



AERONAUT

The Newsletter for the Association of
Experimental Rocketry of the Pacific
Tripoli Rocketry Association, Inc.
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The Commissioner's Two Cents

By Jerry Vaughn, AERO-PAC First Commissioner

Here we are in March and there is a lot happening. The Tripoli Board voted on LDRS 2000 and South Carolina got the bid, we lost. There were several reasons for this. Since the last couple of LDRS's were held west of the Rockies it is time to have another one on the East Coast, even though the next LDRS is in Kansas. Another reason for the decision is that their launch site is a sod farm that can only support large crowds during leap years. (This has something to do with the farmers taking leap years off. Go figure?) During the upcoming months we will be discussing the possibility of holding LDRS 2001. I suggested at the last general members meeting that we hold a larger launch in the year 2000. We will probably add a day or two and have a banquet at Bruno's. Like myself most of the people in the West will not attend the South Carolina LDRS. The members who attended the general members meeting thought it was a good idea to hold an expanded launch in 2000.

During the last couple of months there has been a lot going on with the ATF. Tripoli attended a meeting in February and received some news about the future regulations regarding the hobby and motors in general. The news was not very good. There will be no longer be on-site motor sales at any launch. You will have to pre-order and pre-pay for your motors and they will be delivered to the launch site. Also, the so-called easy access motors are now regulated as well. I will be supplying more information on this as I receive it.

A lot of you have been wondering about the Kosdon situation. At the last meeting Sue McMurray, of Tripoli Motor Testing (TMT), announced that all Kosdon motors are no longer Tripoli certified. This has to do with Frank Kosdon (owner of Kosdon motors) failing to comply with proper ATF regulations. At last year's LDRS Frank was told that he must be compliant within a six-month period and he did

not. Supposedly Kosdon east is in compliance. The word from Tripoli headquarters is that all Kosdon motors that were on the Tripoli certification list last year will have a grace period. Unless Frank becomes compliant you will only have this season to fly the motors you now own. As of now there are only two motor manufacturers in compliance. They are Aerotech and Ellis Mountain. I will be talking to Karl Baumann (the main motor supplier for our launches) about the possibility of handling the Ellis Mountain so we will have a greater variety of motors at our launches. I will keep you posted.

Our June launch seems a long way off. There are some local launches happening before June that I would like to mention. Hayburner 9 is in April and should be a good one. Tripoli Fresno is still holding monthly launches as well. I look forward to seeing you all at the equipment party at Tom's. We all need to help keep our equipment in good shape.

That should do it for now. If you have questions regarding any of the topics mentioned above or anything else for that matter don't hesitate to call or email me. I will do my best to answer your questions.

1999 Event Schedule

April 17-18	Hayburner 8 (Paso Robles)
May 1	Equipment Party
May 23	Member Meeting
June 5-6	Mudroc
July 24-25	Aeronaut
Aug 29	Member Meeting
Sep 11-12	Black Rock 11
Sep 13	Black Rock EX 2
Oct 2-3	Hayburner 9 (Paso Robles)
Dec 4	Member Meeting

Message from the Treasurer

By William Walby

Just a friendly reminder that your 1999 AEROPAC renewals are now due. PLEASE fill out the membership form COMPLETELY and LEGIBLY! Also be sure to include your old email address if you are providing a new one. Last year's financial report is presented below for your information. We had a bunch of expenses last year with the trailer being a major contributor. But the expense is worth it since it gives us a much safer trailer than the old one. Thanks to Tom Rouse for doing most of the work involved in getting it and building all the racks and tie downs for the interior. He also was able to find a buyer for the old trailer as well. Well done Tom!!

As you will note, all this year's launches are free to AEROPAC members as long as you renew PRIOR to the first launch. There will be an additional \$10 launch fee for on site renewals. You do NOT have to send in a launch registration form for any of the launches. But **please** call or email me to let me know how many people are coming with you to the launch and if you will be camping on the playa. This will make the launch registration process much quicker for all of us.

Hope to see you on the playa soon!

