PML RECOVERY COMPONENTS FAQ

10/22/03

Parachutes

Construction/Design

- PML chutes are made by a real parachute company, are not just “hobby parachutes”.
- All are multi-panel chutes, not a flat disc with shroud lines.
- All are a 15-degree conical design.
- All sizes use 1.9 ounce rip-stop nylon coated with urethane for zero porosity. Actual weight of the fabric is 2.6 ounces/sq. yard.
- The lines used on 36” and smaller chutes are braided polyester with a breaking strength of 180 pounds minimum.
- The lines used on 48” and larger chutes are flat braided nylon with a breaking strength of 300 pounds minimum.
- 60” chutes and above have heavier lines and every seam and edge is reinforced with high strength webbing.

Spill Holes

- The spill hole provides straighter descent and reduces swinging or rotation of rocket under the chute while on descent; the swinging occurs with non-spillhole chutes due to the chute trying to dump air. See the Recovery page of the webstore for approximate spill hole sizes; they vary slightly from chute to chute within a size.
- If a rocket experiences rotation or swinging under a PML spill hole chute, this is because the shroud lines are not completely equal lengths to the tie-off point.
- Our 18” chute has a relatively large spill hole as it is intended for drogue applications. This chute is not a good choice as a replacement for a plastic 18” chute from other manufacturers due to the large spill hole.

Sizing

- Chutes come in the following sizes: 18, 24, 30, 36, 48, 54, 60, 72, 84, 96, and 120”. We also offer a drogue X-form chute and a 4”x144” streamer you can cut to length.
- Our diameter ratings for our chutes are measured as follows: From shroud line attach point, along panel seam, across spill hole, down opposing panel seam to shroud line attach point.
- Parachute Sizing Upgrades -- PML chutes are sized for Midwestern and Eastern flying, as opposed to the open areas and hard landing surfaces of many Western sites. We size our chutes for minimal drift for smaller landing sites, while still allowing a safe descent rate into the grassy areas prevalent in the Midwest and East. However, if you're flying in Western areas where drift is not as much a concern and where landing areas are harder (such as desert playa), or if you 're flying from high-elevation launch sites with lower-density air, we can upsize the chute in your kit. Nearly all of our kits have an Upgrade Chute option listed right next to the kit itself in the webstore.

- Upgrade pricing will vary depending upon the base and upgrade chute. There is a fairly large “jump” in upgrade pricing to move from a 54” to 60” chute. This is because the 60” and up PML ‘chutes are a totally different construction. Lines are heavier and every seam and edge is reinforced with high strength webbing.
- RockSim, a popular rocket design and flight simulation program, has a parachute descent calculator as one of it’s features. The parachute descent calculator function routinely “over-recommends” what size PML chute is necessary; said another way, RockSim will report that the chute we ship with a kit is far too small (rocket descends too fast, according to RockSim). Apogee admits that the descent rate calculation in RockSim 4.0 uses a fixed Cd, which may lead to incorrect chute sizing calculations. Here's their reply when we asked them about it:
  "This is one of the things we expect to change in a future version of RockSim. We want to allow the user to change the Cd for the particular parachute. Right now, it is fixed, and it may be too high or too low (depending on the parachute)."
- People sometimes ask us for a “chute size calculator”. We don't really have any hard and fast rules on chute sizing. We do it by "gut feel" and experience. We suggest you look at the Kit Specs sheet on our website and find a rocket of comparable size and weight to what you're working with, and select a chute of similar size to what we ship with that kit. We also have a Parachute Size vs. Weight chart on the Recovery page of our webstore that can help. Sometimes we will upsize a chute one notch from what a similar kit might ship with because the kit in question has something special about it that might need to descend slower. For example, if a kit that would normally ship with a 30" chute has some protrusions, particularly big fins, or fins that extend well below the airframe, we might ship it with a 36" instead to help it descend and land a little softer.

Folding/Packing/Flying

- We have a guide to properly folding/packing PML chutes on the Recovery Page of our website.
- We no longer recommend use of the Gradual Deployment feature on our larger chutes. Successful operation of the system is too dependent on specific flight conditions and exact setup of the system. We have not sold/shipped parachutes equipped with Gradual Deployment for a number of years, but some customers may still have some Gradual Deployment chutes.

Piston systems

Design/Operation

- Very efficient design; captures 95+% of ejection gases.
- A PML first, and exclusive to PML for years.
- Essentially guarantees the chute will eject from rocket and will not be damaged from the ejection charge. Ejection gases can’t leak past the chute and eject the nosecone but not the chute, as can happen in non-piston rockets, especially the larger-diameter ones.

