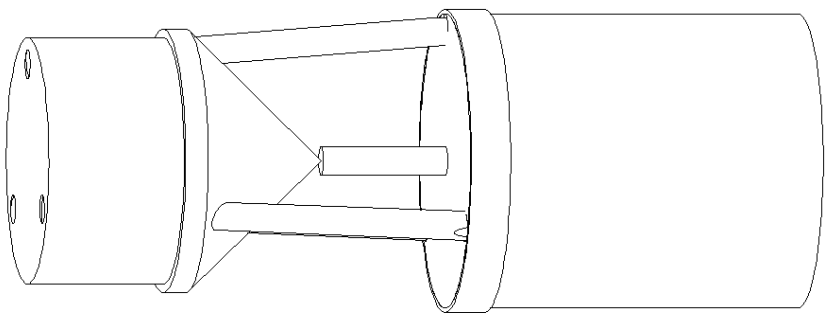
16. Epoxy the bulkhead to the inter stage body tube so that it is flush with the aft end of the tube. Epoxy the booster coupler inside the inter stage body tube so that it rests against the bulkhead. Slide the short dowel through the center hole in the bulkhead so that 1.1" (1 3/32") extends past the aft end of the bulkhead. Make sure that the dowel is perpendicular to the bulkhead. Any misalignment will result in the booster not being parallel with the sustainer. Using wood glue, glue the dowel in place. It will be removed latter, so don't use too much glue.

Fig 16



17. This is the most critical step in the assembly. If the alignment is off, the rocket will not stand straight and could be unstable in flight. The struts are sanded as per figure 17. When they are properly sanded, the small dowel in the booster bulkhead will just touch the booster nose cone and be directly over the tip of it. The bulkhead will also be perpendicular to the booster body tube. Use the full-size 2D drawing of the inter stage area for reference. Slide the struts up through the booster nose cone to get them all in place at once. Do not epoxy the struts at this time.

Fig 17

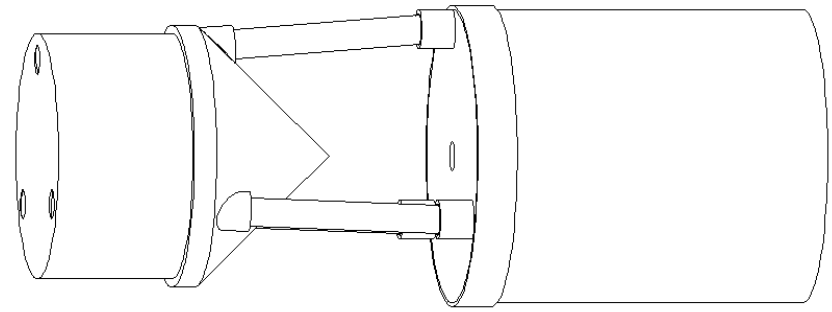


18. Cut out the forward and aft strut-lug patterns. Use the remaining 3 launch lugs to make the strut-lugs. Wrap a forward and aft pattern around each lug and cut out.

Fig 18

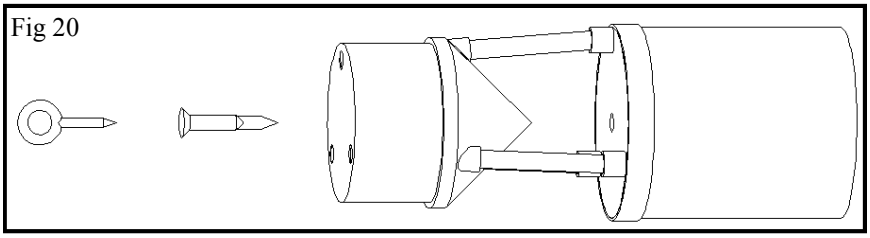
19. Go back to the step 17 assembly. Carefully pull one of the struts back through the nose cone until 1 1/2" is exposed. Be careful not to disturb the alignment of the coupler. Place a lower strut-lug and then an upper strut-lug on the strut. Make sure that the lower strut-lug is right side up. It should rest flush on the nose cone. Apply epoxy to the part of the strut that is below the nose cone. Push the strut back through the nose cone so that it is in its final position in the coupler. Make sure that the alignment of the coupler has not shifted. Let the epoxy cure. Epoxy the other end of the strut to the inside of the coupler. Epoxy the strut-lugs onto the strut. Repeat for the other two struts. Carefully remove the dowel from the bulkhead. Cut off a 1/4" piece from the dowel. Epoxy this piece in the hole in the bulkhead so that the aft end is flush with the bulkhead.

