

# PML MOTOR MOUNTS FAQ

5/21/05

## Kwik-Switch

- PML is the only company with the Kwik-Switch quick-interchangeable motor mount.
- The Kwik-Switch 2000 increases the ease of use and positive retention features of the original Kwik-Switch system.
- The standard Kwik-Switch has 13.75" of "usable length", meaning motor cases less than 13.75" will fit the KS. See the Motor Recommendations Chart on the Specs Page of our website for casing lengths of various motors.
- The Kwik-Switch 2000, whether as a stand-alone part for scratchbuilds or used in kits, comes with the 54mm main motor tube, and 38mm and 29mm adapters included.
- The Kwik-Switch 2000 ships with the 29mm adapter threaded piece screwed into the mother tube mating half. This is done for shipping purposes. Some customers have thought the 29mm piece was missing because they didn't notice it already screwed in.

### ***EXTENDED Kwik-Switch***

The 54mm/1706 reload casing (K185W, K550W, K1100T) will not fit the standard KS2000 system. For \$5.00, you can upgrade to an extended KS2k system that will fit. The standard extended KS is 17", which is long enough for a 54mm/1706 (K185W, K550W, K1100T) case. Also, you do not need an extra (third) centering ring with the extended KS for the center of the longer adapter tubes.

If you have already purchased a kit and wish to upgrade to the extended KS, you must return your original, unbuilt KS2000 components with the \$5.00. Keep in mind that you may also need to have a longer airframe to compensate for the additional length of the KS-EXT, depending upon the kit. That would also be additional cost and/or we'd need to ship you some coupler and airframe extension pieces at additional cost to upgrade your "standard length" kit.

Some of our rocket kits require strengthening from their stock configuration to fly certain larger motors that would require an Extended KS. These rockets **MUST** use phenolic airframe reinforced with fiberglass cloth and have the fins upgraded to a thicker G-10 material. There may be other considerations as well; it depends upon the specific application. See the *Kit Strengthening* section of the Airframes FAQ for information on when and how to strengthen.

### **Extended Kwik-Switch and J570**

The super long 38mm casing (J570; 19.2") does not fit the Extended KS. We do NOT recommend a "super-extended" (even longer) KS to be used with the J570. We do not believe the urethane KS mother tube and adapter tube mounts should be used with the high thrust profile of the J570 motor.

For super-long casing mounts (such as the J570) or custom motor mounts, we recommend our **ADPTR 54/38HD** shown on the Motor Mounts page of our webstore. This adapter is similar to ADPTR-54/38 on our Motor Mounts page, with additional larger-OD centering rings on the bottom of the adapter. This allows the thrust of the motor in the adapter to be transferred directly to the 54mm mother tube instead of through the urethane adapter interface. This will stand up to J570 and other “high-thrust” 38mm motor thrust profiles (assuming of course that the motor mounts were built and installed per instructions).

### ***GIANT Kwik-Switch***

PML also carries a “Giant KS” motor mount. This mount uses a 98mm mother tube and can be equipped with both a 75mm and 54mm adapter tube. This Giant KS is based on the original Kwik-Switch locking tab design. It comes standard with a 54mm adapter; the 75mm adapter can be purchased separately.

### ***75/54 Kwik-Switch***

PML carries a 75/54mm Kwik-Switch motor mount based on the original Kwik-Switch locking tab design similar to the Giant KS discussed above. The KS-75/54 system comes standard with the 54mm adapter, though it can also be purchased separately.

## **Friction-Fit Adapters**

Friction fit adapters are available for those who do not want the KS system, or for kits that are not equipped with the KS system. Available adapters are: ADPTR-38/29; ADPTR-54/38; ADPTR-54/29.

PML recommends you purchase the 38mm mount option for all kits that can be purchased standard with a choice of 38mm or 29mm motor mount, and also purchase an adapter for 29mm (ADPTR-38/29). This allows maximum flexibility in motor selection, since if you build with 29mm that’s all you can use. If you build with 38mm you can always install the 29mm adapter if you want to step down to smaller motors, but can also fly 38mm as well.