- The operation of the piston system is quite simple. The piston sits in the airframe "over" the motor and "under" the parachute. It is attached to the motor mount via a nylon blend strap, which is epoxied to both the motor mount and the piston itself. When the ejection charge goes off, the pressurization between the motor and the piston bottom pushes the piston upward, which separates the rocket and pushes the chute out. That's all there is to it. No special prep needed, nothing to do...just push in the piston, load the chute, and you're done.
- We use metal D-rings with a butt-welded joint for shock cord attachment to the piston on all kits up to and including 4”. On 6” and larger kits, we use Kwik-Links.

Fitting the Piston

- After cutting airframe tubing, it may be necessary to deburr the edges inside and out using 150 grit or finer sandpaper. This is especially true with QT, as the cutting process may “squeeze” the cut end ever so slightly, making it tight for inserting a nosecone or for inserting the piston. Deburring or chamfering the inside edge of a QT will eliminate those problems.
- Phenolic pistons should slide easily in or out with just a little push or pull from you. Sand until you achieve this fit, and chamfer (round) the edge of the upper and lower portion of the piston. We also recommend that you keep some sandpaper in your range box to adjust the fit at the field if necessary. The first few times you fly you may need to "tune" the fit for differing temperature and humidity; once you've gotten it dialed in you should be good for the life of the rocket. Sometimes it just takes a bit of tweaking the first couple of times out.
- A little baby powder on the ID of the body tube and OD of the piston helps lubricate the piston assembly. Only do this when the rocket is completely finished! The baby powder may prevent glues and paints from adhering.

Pistons, QT Tubing, and Cold Weather Flying

- The first time you fly a QT rocket in cold weather, take it with the piston OUT to the launch site with you, and set it outside while you're doing other things. Once the rocket's come to ambient temperature, try to fit the piston; it'll probably be too tight. Sand it until it has the nice slip-fit you'd expect. Voila...you're done. Your QT rocket is now ready to go now and forever. Basically once you sand the piston for cold flying conditions it'll fit well then, and also will be fine in warmer weather, as it's nearly impossible to sand a piston so much it's too loose. Think of it sort of like setting CG/CP...when you build the rocket, you add as much weight as the heaviest motor you'll fly to the tail, then adjust the noseweight once until it's right. It's something you do one time to make sure you're set for the future. Same thing with the piston.

Piston Systems and Black Powder Ejection Charges

Piston systems require less black powder (BP) than non-piston systems. This is very important, as ***most recovery system damage we see to our kits can be traced back to too much BP*** and a too-strong ejection charge. The following shows how much BP to use with our piston systems, for a piston travel of under 30 inches.

- 1.5-2.0” diameter: 0.3-0.5g BP

- 2.5-3.0” dia.: 0.6-0.8g BP
- 4.0” dia.: 0.8-1.2g BP
- 6.0” dia.: 1.4-1.7g BP
- 7.5” dia.: 1.7-2.0g BP

The measuring cup provided in our LES Kit measures out 1 gram. If you don’t have the measuring cup from the LES kit, the cup provided in the kit measures out about ¼ teaspoon of 4f (FFFFg) black powder. We also offer the cup separately (CPR-1GM) on our CPR Systems page.

The following will give you an idea of how much ejection charge BP is commonly supplied with various size motors:

- G: 0.7g
- H: 1.4g
- I: 2.0g
- J, K: 2.1g

The values below are intended as a guide for determining the proper amount of ejection powder used with various diameter CPR-MAX rockets using a piston ejection system and a 24” fore or aft recovery airframe.

6.0” dia. — 1.0 to 1.3 grams
7.5” dia. — 1.2 to 1.5 grams

Using too much BP for the ejection charge causes damage like that described by this customer in an email to us:

> “I discovered damage to the piston tube on the piston ejection assembly. About a 1-inch square portion on the end opposite the bulkplate was broken off. Is this a common failure? Is there anything I can do to prevent it from happening again? I showed it to someone else at the launch and they indicated the same thing had happened to them.”

This damage to the piston is the classic indicator of too much BP used for the ejection charge. What's happening is the piston is ejecting with so much force that it's coming to the end of the piston strap at tremendous velocity, then snapping back against the top of the airframe and, voila, chunked piston skirt. In phenolic airframe, this is usually manifested by a cracked or chunked top of the airframe, too. QT can sometimes crack from this problem. Look carefully at the top of your airframe and you may find a small indentation or other witness mark of where the piston hit. Follow the directions on how much BP to use on the sheet that was packed in your piston kit baggie, or as shown above.