1998 AEROPAC Financial Report:

8 Feb 1998 Beginning Balance	\$6359.63
Income	\$5123.00
Expenses	-\$8156.36
5 Feb 1999 Ending Balance	\$3326.27

AeroPac Equipment Party

The annual equipment party will start at 0900 Saturday, May 1st. Aeropac will provide lunch and refreshments. Contact Tom Rouse for more information, directions follow:

From 880 - Take freeway 880 south towards Los Gatos. Exit at Camden Ave. Turn left onto Camden (you will turn left and go under the freeway). Follow approximately 6 miles. Watch for Blossom Hill. After crossing Blossom Hill count the lights. The 4th one is McAbee (a Jr High will be on the right.). Turn on the third street after McAbee which is Crystal Springs Dr. Follow till you get to 6590.

From 680 - Take freeway 680 towards San Jose. 680 turns into 280 at the 101 crossing. Stay to the right and exit at 87 south. Take 87 south and exit onto Santa Teresa Blvd. Keep going straight (Oakridge Mall will be on the right). Cross Blossom Hill Rd and then turn right at Coleman Ave. Take Coleman to Almaden Expressway. Turn left on Almaden (There will be a lake/park on the left). Follow Almaden and turn right at Camden Ave. Follow Camden and turn left on Crystal Springs. It will be several streets past the park on your left.

Follow to 6590

From 101 south - Go north on 101 and take the freeway 85 exit towards San Jose. Exit 85 at Almaden Expressway South. Follow Almaden Expressway south and turn right on Camden Ave. Turn left on Crystal Springs Dr. It will be several streets past the park on your left. Follow Crystal Springs to 6590

Minutes

Aeropac Board Meeting February 03, 1999

Jerry Vaughn convened the meeting at 9:20.

Present: Jerry Vaughn, Arnoldo Roldan-Suarez, William Walby, Tom Rouse, Mike Vaughn, Ranny Mitchell.

- 1.) The Breedlove crew has applied for use of the Playa again this summer. Jerry reports the Aeropac paperwork is already in the pipeline, and this should ensure we do not lose our use of the Playa to the race crowd. Jerry will follow up by phone in a week.
- 2.) Aeropac Dues for 1999. By unanimous vote, membership dues will be \$40 annually, plus \$5 per additional family member. On-site registration will cost an extra \$10. The launch fee for non-members will be \$20 per launch. This increase in fees will help recoup last year's deficit, and better prepare the club to host a large-scale event such as LDRS 2000.
- 3.) Updating the Membership Application was discussed - Arnoldo volunteered to update the PDF and post online.
- 4.) Treasurer's Report: William's detailed report showed a beginning balance of \$6359.63, income for the year of \$5123.00, Expenses of \$8156.36, and an Ending Balance of \$3326.27.
- 5.) The purchase of a used IBM-compatible printer was approved for production of membership cards, flyers badges, and financial reports. The board voted to accept Pius' offer of his slightly used printer for \$175.
- 6.) The annual Work Party is set for Saturday, May 1st, at Tom's house. Bring gloves and grubbies; pizza and drinks will be provided.
- 7.) New/Replacement Equipment:
 - Launch rods: identify needs at work party.
 - Mike & Jerry will adapt Pro-Rail for use with our launch pads.
 - FM transmitter: power is being boosted to increase range.
 - PA system is still with Carl Arnett - Tom will make courtesy call to check status.
- 8.) Waiver: Arnoldo will coordinate with Al Frazier and file the application.
- 9.) Aeropac's proposal to TRA to host LDRS 2000: TRA

was to have made a decision by the end of December; Jerry reported the vote has been postponed once or twice. He has advised Bruce Kelly that Aeropac needs notification by March 1st. It is possible TRA will decide to hold LDRS 2000 nearer to the population centers on the east coast. One way or another, Aeropac will host a memorable Y2K event.

- 10.) Aeropac launch advertisement for HPR magazine: layout and content approved with minor additions.
- 11.) BLM Volunteer Program: Aeropac will schedule an all-day Work Party on the Playa, on Thursday Sept 10, the day before Black Rock XI and EX II. Last year, conditions were too wet for this event, but this year we hope to repay Mike Bilbo's hospitality and professional courtesy by hauling away a few junked cars & recovering a few lost Level III projects :-). If you can only attend one day this year, consider making this the one! Mike Bilbo has requested a meeting with our members, and the board will propose three options:
 - Come to a member's meeting in San Jose.
 - Speak at a launch.
 - Coordinate a meeting in Sacramento.