Some people have asked why the PML 29-to-38mm adapter (ADPTR-38/29) costs more than the one from LOC, and why is ours worth the extra money? Our adapter is built up of various tubing sizes so it ends up like a double-thickness tube. LOC’s is a standard 29mm tube with centering rings to adapt out to the 38mm tube. Ours are worth the extra money for two reasons:

1. It’s easier to friction-fit ours because you have the entire tube area to work with instead of just the two thin contact spots of the centering rings.
2. If you happen to have the misfortune of a motor blowing up, the super-thick tubing of our adapter will tend to contain and absorb the explosion, usually leaving the rocket without damage.

## Hybrid Motor Mounts

Hybrid motors require very long motor mounts. Call us for specific assistance in obtaining a hybrid motor mount for a scratch-build project. We do offer kits that are already designed specifically for 54mm hybrid motors; see the Hybrid Ready section of the webstore.

Currently our Hybrid-Ready rockets are only 54mm. We sell the Tempest and Aurora as Hybrid-Ready, which can both take the "Standard J" and the "New Hammerhead J".

## Motor Retainers

### ***Thrust Ring***

High-power kits don't use a thrust ring in the front of the motor mount like Estes-class rockets do, because high-power motors can vary greatly in length. Therefore, if you glued in a thrust ring you'd be stuck flying only that length of motor.

If you use a reloadable motor for high-power flights, the lower closure has an OD larger than the OD of the motor mount tube, so that provides the thrust ring by transmitting the force against the bottom of the motor mount tube. If you're using a single-use motor, as opposed to a reloadable, you'll need to wrap masking tape around and around the base of the motor, until you've built up maybe 1/16-3/32" thickness of tape to act as a thrust ring against the OD of the motor mount tubing. That's typically how it's done, and works just fine.

### ***Motor "Ejection Clip"***

Regarding retaining the motor from ejection, you have a few options. In high power rockets, there is no "engine clip" like you may be used to with model-rocket-sized products. Many people use masking tape around the motor casing for a tight friction fit to the inside of the motor tube. You need it to be tight enough that the motor will hold against ejection charges, but not so tight you won't be able to get it out after the flight; it just takes a little practice.

A more solid retention option is to use one of our PMR motor retainers described below. They work great and are really easy to use.

### ***PMR Motor Retention System***

- Regular (non-KS) motor retainers use the lower centering ring as the anchoring point for the threaded inserts. For Kwik-Switch motor retainers, they do not mount to the KwikSwitch adapters, but actually span across to the CR that holds the KS Mother tube to the airframe. Both KS retainers (one for 29/38mm and one for 54mm) have the same bolt hole pattern, just the ID is different. The reason is that the Medusa nozzle on the 54mm motors is larger in OD than a 29mm motor casing; two different retainers with different ID's were required.
- The PMR-29/38-KS and the PMR-54 stainless steel retainers have the same "hole pattern" dimensions. This means they can be interchanged on the same rocket.

However, they will NOT interchange with the hole pattern for a PMR-29/38. Said another way, if you have a rocket that can use a 54mm and a 38 or 29mm, EVEN IF IT DOES NOT USE A KWIK-SWITCH SYSTEM, you must buy the PMR-54 and PMR-29/38-KS. The “non-KS” PMR-29/38 and the PMR-54 do not have the same hole pattern; the PMR-29/38-KS and PMR-54 do.

- PMR-29/38 should not be used on CR-2.1-1.5 (1.5=38mm) and CR-2.5-2.1 (2.1=54mm) as there is not enough wood for ample insert anchoring. PMR-29/38KS and PMR-54 should not be used in a Quasar kit or with any CR-2.5-2.1 application.
  - CR-2.1-1.5 kits: Callisto 38mm, Io 38mm, Phantom/X-Calibur, Phobos 38mm
  - CR-2.5-2.1 kits: Black Brant VB 38mm, Explorer 38mm, Quasar, Small Endeavour, Tempest, Thunder ‘n’ Lightning
- Since the threaded inserts for the KS-compatible retainers require a 3/16” hole drilled in the aft centering ring, no retainer is available for a 2.5" diameter rocket using a 54mm motor mount. The PMR retainers cannot be used with boattailed or minimum diameter rockets (with the exception of our Bulldog kit, which has enough exposed centering ring area at the boattail). For ideas on other motor retention options for kits which cannot use a PMR system go to Rocketry Online at [www.rocketryonline.com](http://www.rocketryonline.com), click on InfoCentral, then on Construction, then on Motor Retention.
- Extra PMR inserts are available separately so you can equip all your rockets for the motor retention system without having to buy a complete retainer system for every rocket. Install inserts in all your rockets and you can use the PMRs in whichever rocket you’re flying.
- We recommend installing the PMR after the rocket is built. This gives the best support for the ID of the centering ring when drilling for the inserts.
- The PMR-54 will work with many hybrid motors; it does not work with a Hypertek J grain, the hole ID on the PMR is about 1/8” too small.
- The PMR system will work with Cesaroni Pro38 motors.
- The PMR-29/38KS and PMR-54 use 8-32 screws. The PMR-29/38 uses 4-40.