Fig 19



20. Thread a small screw eye into an anchor and remove. Apply a small amount of epoxy to the inside of the anchor and re-install the screw eye. Let the epoxy cure. Thread the screw eye/anchor into the base of the booster nose cone and remove. Fill in the hole with epoxy and reinsert the screw eye/anchor. NOTE: There is not a lot of room in the booster for the parachute, part of the booster nose cone may have to be hollowed out to make more room. Test fit the parachute before epoxying the screw eye in. It mat also help to install the screw eye in the booster nose cone off-center.

Fig 20



21. The booster coupler is a tight fit into the sustainer body tube. Sand off the Glassine coating of the coupler (and sand away any epoxy that may have dripped onto the sustainer body tube below the centering ring). The booster should stay attached to the sustainer when the rocket is lifted by the sustainer, but not be so tight that the ignition of the sustainer motor cannot blow off the booster. If you have used the payload section, this too will have to have its Glassine coating removed for proper separation.

22. Feed one end of the sustainer shock cord through the sustainer screw eye and tie it to itself forming a loop. Tie a loop in the shock cord 1 foot from the nose cone. This is where the parachute is attached. Tie a loop in the other end of the shock cord. The quick link will go through this loop and attach to the shock cord mount. Feed one end of the booster shock cord through the booster screw eye and tie it to itself forming a loop. Tie a loop in the shock cord six inches from the nose cone. This is where the parachute is attached. Tie a loop in the other end of the shock cord. The quick link will go through this loop and attach to the shock cord mount.

Fig 22a

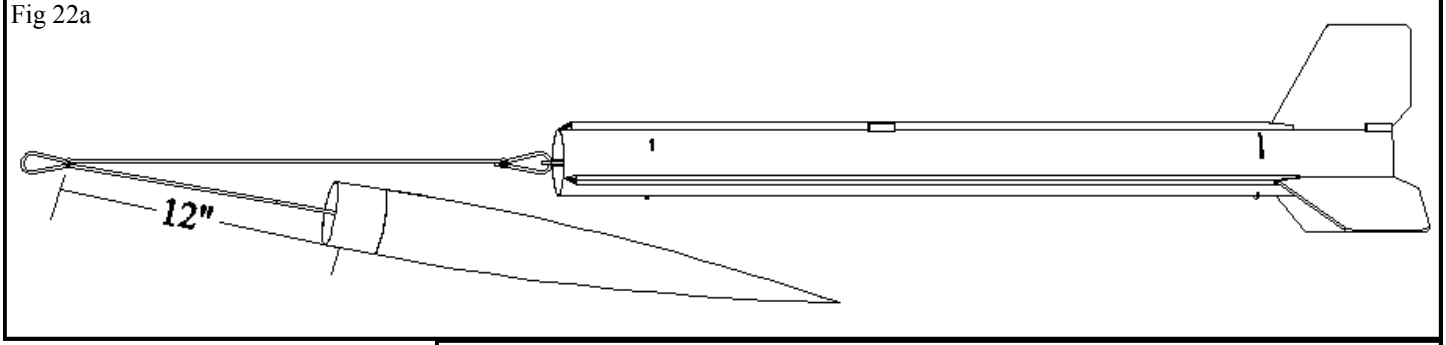
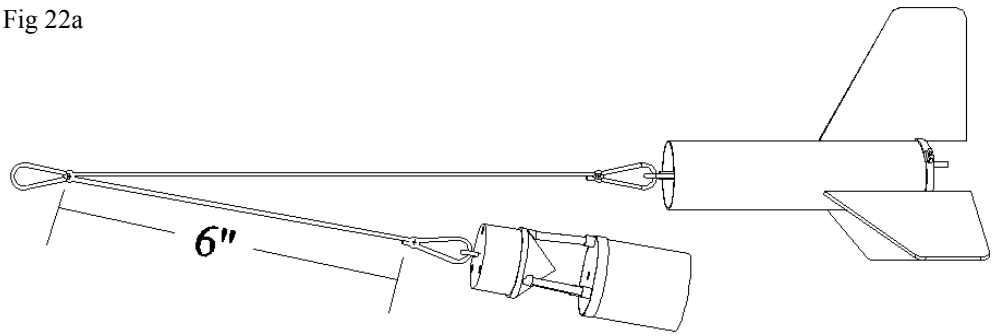