The board will also offer the BLM prominent space for a booth at LDRS 2000, should we host the event.
- 12.) The newsletter VIP list (prefects, international fliers and vendors) needs to be updated.
- 13.) Board members will be issued a second fliers badge this season, designating each as a 'Launch Official.'
- 14.) Newsletters will be published on March 15, May 15, August 15 and November 15; submission deadline is 7 days prior. (Mike will summarize contents of each to the board, to check for completeness.)
- 15.) There will be a member's meeting & board meeting at Portal, two weeks before Mudrock. Remaining member's meetings for this year: Sunday, May 23rd at 1:00; Sunday August 29 at 1:00; Saturday December 04 at 1:00. There will also be a member's meeting at the close of launch each Saturday.
- 16.) Tom recommends the RSO scrutinize all flight cards for completeness, especially those for large projects.

The meeting adjourned at 12:00.

A few notes of interest from the Member's Meeting:

- a.) Sue McMurray reviewed proposed restrictions on launch activity now under consideration by the BATF. It appears that future launches may be limited to 10 miles AGL. Other restrictions may come to bear as well.
- b.) Some LEUP holders have reported inquiries from the BATF questioning their need to use/store 'high explosives.' This is evidently a mis-communication.
- c.) Kosdon motors are not presently certified - holders take note.
- d.) E-Z Access motors composed of grains no larger than 62.5 grams remain legal without a permit at this time.
- e.) Firestar is presently not able to ship due to an issue with the USPS.

Respectfully submitted,
Randolph Mitchell

Note: Since Sue made the above comments things have changed, we will try to keep you posted.

How To Contact The Board

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Second Commissioner	Arnaldo Roldan-Suarez	arnaldo@portal.com	(650)428-1583
Treasurer	William Walby	wfwalby@aeropac.org	(916)739-0404
Launch Director	Tom Rouse	tomr@aeropac.org	(408)997-9586
Secretary	Randolph Mitchell	ranny@aeropac.org	(707)944-8755
Newsletter Editor	Mike Vaughn	mvaughn@aeropac.org	(805)659-3409

Other AeroPac email addresses: board@aeropac.org and members@aeropac.org

Kitchen Table Vacuum Bagging

Technique: Pius Morozumi and William Walby

Article: John Coker

An ideal fiberglass layup optimizes the ratio of resin to cloth for maximum strength and minimum weight. When doing fiberglass layups by hand, it is hard to avoid using too much resin because you need enough to soak the cloth and the cloth doesn't lay completely flat against the surface. The solution to this problem is vacuum bagging.

Vacuum bagging uses atmospheric pressure to press the cloth tightly against the surface being covered so that the excess resin is squeezed out and soaked up in a disposable outer wrap. This technique requires a vacuum bag and a vacuum pump capable of pulling a significant vacuum (at least 25 inches of mercury), and various accessories and supplies. Until now vacuum bagging has been mostly restricted to large commercial use and a few enterprising hobbyists.

Pius Morozumi and William Walby have invented a technique for doing vacuum bagging which uses a readily-available kitchen appliance, the *FoodSaver*, which provides the vacuum pump and bags in a convenient form! They developed this technique while building a set of six 6" rockets with 98mm motors for a research program and it has also been used in several other rockets.

WARNING: Because the FoodSaver uses an electric motor to evacuate the air (as do most vacuum pumps and air compressors), you should not use products which are highly combustible. In particular, we recommend not using polyester resins, although epoxy resins are generally fine. Please check your epoxy system to make sure that it isn't combustible (West System has no such warnings).

Vacuum Bagging Theory

Vacuum bagging requires that the part being laminated be covered with cloth (as in hand layups). The part is wrapped with a thin film which is porous and will not stick to the epoxy, called "release," and a thick layer of absorbent material, called "breather." This whole assembly is then inserted into the vacuum bag and the air inside is removed by a vacuum pump. Because the air inside the vacuum bag is removed, the air pressure from the atmosphere outside the bag pushes tightly from all sides, pressing the bag against the breather. The excess epoxy is squeezed out of the cloth, passes through the release and is soaked up by the breather.

