

# Inter-stage 3000



## STAGING COUPLER WITH TIMER BAY

### Parts list:

#### Inter-stage 3000 kit includes:

Coupler 8.5" long	Fore timer mount
Airframe section 2.5" long	Aft timer mount
Timer tube 1.5" x 5" long	Safety switch
Bulkplate	Wire 10" long
Coupler centering ring	(2) Set screws
Notched coupler centering ring	(4) Socket head screws
Strap 12" long	Kwik-Link
D-ring (for strap above)	(2) Safety switch screws
	Safety switch stand-off (2.1 systems only)

#### Other items you will need:

One set of epoxy	X-Acto knife
One sheet 120 grit sandpaper	Drill and small drill bit
Ruler and pencil	Soldering iron and solder
	#1 Phillips screwdriver

**Please read and understand all instructions before continuing!  
All surfaces to be bonded must be scuffed with 120 grit sandpaper.**

## Basic Construction FAQ

**The major parts involved in each step are shown shaded at the beginning of that step. Areas where epoxy should be applied are shown as well.**

### PREP & ASSEMBLY

Read and understand the instruction steps fully before you begin the step.  
ALWAYS sand the parts to be bonded with 100-120 grit sandpaper.  
We strongly recommend you dry-fit (assemble without gluing) all parts in each step BEFORE epoxying them together. Sand or adjust fit as needed before gluing.  
Most epoxies work fine. Use 5 or 15 minute depending on how quickly you feel you can complete the step. Use longer set-time epoxy if you're unsure.

For our complete FAQ, see the FAQ Page on our website at [www.publicmissiles.com](http://www.publicmissiles.com).

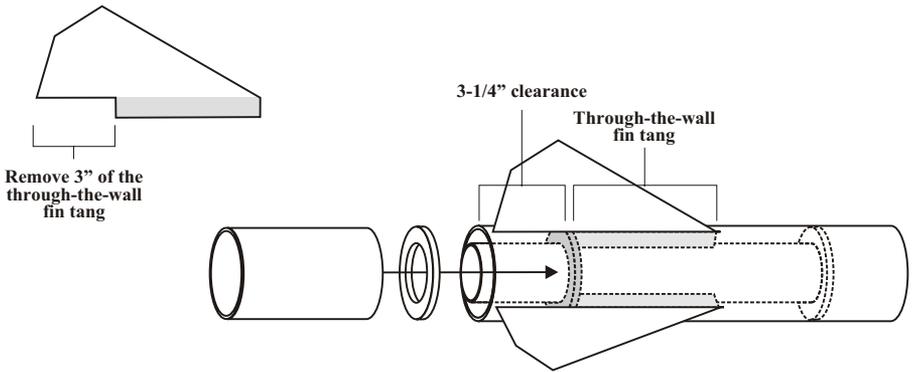
## Important design criteria for upper stage

To use the Inter-stage 3000 system, the upper stage motor mount and fins must be constructed in the manner described below in Step A. The Inter-stage 3000 system requires 3-1/4" of clearance between the base of the airframe and the lower centering ring. To accomplish this, the fin tabs must be cut and removed from the lower 3" of each fin and the fin slots in the airframe should begin 3-1/4" from the base. The lower centering ring must be slid up into the airframe until it contacts the fin tabs.

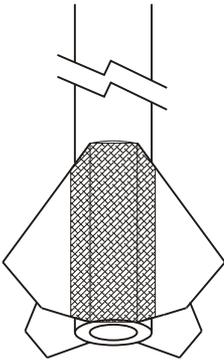
Now because the bottom 3" of each fin is essentially surface mounted to the airframe, we recommend fiberglass reinforcement for added strength as described in Step B.

### Step A

Using a stick, apply a layer of epoxy in the base of the airframe just below the fin tangs. Press the centering ring into the base of the rocket using the coupler tube. Push the ring in until it contacts the fin tangs. Immediately remove the coupler tube and wipe off any epoxy residue using a cloth.



### Step B



Because of the partial fin tabs necessary on the sustainer stage, fiberglass cloth is recommended to strengthen this area. Be very careful not to distort or fray the edges of the fabric. Mix up a batch of 20 minute finishing epoxy in a small cup. Using a 1" wide disposable brush, Coat the facing sides of two adjacent fins and the airframe between and 1/4" above the fins with the epoxy as shown. Apply just enough epoxy to completely wet the surfaces, but not enough to run or sag.