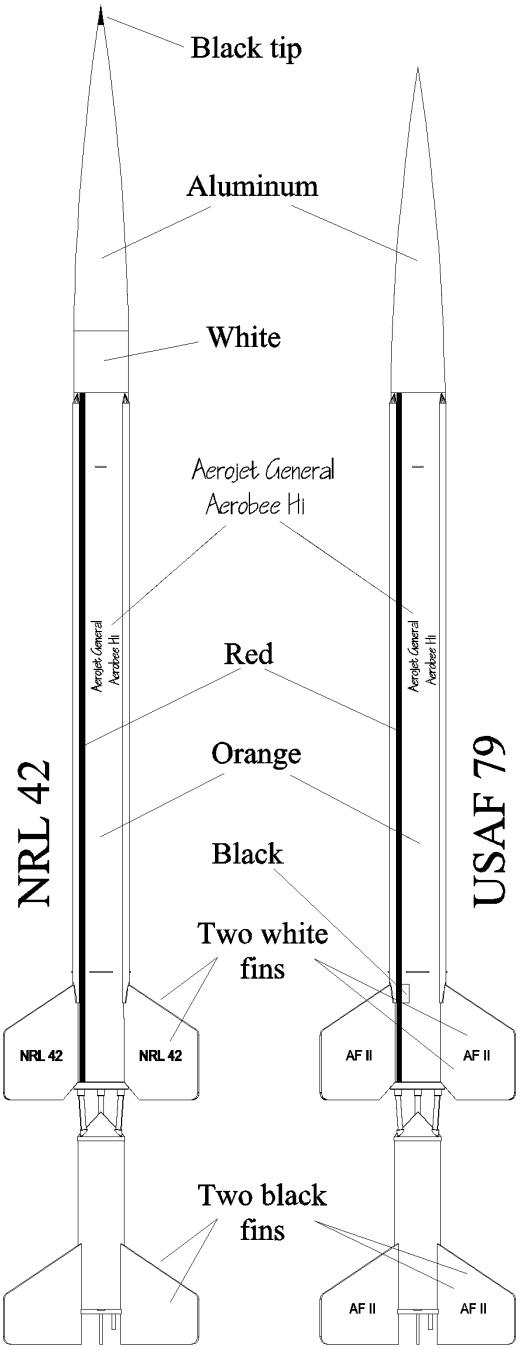
Fig 22a



23. Finishing. This step is optional, but recommended. The NRL 42 and USAF 79 versions of the Aerobee Hi are outlined here.