After partial cure (at least 12 hours for West System 206 hardener at room temperature), the part is removed from the bag and the breather and release are peeled off. Because epoxy does not bond to the release, this generally comes off easily. At this point, the breather has soaked up the excess epoxy and the remainder makes up only about half of the bulk, which is ideal.

At this point, the next layup can be applied, if there is one, or the tube can be left to completely cure. The next layup will form a chemical bond with the previous layup as long as the previous layup has not fully cured. A chemical bond is preferred between the layups. If the prior layup cures fully, you will have to sand it with coarse sandpaper so that the epoxy can grab onto the roughness to get a reasonable mechanical bond. (West System epoxy has a full cure in 1-4 days at room temperature.)

You keep hearing the phrase "at room temperature" because the cure rate of epoxy is highly dependent on the temperature. Higher temperatures speed up curing, which is desirable in most cases. In addition, "cooking" the tubes to speed up the cure actually increases the strength of the epoxy. Most commercial processes use a "curing oven" to speed up the process and produce a stronger part. For most hobbyists, this is not practical, as the desired temperatures (150-200F) are too low for most kitchen ovens, but too high for most stand-alone heaters. People have used closed cars in the summer as a low-tech substitute. (The dashboard of a car can reach 180 on a hot summer day.) Note that most epoxies will not cure properly in cold weather and you should work and let the part cure in a heated area overnight. (For West System, keep the part over 60F until fully cured.)

Bagging with the FoodSaver

The major piece of equipment you will need is a *FoodSaver*, which is used to preserve fresh food for freezing or room-temperature storage by removing the air around it. The system works by dispensing bag material which you can seal at one end and measure out the length necessary. Once the food has been inserted into the bag, the open end goes into the machine which will remove the air using a powerful vacuum pump and seal that end. The sealing is a heat process which produces a weld-like seam across the bag. This is a handy device to have in the kitchen as it can keep foods fresh much longer than ordinary plastic bags. The basic FoodSaver can be purchased for about \$150 while the FoodSaver Pro

costs a little under \$300. There are several on-line retailers which carry the FoodSaver and the basic model has also been spotted at Price/Costco. The FoodSaver is made by Tilia, Inc. and there is another product, *Seal-A-Meal* made by Rival and several other products as well.

Equipment and supplies you will need for this project:

- your body tubes (shown: 6" flexible phenolic)
- enough couplers to fill the tube(s) and extend at least 1" on both ends
- a body tube bulkhead for each end of each tube which won't slide into a coupler
- your base cloth (shown: 5.7oz. carbon fiber)
- your veil cloth (shown: 3oz. S-glass cloth)
- vacuum bagging release (you need the real stuff here)
- vacuum bagging breather (cotton batting will do)
- a *FoodSaver* or *FoodSaver Pro* (shown: an older FoodSaver Pro)
- enough FoodSaver bag material for each tube length plus three calibers (tube length plus 18" for 6" tubing)
- fiberglass epoxy system (shown: West System 105/206)
- flexible plastic spreaders (such as those for automotive body work)

The first thing to do is prepare the tubes for laminating. They should be sanded outside with coarse sandpaper such as 100 grit to rough up the surface so the epoxy can make a good mechanical bond. You don't want to sand too much, just make sure all shininess is removed from the surface. Wipe off the sanding dust and make sure the tubes are free of oil and dirt.

When the air is removed from the bag, the bag will press tightly onto all sides of the tube. The bulkhead end caps prevent the bag from being sucked into the inside and the tube couplers provide extra support for the tube to prevent it from collapsing inward. Also, the extra coupler at the ends provides support for the excess width of cloth. If possible, you want to keep the cloth from bonding to the coupler (otherwise you will lose the coupler). Most importantly, you want to make sure that no epoxy can wick or be forced between the body tube and coupler. If this happens, your tube will be a loss because the coupler will not come out. Use enough couplers to fill the full length of the tubes and stick out at least 1" on both ends.



Before installing the end couplers, wrap enough plastic wrap over the end of the coupler to drape down past the other end. (Teflon sheet is even better, but hard to find.) Use two pieces across each other at right angles. You should end up with one end of the coupler covered with two layers of plastic wrap, the outer surface of the coupler covered in plastic wrap and the ends tucked into the other end of the coupler. Use enough layers that you can just slide the coupler in without tearing the plastic wrap. This way, even if some epoxy does get under the body tube, it won't bond the coupler in place.