Apply a piece of glass cloth to the coated surfaces. The cloth should over hang the fins at the top and bottom. Press the cloth into the epoxy by dabbing it with the brush. Be sure there is no air trapped under the cloth. The cloth becomes transparent when it is properly wetted with epoxy. If some areas do not appear wet, dip the brush in the epoxy and dab the dry area.

When the epoxy has set firm, but not completely cured, trim the overhanging cloth with an X-Acto knife. Don't worry about making it perfect at this point. Repeat this process on all four sides. When the epoxy has completely cured, sand off any bumps that may have occurred using 120 grit sandpaper. Wipe clean and apply another coat of finishing epoxy to the entire fiberglass surface. When cured, sand with 220 grit sandpaper. Repeat if necessary until smooth. Sand the edges of the fins smooth and round. Apply thin CA to all the edges of the fins and cloth. Fill any imperfections with spot putty or other filler. Allow to cure, then sand again lightly using 220 grit sandpaper.

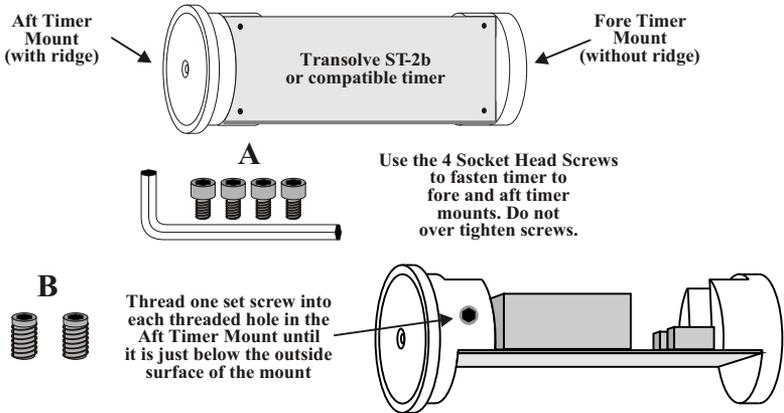
## Step 1

# Assembling the Inter-Stage 3000

*The Fore and Aft Timer Mounts used in the Inter-Stage-3000 system are designed around the Transolve ST-2b or compatible timer. Other units may work as well with slight modifications to the mounts. Modifications may require relocating the mounting holes and grinding away material for clearances. Be careful not to weaken the mounts. Consult the timer manufacturer for their recommendations.*

**A)** Mount the Transolve ST-2b or compatible timer to the fore and aft timer mounts using the 4 Socket Head Screws and wrench supplied with this kit. Do not over-tighten the screws to prevent stripping the mounts.

**B)** Thread one set screw into each threaded hole in the Aft Timer Mount until it is just below the outside surface of the mount.



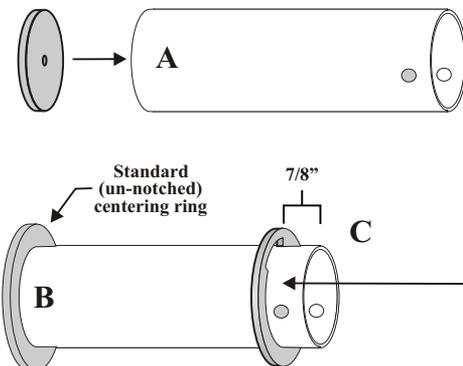
## Step 2

**A)** Epoxy the bulk plate flush with the end of the timer tube opposite of the end with the drilled holes.

**B)** Epoxy the standard (un-notched) centering ring flush with the end of the timer tube on the same end of the tube as the bulk plate.

**C)** Epoxy the notched centering ring to the timer tube 7/8" from the end with the drilled holes. Make sure the notch in the ring is NOT in line with either of the two holes near the end of the timer tube.

Apply an epoxy fillet to both centering rings but keep the notch open.



**NOTE for 2.1" diameter systems:**  
The notch centering ring will actually have a section cut out rather than just a notch due to the narrowness of the ring. Be sure to hold the ring in place securely while the epoxy sets.

Epoxy the notched centering ring to the timer tube 7/8" from the end. Make sure the notch in the ring is NOT in line with either of the two holes near the end of the timer tube.