1. Fill in the spirals in the body tube.
2. Coat the nose cones, struts, conduits, details and fins with a sanding sealer to remove the grain of the wood.
3. Coat the inside surfaces of the of the booster body tube, booster coupler, sustainer body tube, payload bay body tube, payload bay coupler and the aft end of the motor mount tubes with thin CA. Sand the motor mount tubes until the motors fit. Sand the forward end of the booster body tube and sustainer body tubes until the nose cones fit. Sand the aft end of the sustainer body tube until the booster coupler fits. This will help increase the life of your kit.
4. NRL 42 paint scheme:
    a. Sustainer body tube: Orange
    b. Payload body tube: White
    c. Sustainer nose cone: Silver
    d. Sustainer nose cone tip: Black.
5. USAF 79 paint scheme:
    a. Sustainer body tube: White
    b. Sustainer nose cone: Silver
    c. Sustainer body tube between fins: Black (see diagram for correct location of this detail).
6. Both Versions:
    a. Sustainer body tube alignment stripe: Red (see diagram for correct location).
    b. Sustainer fins: 1 Black, 2 White
    c. Booster body tube, nose cone, struts and inter stage body tube: White
    d. Booster fins: 1 White, 2 Black
7. NRL 42 decals:
    a. Sustainer fins: NRL 42 decals per diagram
8. USAF 79 decals:
    a. Sustainer fins: AF II decals per diagram
    b. Booster fins: AF I decals per diagram
9. Both versions:
    a. Sustainer body tube: Aerojet General Aerobee Hi decal per diagram