Wrap masking tape around the outside of the coupler, over the plastic wrap, right up to the end of the tube. Build up a good band so it covers about half the thickness of the body tube. (This is another barrier to epoxy.) Also try to get the last double-wrap of tape to go up the end of the tube a little to make a dam. Be careful not to get any tape on the outside of the body tube itself. Finish both ends of both tubes this way. Finally, cover your bulkheads with

waxed paper and tape them securely to the couplers at both ends. Now you have a solid surface with only the parts you want to laminate exposed.

When lining up the cloth, it is much easier to have a reference line on the tube. Using a piece of angle iron or a door jamb, draw a bright line (red felt-tip pen works well) along the length of the tube. You will line up the edge of the cloth with this line when you roll it on.

Cut out your release and breather. These aren't critical and are easy to handle. Make sure your release is 1" longer than the tube's circumference and 2" wider than the tube length. The breather should be a little longer so that you have a nice overlap. Set these materials aside for now.

Lay out your carbon fiber on your work table on a good cutting surface. Carefully straighten out the cloth so that two edges are at right angles and the weave is straight both ways. You need to cut the cloth slightly longer than the tube



is around (the outer circumference). Cut at least 1/2" extra (for example, 3/4" for the 6" tubes). You want the cloth at least 1" wider on both ends than the tube is long. The weave along the edges tends to come out once you cut it and every time you handle the cloth, it tends to lose more and more of the edges. (See the tips section below for more.) Try to make your piece include the selvege (sewn edge), if you can, as this edge won't fray. Cut the other three edges out straight and make sure they line up with the weave.

You can cut the cloth with scissors, but a much easier and more accurate way is with a fabric cutter as pictured.

This tool has a sharp cutting wheel which rotates as you

push it along your guide. Experiment with the pressure until you cut through the cloth in one pass. Note cutting mat (actually two mats joined together) which is marked with dimensions. This makes layout easier and saves wear and tear on the cutting tool and your table. Both the cutting tool and the mat can be found at sewing and craft stores.

Carefully set the cloth aside by sliding it onto pieces of freezer paper and set the whole thing away from your work table on a flat surface. Be very careful not to allow the cloth to distort, as it loves to do. Both carbon fiber and fiberglass cloth are very sensitive at this stage and require delicate handling.

Now lay down newspapers on your surface. Use several layers so you can remove pieces as they get dirty with epoxy. Lay your cloth with its freezer paper down on the table on top of the newspapers and get out your epoxy and plastic spreaders. Make sure the cloth is straight and the weave is aligned along the whole piece.

Now put on two pairs of gloves, one over the other, and mix your epoxy. Pour the epoxy onto the cloth and gently use the spreaders to "wet out" the entire piece. Be careful working at the edges to make sure you don't pull out any of the weave. The entire piece should be soaked with epoxy and the surface should glisten. You don't want puddles on top of the cloth, but you don't want dry spots either. For fiberglass cloth, it is easy to tell because the wet-out cloth becomes transparent; for the carbon fiber; you have to make sure the entire surface glistens.

Now you're ready to roll the cloth onto the tube! Start by laying the tube onto the cloth with one edge lined up with the line on the tube. Make sure the cloth overlaps the tube an equal amount at both ends. Now pick up the edge of the freezer paper and start rolling the tube across the cloth. Go slowly and smooth out the cloth and any bubbles or wrinkles. It helps to pull the tube toward yourself as you roll to make sure the cloth is tight. Peel back the freezer paper as you roll to make sure it doesn't get under the cloth as it



wraps around the tube. Once your wrap the cloth around, carefully inspect the entire surface to make sure you don't have any bubbles or wrinkles. The cloth should be stretched tightly and should overlap only slightly. Ideally, the overlap should be only the frayed edges of the cloth so that it makes the same thickness at the seam as the solid cloth on the rest of the tube.

Set the tube on its end on the floor and remove a layer of newspaper so you have another clean surface. Remove the outer set of gloves and take a deep breath. You just finished the hardest part!