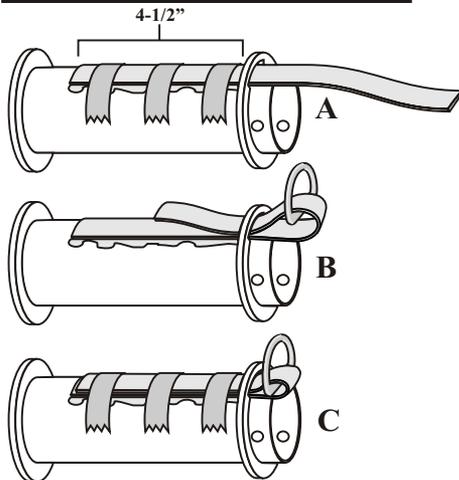
### Step 3

**A)** Slip one end of the 12" long strap through the notch in the centering ring. Pull the strap through until 4-1/2" of the strap is pulled through the centering ring. Epoxy the strap to the timer tube between the two centering rings. Hold the strap to the tube using masking tape while the epoxy cures.

**B)** Place the D-Ring over the strap. Push the free end of the strap through the same notch in the centering ring and pull until another 4-1/2" is pulled through the centering ring.

**C)** Epoxy this section of strap over the strap already bonded to the timer tube. Again, use masking tape to hold the strap in place while the epoxy cures. Once epoxy has cured, remove the masking tape. Fill the remaining gaps in the notch with epoxy. For 2.1" diameter systems, fill the gaps in the notch after the next step.

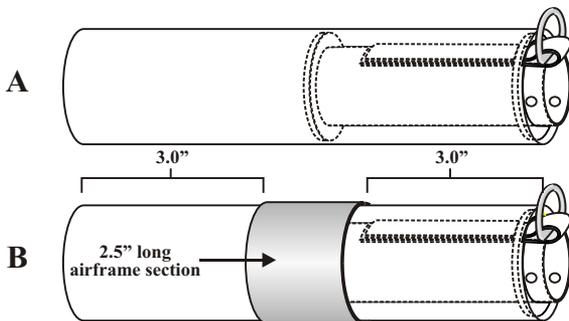
**NOTE for 2.1" diameter systems:**  
The notch centering ring will actually have a section cut out rather than just a notch due to the narrowness of the ring.



### Step 4

**A)** Epoxy the timer tube assembly into the 8-1/2" long coupler tube. The notched centering ring should be just 1/8" from the end of the coupler.

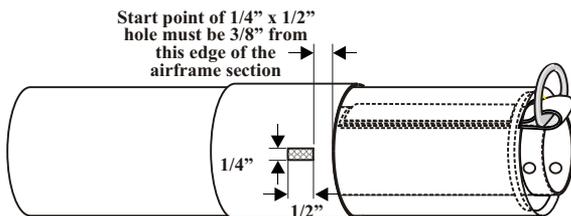
**B)** Epoxy the 2.5" long airframe section over the exact middle of the coupler tube.



### Step 5

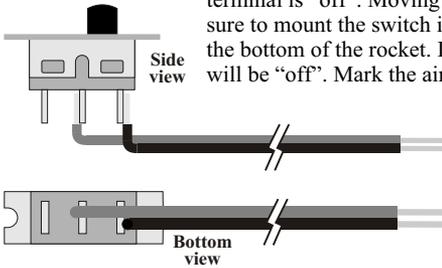
In order to properly install the safety switch, you will need to cut a 1/2" x 1/4" opening into the airframe starting 3/8" from the bottom edge as indicated in the drawing below. First mark out the perimeter of the opening on the airframe, then drill a series of small holes within the marks, starting near the corners, and removing the remaining material with a pointed X-Acto knife. Test fit the switch into the hole to assure a good fit.

**Drill a 1/8" hole in the timer tube through the rectangular switch opening so that the safety switch leads can pass through into the timer tube.**



## Step 6

Solder one safety switch wire to the center terminal of the switch and the other wire to one of the outside terminals of the switch. Polarity does not matter in this application. This switch has two positions; ON-ON, meaning the switch is able to make connections in both positions. Since you are using only two wires (center terminal and one end terminal), the switch position toward the unwired terminal is “off”. Moving the switch toward the wired terminal is “on”. Be sure to mount the switch into the rocket with the two wired terminals towards the bottom of the rocket. In this configuration, “down” will be “on” and “up” will be “off”. Mark the airframe for the on-off positions.