### **Other Motor Retention Solutions**

*Many of the following are emails from PML customers with solutions they have come up with for retaining motors in PML rockets. PML has not tried these solutions themselves, and does not endorse them as viable, safe, and effective solutions. They are presented here simply as “thought-starters” for you in coming up with your own solutions to motor retention concerns you may have. PML cannot/will not be able to comment on using any of the information below with your rocket.*

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#### **Mini-BBX and Terrier Booster**

If possible I'd like to find an alternative to friction fitting the upper stage engine. I know this subject has been discussed before on RMR.

I haven't, but will do, what Daniel Flury from Switzerland has done:

[http://www.shuttle-endeavour.de/webimg/bbx\\_tailcone.jpg](http://www.shuttle-endeavour.de/webimg/bbx_tailcone.jpg)

The blue circle shows where the 29 mm engine is protruding from the tailcone, the red shows to U-shaped lengths of 1 mm steel that are glued into small holes drilled into the

"lip" of the tailcone, between the engine and the 38 mm tube (shown with brown dots). The steel Us can be bent outwards (see arrows) to allow changing the motor.

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### **Bullpuppy**

I've started working on the Bullpuppy and I wanted to let you know that your assistance was invaluable. I decided to go with the Aeropack retainer. Fortunately, Aeropack is based right here in San Diego so I was able to get the retainer directly from them. In fact, Bob Mosley (the owner) met me personally to deliver it. Bob had a great suggestion, which I have used and I thought I would pass on to you.

The outer diameter of the retainer is slightly larger than the boat tail. I shortened the boattail by 3/8" so that the diameters matched - very clean look. The motor tube extends the shortened boat tail by 3/8" to allow attachment of the ring so the motor is actually in the same position as the stock kit. The outer diameter of the Aeropack ring was a nice snug fit in the shortened boat tail.

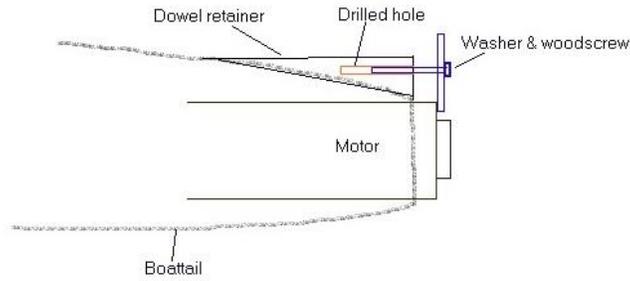
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### **Bullpuppy/Little Lunar Express/Lunar Express**

I've made a minor modification to my full-size Lunar Express that may work for you as well. (I've also done it to my Bullpuppy...it works for any boattail kit). I'll try to describe it to you, but bear with me! I've attached a crude JPG drawing that'll help make sense of what I'll describe. What I did was to take about a 3" long piece of 3/4" dowel (you may want to go smaller for the Little Lunar Express), and cut it lengthwise from "corner to corner". Imagine taking a piece of flat wood 3" long by 3/4" wide and drawing a line lengthwise from the lower left to the upper right corners, then cutting along that line. It's the same idea with the dowel. Then, tape a piece of sandpaper to the boattail of the rocket at the bottom end. Now take the dowel you cut and, moving the dowel up and down along the centerline of the rocket, sand the flat area from the cut until it conforms to the shape of the boattail. Now sand the boattail area well where the retainer will go, and epoxy it in place. You might even want to drill a few holes through the boattail under the retainer before installing it to allow epoxy to seep in and "rivet" the retainer to the boattail. The most important thing is to ensure you get a very good bond of the retainer to the boattail, since epoxy doesn't bond as well to the plastic as it does to other materials. In my full-size LE I also slotted the front of the retainer to fit over the fin, but you can also put it between fins. Whatever looks good to you.