10 Apply a coat of clear gloss to protect the decals.

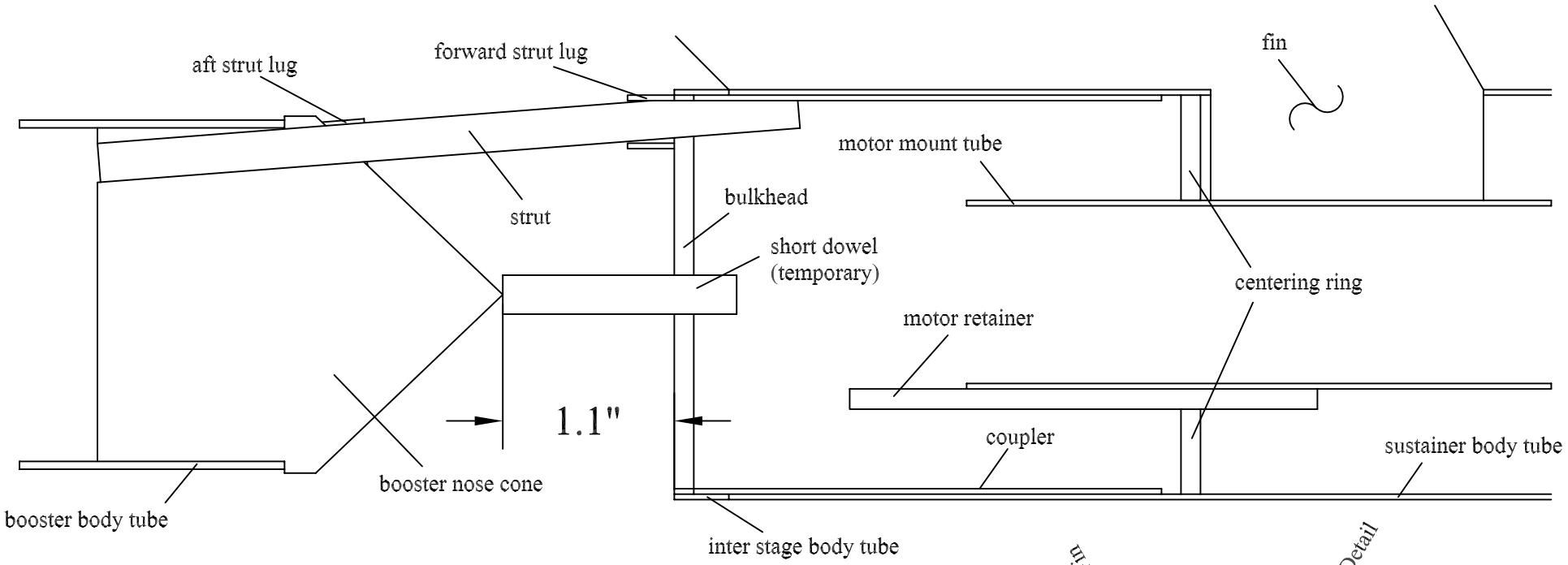


24. Flying.

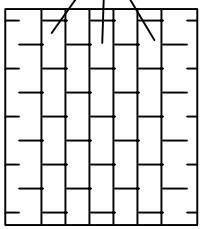
1. Insert recovery wadding into the sustainer body tube and loosely pack the sustainer parachute.
2. Install the sustainer nose cone.
3. Insert recovery wadding into the booster body tube and loosely pack the booster parachute.
4. Install the booster nose cone.
5. Select a motor according to the most up-to-date recommended motor list available at http://www.cosmodromerocketry.com
6. Disposable motors:
    a. Build up a thrust ring on the aft end of the motor using 1/2" masking tape. Wrap tape around the motor until it is at least as thick as the motor mount tube.

4. Reloadable motors:
    a. Assemble the motor according to the manufacturer's instructions.
    b. The thrust ring is built into the aft closure of the motor. No tape ring is needed.
5. Install the motor into the motor mount tube.
6. Slide the washer over the engine retainer.
7. Thread the nut on the engine retainer and tighten against the motor.
8. Install the igniter according to the manufacturer's instructions.

full size 2D details



aft sustainer details

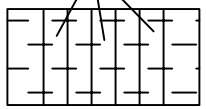


1/16" x 1 1/8" x 1" balsa

booster details

1/16" x 3/8" x 1" balsa

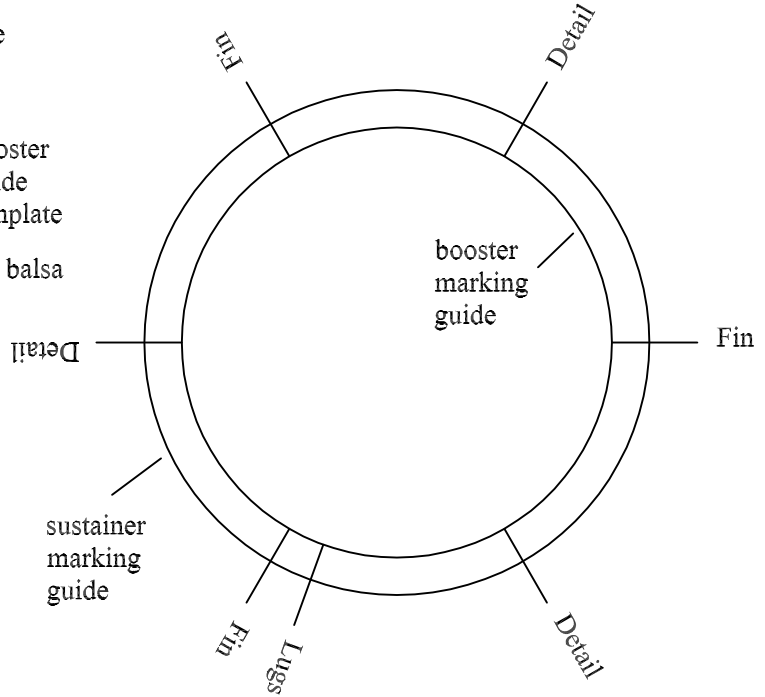
forward sustainer details



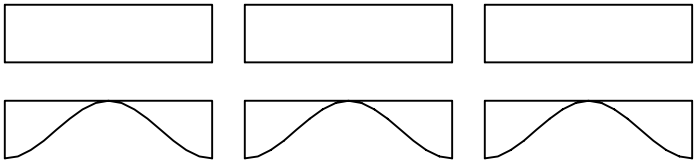
1/16" x 1/2" x 1" balsa

booster guide template

1/8" x 3/8" x 1/2" balsa



forward strut lug wraps



aft strut lug wraps