Post-Flight

There are debates as to whether the piston and airframe need to be regularly cleaned of black power residue. All of us at PML occasionally run a damp cloth in the airframe and around the OD of the piston (just like wiping off dirt) and let them dry. If necessary wrap the cloth around a stick to reach inside.

Piston strapping

Piston retaining strapping: 10mm tubular = approx. 500 lb., 3000 lb. (3/4”), and 6000 lb. (2”). The piston strapping comes with a PML piston kit if you buy the piston kit separately.

Piston Strapping Selection Criteria

- 10mm tubular for 1.5" rockets like the Cirrus.
- 0.75" for 2.1" through 3.9" rockets; strap 5’ long for these diameters
- 2.0" for 6.0" and larger rockets; strap is 6’ long for 6.0” and 7.5”

Piston Strap Heat Resistance/Nomex Protectors

We sometimes get questions about whether the piston strapping needs to be protected from ejection heat. First, the strap is a nylon blend, not pure nylon, so it's relatively resistant to the short-term heat of an ejection charge. Regarding strap protection, PML has sold more than 20,000 kits over the past 10 years. That's probably 100,000 flights assuming only 5 flights per kit (which is probably substantially too low, but for the sake of argument that's what we'll use). We've only had two piston straps returned because of burn-through damage. That's a 0.00002% failure of piston straps due to heat damage. Clearly, customer experience has shown there’s no need to add piston strap protection; it only adds unnecessary weight and cost.

Also, to be perfectly honest, most people will lose their rocket to either drifting away on a very windy day, a motor cato, super-late ejection, or some other problem long before degradation of the piston strap becomes a concern.

Shock cords

Tubular Nylon Shock Cords

- We offer three sizes of tubular nylon shock cords: 3/8”, 9/16” and ¾” (actually, the 3/8” isn’t tubular, but it is/should be used just as you would TN)
- Strength Ratings: 3/8” 1000#; 9/16” 2100#, ¾” 3100#
- You may need to clear out flashing from manufacturing in the nosecone eyelets to pull the shock cord through; use an X-Acto knife. If you must open up the eyelet to allow the shock cord to pass through easier, do it toward the body of the nosecone, not toward the edges of the eyelet (that will weaken the eyelet). An easy way to pull through a shock cord strap is to put one corner through the eyelet and pull the strap through using pliers.
- We have a guide to properly tying tubular nylon available on the Recovery Page of our webstore.
- Regarding why we have you attach the ‘chute to the shock cord and not to the nosecone, if you attached to the cone and the cone came off the shock cord, the whole rocket would plummet. If the chute is attached to the shock cord and the cone comes loose, only the nose cone falls. The reason it's one-third of the way up is that if it were exactly halfway, the nosecone would bang into the rocket on descent, since they

were both equidistant from the chute. With it at 1/3 and 2/3, respectively, they are separated on descent.

Shock Cord Selection Criteria

We use the following as general guidelines for kits. For scratchbuilders: more and wider shock cord may be better if it fits. We recommend using our ½" Tubular Nylon for kits up to 4" diameter, with ¾" Tubular Nylon for larger than 4".

- 2.1" dia. rockets w/o payload (nosecone only at other end of shock cord): 3 yrds. ½" TN.
- 2.1" and all 2.5" dia. rockets w/ payload (payload section and nosecone at other end of shock cord): 4.5 yrds. ½" TN.
- 2.5" dia. rockets w/ payload (payload section and nosecone at other end of shock cord) and 54mm motor mount (more weight and higher velocity; harder to predict exact ejection time): 4.5 yrds. ½" TN.
- Most 3.0" dia. rockets 4.5 yrds. ½" TN. Heavy or with large payload, section 7.5 yrds ½" TN.
- Economy 3.9" dia. rockets 7.5 yrds. ½" TN. Heavy or with large payload, section 7.5 yrds ½" TN.
- 6.0" and 7.5" dia. rockets w/o payload (nosecone only at other end of shock cord): 7.5 yrds. ¾" TN.
- 6.0" and 7.5" dia. rockets w/ payload (payload section and nosecone at other end of shock cord): We usually have each section come down with it's own chute and use 7.5 yrds. ¾" TN for the booster and 4.5 yrds. ¾" for the payload.