Now that it's mounted, drill a hole for a woodscrew **\*\*parallel to the centerline of the rocket\*\***. Drill it small enough that the woodscrew will "cut threads" into the dowel when you install it, but large enough that it won't split the wood. Be careful to go deep enough but also not so deep you come through the side of the dowel. Now get a washer from your local hardware that'll capture the edge of the motor when it's installed on the woodscrew, and you're done. You may need to get what's called a "fender washer". They're just like a regular flatwasher but with a much larger OD for the size of the center hole. With careful installation of the woodscrew each flight to make sure you don't strip the threads, this will work very well for you. If you spend a little time shaping the retainer as well, you can make it blend in and look like it belongs there rather than just an add-on piece. If you use a harder material for the retainer than wood, you can actually

thread the hole and use a threaded machine screw instead of the wood screw. I've done 'em both, and they both work.



**Figure 1 - Boattailed Kit Motor Retainer**

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**Bullpuppy**

On my Bullpuppy, and all my minimum diameter rockets, I thread the inside of a piece of brass tube. In this case choose tubing to fit a 6-32 screw. Then I drill a hole in the tail cone parallel to the axis of the rocket. Be sure it is located far enough from the aft closure of the motor to allow the screw to just clear it. I epoxy the brass tube in the tail cone and to the motor tube. With a little filling you can blend this into the tail cone and it is almost invisible on the finished rocket. I use 6-32 all thread rod for the actual retainer. I cut a piece long enough to engage most of the treads in the brass tube plus about 1/2 inch. I then bend it 90 degrees about 1/2 inch from the end. Thread the rod in the tube and turn it down until it firmly holds the motor in. It works. It is cheap and easy. It takes up very little room. It is a low CD approach.

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**Bullpuppy**

Attached is a photo of a big external motor clip one customer made; looks like aluminum stock to me. With this one you'd have to work with some retaining nuts, etc. on the inside of the boattail before assembly, but it may be an idea you'd like.



**Figure 2 - Bullpuppy Aluminum Retainer Clip**

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**Thunder 'n' Lightning**

I think maybe I found a solution to retaining the motor in the booster for "Thunder & Lightning". I acquired an Aeropack motor retainer. I took a "spare" piece of pml 38 mm motor mount tube and rubber cemented a strip of 220 grit emery paper (The same width as needed) around one end. I then inserted the other end into the aft end of the tail cone and rotated to remove material from the inside of the aft end. (The forward extension of

the tube keeps the assembly square and by rotating the "relief" is constant. when the Paper loads up pull it out and clean it with a brush. when the strip is all inside the cone, pull it out, clean it and glue on another strip. (Try not to get glue on the working side of the emery paper). I'm holding a PML tailcone that has an Aeropack motor retainer that looks like it belongs there.

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### **Sudden Rush**

I believe it was Darrell Mobley (Darrell, can you confirm?) that epoxied a short piece of 54mm airframe inside the boattail, then screwed the boattail onto the airframe, "sandwiching" the rear closure of the reload between the 54mm MMT and the short piece of 54 in the boattail.

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### **BBX/Sudden Rush**

I incorporated positive retention into my PML Black Brandt X. The BBX is a 4" kit while the Sudden Rush is 3", but I believe you can find a variation on what I did that will work.

I can't remember whether it was part of the kit or if I had to add it, but you need a centering ring that will go immediately in front of the boat tail. Drill two holes 180 degrees apart for retaining screws. On the BBX, I inserted long screws (use washers to keep from crushing the plywood ring) and threaded 3 hex joiners (these are used to join threaded rod and can be obtained from Home Depot) onto each of them. 3 happens to be the number that equals the length of the BBX boat tail. The tip of the screw should be about half way into the final joiner so you have room to screw in the retaining screw when finished.

Resting the boat tail's aft end on the table of my drill press, I drilled two holes 180 degrees apart that match the locations of the screws. This allows the boat tail to be slipped over the studs we have created on the centering ring. Make sure the MMT holes in the ring and boat tail line up! When it comes time to install the boat tail, apply epoxy as directed and also apply epoxy to the base of the studs and to all the joints so the assembly can't come unscrewed. Slip the boat tail over the studs and install the complete assembly into the rocket.