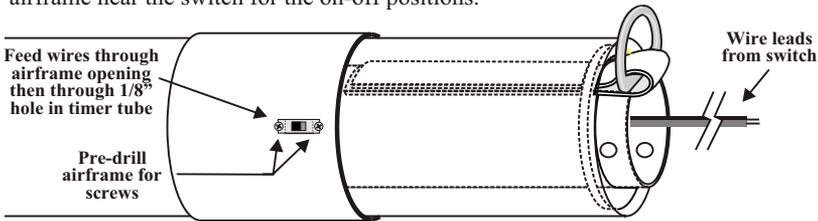


Strip about 1/4” of the insulation from the two wires and “tin” the exposed wires with a bit of solder to stiffen them. These wires will be attached to the safety switch terminals of the timer.

## Step 7

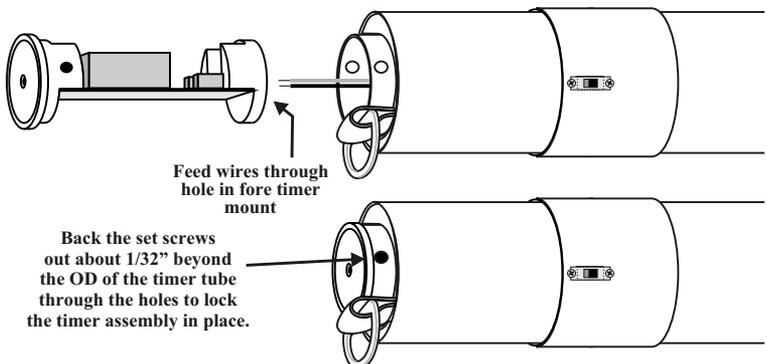
**Inter-stage 3000 2.1” users must install the switch stand-off that is packaged with 2.1” systems**

Feed the wire ends into the airframe opening, then through the 1/8” hole in the timer tube and finally out through the end of the timer tube. Set the switch into the rectangular airframe opening, pre-drill the airframe for the mounting screws, and install the screws. Mark the airframe near the switch for the on-off positions.



## Step 8

Align the timer assembly with the timer tube. Pass the safety switch wires through the hole in the fore timer mount (in flight prep, you will also pass the igniter leads through this hole). Begin sliding the timer assembly into the timer tube while gently pulling the wires through the hole. As soon as the fore timer mount is in the tube, attach the safety switch wires to the appropriate terminals on the timer. Once the wires are attached, continue to push the timer assembly into the timer tube until the ridge on the aft timer mount contacts the timer tube. Turn the timer assembly until the set screws in the aft timer mount align with the holes in the timer tube. Using the supplied Allen wrench, back the set screws out about 1/32” beyond the OD of the timer tube through the holes to lock the timer assembly in place.



## Step A

**WARNING:** Not all igniter types will fire using the timer you have selected. In most cases you will need a low current igniter. Be sure to test fire an igniter with the timer of the exact type you will be using in the rocket. Refer to the instructions provided by the timer manufacturer. In addition, E-Matches alone may not produce enough heat or for too short a duration to properly ignite the motor.

Once you have selected the proper igniter, use one of the two methods described below for prepping the igniter before insertion into the upper stage motor.

### Method A:

If the nozzle throat and propellant core are large enough, this is the preferred method of igniter preparation. Very carefully bend the lead wires just below the pyrogen as shown. If the pyrogen cracks or flakes during bending, discard the igniter and try again with a different one. If done properly, the igniter should have a slight friction fit within the propellant core and the pyrogen will be in firm contact with the core. Be sure the igniter is inserted to the very top of the propellant core.



### Method B:

If the nozzle throat and propellant core are too small for Method A, then this is the preferred method of igniter preparation. Very carefully bend the lead wires just below the pyrogen as shown. If the pyrogen cracks or flakes during bending, discard the igniter and try again with a different one. If done properly, the igniter should have a slight friction fit within the propellant core and the pyrogen will be in firm contact with the core. Be sure the igniter is inserted to the very top of the propellant core.



## SUSTAINER MOTOR IGNITER SELECTION

Make sure to use a motor igniter (as opposed to an electric match) for motor ignition. Igniters are specifically designed for motor ignition, whereas electric matches usually do not have the heat energy level or "length of burn" necessary to reliably ignite a rocket motor. Also, the resistance reading of what you intend to use is important. Here's why:

$E = I \times R$ , where E is Voltage, I is Amperage, and R is resistance. We know the Voltage involved depending on the battery used in your staging timer. We also know from the specifications of the staging timer that the ignition device must fire with a certain amperage. (See the specifications section of your timer's instructions for the voltage and amperage the unit delivers to the firing circuit). So, you need to find R, the Resistance, to determine which ignition device can work successfully with the staging timer you intend to use.