Now you need to wrap the release fabric and breather. These are obviously not as critical as the actual laminate, but you should make sure there are no wrinkles in the release as these may transfer to the cloth. Tape the breather at the overlap and at the ends so that it covers



the entire tube surface. Cut a bag 3 calibers longer than the tube and seal one end with a double seal. Slide the tube into the bag so that the end is near, but not quite touching, the sealed end (using up one caliber of extra bag).

Place the open end of the bag into the FoodSaver and start vacuum sealing the bag. Use the full-vacuum seal. Try to pull out wrinkles in the bag as the vacuum develops by pulling apart on the seams at the sides along the length of the tube. Once the cycle finishes, the bag will be sealed. Seal it again for good measure. If your bag is clear, you can see the breather starting to soak up the epoxy and the entire bag will be too tight around the tube to pull away from it.

Set the tube aside to partially cure. You don't want a full cure, but you want well past the gel stage. For West

Systems 206, let the tube sit at least 12 hours at room temperature. (Don't work or store the tube below 60F while curing.) Check on the bag after 20 minutes and then an hour to make sure the vacuum holds. You should have no trouble with a new bag and double seals, but just make sure.



When this first wrap has cured enough to be hard, but not to a full cure, debag the tube and remove the breather and release. They should come off without much trouble and the breather may be usable again. Proceed to the second layup of the veil, following the same procedure as for the base layup and bag it. Once the second layup has partially cured, debag the tube and remove the breather and release. Set aside to fully cure.

To remove the end couplers, use a razor saw to carefully cut around the coupler, just past the end of the tube. You need to cut through the laminations and into the tape but if you can avoid cutting the couplers, they can be used again. Once you cut through all around, pull out the couplers and peel off the bulkheads and couplers sealed in wax paper and plastic wrap. Ideally, you can use these again.

To trim the excess lamination down, use a palm sander or paper on a sanding block. Go slowly and don't sand into the tube itself; just sand the lamination down to match the tube.

You now have the tube laminated with a minimum of resin. The tube will be noticeably lighter than the ones you've done with hand layups. It will also be just as strong and less brittle. Congratulations!



Tips and Tricks

Here are some tips and tricks discovered while perfecting this process:

- this is really a two-person job, especially for larger tubes
- cut the lamination fabric out *last* so you have to move it as little as possible
- take the time to get the fabric square and handle it carefully so it stays square
- the bulkheads prevent the bag from being sucked into the tubing as the vacuum increases
- use a double seal on the bag at both ends
- don't re-use bags without carefully examining them (using them twice should be no problem)
- don't try to do more than one fabric layer per bagging
- *make sure the cloth is tight*, otherwise the bagging will produce wrinkles
- then really make sure the cloth is tight!
- make sure you have everything ready to go *before* you mix the epoxy
- put on two pairs of gloves so that you can throw the outer one away and still be covered
- try to move the cut cloth as little as possible
- leave enough overlap for loss of cloth weaves (no less than 1/2" and 3/4" for the 6" tubes)
- you can always pull a weave out after you complete the wrap to avoid a double thickness
- stagger the seams of the base and veil cloth
- make sure the tube mark is parallel to the tube
- make sure to line the cloth up with the mark so that you don't roll off one end
- the ridges made by the edges of the bag can be lightly sanded before the next layup
- same with the overlap if you end up with a thick section
- after debagging, remove breather threads and wipe off any sanding dust with alcohol

The hardest part of this process is cutting and handling the cloth. The carbon fiber is great stuff, but a pain to deal with. You need to treat it very gingerly to keep from losing the weave which is why you need so much overlap. Each time you touch the carbon fiber you will lose a weave at each cut side and each weave is about 1/8". You want enough extra so you can lose a few weaves and still cover the tube, but not so much that you have a large overlap. Cut at least 1/2" longer than the tube's outer diameter (you can always pull out weaves at the end to make a smooth transition).

Make sure you get the cloth edges square to the weave and cut along *the same weave*. Try to make your piece include the selvege (sewn edge) if you can as this edge won't fray. When you move the cloth, keep it on the freezer paper and try to keep it from distorting, which it is very prone to do. There is some trial and error here, but you should be able to get it the first time if you are careful.