I made my own retainer from aluminum sheet and it looks a lot like PML's retainer except that it only has 2 tabs. Socket head screws hold it onto the studs, which are recessed slightly into the boat tail. For the Sudden Rush, you may have to modify this approach by allowing the screw threads to project through the boat tail and anchor the retainer ring with nuts. Not as pretty, but effective. Another approach might be to install blind nuts into the aft centering ring and use really long screws to hold the retainer ring in place.

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### **Sudden Rush & Slimline Motor Retainer**

If anyone else ever asks, the slimline tail cone does create problems with the Sudden Rush kit.

**Details:**

The Slimline Tail Cone is shorter than the PML tail cone. In addition, the design of the retainer has the end of the motor tube about 3/8 inch inside the tail cone. The combination of a shorter cone, and the motor tube being inside the cone, pushed the motor tube's top centering ring close to 1.5 inches further up the body. The result is that the 5 inch coupler that is used to form the top of the fin section can only be inserted about 3/4 inch into the top of the fin section before it hits the top centering ring. I doubt that a 3/4 shoulder is a good idea that close to the business end of the rocket.

**Solution:**

Since the SlimLine retainer was not cheap, I'm determined to use it. I plan to sand the top centering ring on the motor tube until it fits INSIDE the 5 inch coupler. I'll attach the strap to the motor tube per the instructions. I'll then dry fit everything. With everything dry fit in place, I'll glue the motor tube into the coupler. I'll then assemble the rest of the bulkhead per the instructions. I'll now have a bulkhead, with the top of the motor tube glued inside. I'll then prep the outside of the coupler and the inside top of the body, apply the epoxy, and slide the whole assembly into place, dry fitting the tail cone to ensure that it is all in the right place. Once all that sets, I'll pull the tail cone and install the fins per instructions. Make sense? I figure this will have a plywood to phenolic bond for the top centering ring, and a 2.5 inch wide phenolic coupler to quantum tube bond for the coupler/bulkhead. That combo should be strong as steel.

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**Modification of PMR-29/38 motor retainer for CR-2.1-1.5 kits (PML Io):**

As described in the PML Hardware FAQ, there is not enough wood in the aft centering ring of the CR-2.1-1.5 kits (e.g., the Io with a 38 mm motor mount) to hold the brass inserts that come with the PMR-29/38 motor retainer. A solution is to purchase some 4-40 nuts from a hardware store and epoxy them to the back of the aft centering ring before gluing the centering ring in place.

1. Center the motor retainer on the centering ring and mark the position of the screw holes on the centering ring.
2. Drill a small pilot hole (5/64" drill bit). Hold the centering ring securely, GO SLOW and BE CAREFUL – if you rush this step or the next one, you could split the centering ring.
3. Carefully enlarge the hole to the proper diameter for the bolt to pass through (7/64" drill bit).
4. Line up a 4-40 nut with the hole in the centering ring. You probably will find the nut is slightly wider than the centering ring. In this case, grind or file off part of the outside edge of the nut until it's the same width as the centering ring (a Dremel tool works fine).
5. Scuff up both sides and edges of the nut with 100-150 grit sandpaper (to help epoxy adhere to it).
6. For each of the 3 holes in the centering ring, insert a 4-40 bolt through the hole and attach the nut on the other side of the centering ring (don't use the bolts that came with the retainer, since you might ruin them during the following steps). Use a small amount of epoxy to tack the nut in place on the back of the centering

- ring (the bolt is used to center the nut and pull the nut back against the centering ring while the epoxy sets). While the epoxy sets, carefully back off the bolt a turn or two (while holding the nut secure) to free up any epoxy that may have found its way into the hole in the centering ring, or between the nut and bolt.
7. After the epoxy has set, build up a “shoulder” of additional epoxy around the nut to firmly anchor it to the centering ring. Make sure some the epoxy actually goes up and over the edge of the nut. It will be difficult not to get epoxy between the nut and bolt at this stage, but if you occasionally turn the bolt a turn or two while the epoxy cures, you’ll break any bond that forms. Make sure you turn the bolt in the direction that won’t pull additional epoxy down into the threads of the nut.
  8. After the epoxy has cured, remove the bolt. It may be helpful to use a fresh bolt and run it back and forth a couple of times through the nut to remove any epoxy that found its way into the threads.
  9. Attach the centering ring to the aft airframe/motor mount per the kit instructions. Make sure the side of the centering ring with the nuts faces INTO the airframe, and that the holes are NOT in line with the fins.