Let's use an example of the Transolve ST-2B Staging Timer (again, be SURE to use the specifications from your timer!)

ST-2B Staging Timer

Battery = 9 volts

Current = 1 amp (Alkaline Battery) or 5 amps (NiCad battery)

(Alkaline Battery)

$E = I \times R$ ,  $9 = 1 \times R$ ; rearranging, we get  $R = 9/1$  or 9 ohms

Your sustainer motor igniter must be 9 ohms or less to work properly with the ST-2B using an Alkaline battery.

(NiCad Battery)

$E = I \times R$ ,  $9 = 5 \times R$ ; rearranging, we get  $R = 9/5$  or 1.8 ohms

Your sustainer motor igniter must be 1.8 ohms or less to work properly with the ST-2B using an Alkaline battery.

Igniter manufacturers will specify the proper electrical ignition requirements (ohms and volts) for their devices; contact the igniter manufacturer for their specifications. We strongly recommend that you check each igniter you intend to use before flight to determine that it is good and within the ohm range needed. We also strongly recommend that you ground-test the electronic device you intend to use with the ignition device you intend to use before committing that combination for use in an actual flight. Remember, the proper operation of the staging timer AND igniter combination is the ONLY thing that will ignite your sustainer stage! You do NOT have a second chance like you do when launching from the pad!

## Step B

**WARNING: REMOVE ALL OF THE EJECTION POWDER FROM THE SUSTAINER STAGE MOTOR, FILL THE WELL WITH WADDING AND REPLACE THE CAP BEFORE INSTALLING THE MOTOR.**

Friction fit the motor into the upper stage. Install the igniter as described in the previous step.

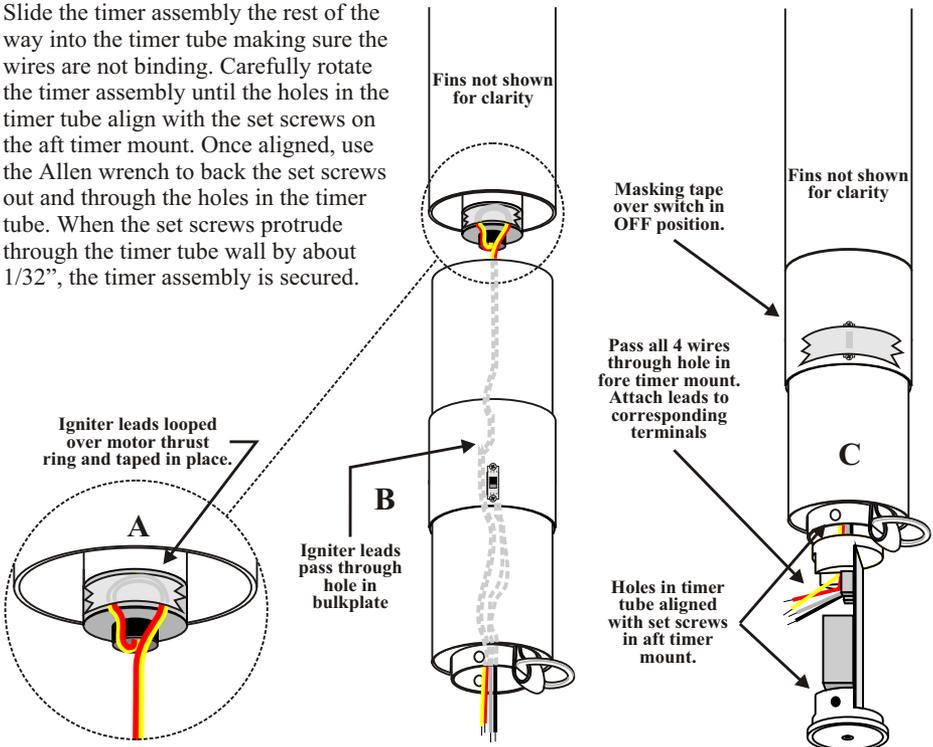
**A)** Once you are sure the pyrogen end of the igniter is at the top of the propellant core, carefully bend the leads up and into a loop against the thrust ring of the motor. Use masking tape to secure the leads to the thrust ring.

**B)** Feed the igniter leads through the small hole in the bulkplate within the interstage coupler. Continue pushing the leads through until they exit the timer tube at the bottom of the interstage. Begin joining the interstage to the base of the upper stage. Take up any slack in the igniter leads by pulling them through as you join the sections. Once you can no longer see the motor with the igniter leads taped to the thrust ring, discontinue pulling on the leads. There is plenty of room for the leads to bunch up inside of the interstage. Do not risk pulling the igniter loose or out of the motor. Once the two sections are fully joined, cut the igniter leads so they only extend about 3" from the bottom of the timer tube. Strip about 1/4" of the insulation from each lead. Now make sure the leads from the safety switch are also protruding from the bottom of the timer tube.

**Make sure the safety switch on the interstage is in the OFF position. Place masking tape over the switch so that the system is not accidentally armed during handling. Mark the tape with "Remove before flight" as a reminder.**

**C)** Bring the timer assembly into position near the timer tube and feed all four wires through the hole in the fore timer mount. Slide the timer assembly into the timer tube just enough to start it in yet leaving the terminal strips exposed. Secure the igniter wires to the proper terminals for the igniter. Now secure the safety switch wire to the safety switch terminals.

Slide the timer assembly the rest of the way into the timer tube making sure the wires are not binding. Carefully rotate the timer assembly until the holes in the timer tube align with the set screws on the aft timer mount. Once aligned, use the Allen wrench to back the set screws out and through the holes in the timer tube. When the set screws protrude through the timer tube wall by about 1/32", the timer assembly is secured.



## Step C

Slide the piston down into the airframe (if used). Pack the parachute as described in the parachute packing instructions supplied with the chute. Attach the Kwik-Link from the booster shock cord to the D-Ring on the inter-stage coupler. Make sure the inter-stage fits snugly into the booster. Use strips of masking tape placed on the shoulder of the inter-stage to tighten the fit if necessary. Sand the shoulder if the fit is too tight. The fit is proper if you can lift the rocket by the inter-stage and shaking it vertically, the inter-stage does not begin to slip out.

Rotate the booster so that the fins and launch lugs on the upper and lower stage are aligned.

## Check list

### *At the flight prep table...*

#### UPPER STAGE

Make sure all shock cords and parachutes are attached correctly.

Pack the upper stage recovery system.

Prepare but do not arm the upper stage parachute deployment electronics.

Remove all ejection powder from the upper stage motor, pack charge well with wadding, and replace the charge cap.

Install the motor in the upper stage.

Install and secure the igniter into the upper stage motor.

#### BOOSTER STAGE PREP/FINAL ASSEMBLY

Test the upper stage ignition timer per timer instructions and adjust the time so that upper stage ignition takes place 0.5 to 2.0 seconds after booster burnout. (Depending on velocity at booster burnout) If simulations predict relatively low velocity of the rocket at booster burnout, do not have a long delay before sustainer ignition! Remember, you **MUST** keep good forward airspeed to keep stability with the fins, and the sustainer motor also may take a bit of time to come up to pressure and thrust. When in doubt, **SHORTEN** any delay time used for starting sustainer motor.

Set timer safety switch to OFF position and place masking tape over switch.

Join the inter-stage to upper stage adjusting the fit if necessary.

Secure all leads from timer and safety switch to proper terminals on timer.

Secure timer assembly within timer tube using the setscrews.

Check fit of booster stage piston; sand if necessary for smooth slip-fit.

Make sure to pack the booster stage chute properly and that all shock cords are attached.

Install and secure motor in booster.

Fit the booster to inter-stage bottom adjusting the fit if necessary.

### *At the launch pad...*

Slide the complete rocket onto the launch rod. Make sure the stages and other components are aligned so that the lugs do not bind on the launch rod,

Use a stand-off to keep the base of the rocket a few inches from the blast deflector.

Install the igniter into the booster motor and make sure it is secure.

Arm the upper stage parachute deployment electronics.

Allow the altimeter time to arm and calibrate itself.

Listen for the proper tones emanating from the altimeter to assure deployment charge continuity and flight readiness.

Attach launch control wire leads to the igniter of the booster and check continuity.

When continuity is verified, remove the tape from the timer safety switch and move the switch to the "ON" position.

The rocket is now fully armed and ready for flight.

Get your camera and/or binoculars ready!

As with any complex flight profile, call for a "heads-up launch" and begin your countdown.