

Bladder Fuel Tanks for R/C Pulsejet Models

by Bruce Tharpe

Over the years, my father and I have slowly been refining the fuel tank system for our R/C pulsejet models. Although we've experimented with other types of bladders and pressurization systems, the latex bladder is our current top choice for simplicity, affordability, and reliability. There's plenty of room for further experimentation, but the components described below have been proven to work just fine. My good friend Richard Caine, another experienced R/C pulsejet pilot, has some good advice and alternate techniques for making bladder tanks on his website: <http://Home.earthlink.net/~famcaine/pulsejets/PulseJet.htm>

A quick description of the system will help you understand the reasoning behind the component choices. When fueled, the bladder inflates like a balloon and provides fuel under pressure to a Cline regulator before passing through to the engine. The beauty of this system is that there is no air in the tank, therefore no chance for an engine-stopping air bubble. The latex is not compatible with gas or Coleman fuel, so we use a mixture of 80% methanol and 20% nitromethane. This fuel provides a bit more power and keeps the reed valve cooler, at the expense of a much higher fuel flow. With a methanol-based fuel, count on a fuel flow of about 8 ounces per minute for a Dynajet (or Dynajet clone).

Description of Components and Construction Techniques

1. Bladder Material - Natural Latex Rubber Tubing, 1/2" i.d., 11/16" o.d., 3/32" wall thickness. Available from McMaster-Carr, order number 5234K36. We buy this in long lengths, usually about 25 feet. It's relatively inexpensive; about a dollar per foot. It comes coiled, so most of it will have a natural curve, but there will be some sections that are straight or nearly straight. I try to cut the straightest bladders possible because a curved bladder may not fit well in the plastic bottle container. Cut a piece about six inches long. When fueled, this will expand into a fat sausage shape approximately 3-1/2" in diameter by 12 to 14 inches long, and will hold 35 to 40 ounces of fuel.

2. Bladder End Cap - Copper 1/2" Tube Cap. You'll find these in any big hardware store that sells plumbing supplies. They are actually about 3/4" o.d. and cost pennies. Round off the edges of the caps with a wire brush to prevent damage to the bladder. Use one of these, unmodified, to cap off the end of the tank. Now comes the fun part - installing the cap into the bladder. I wish there was an easier way, but I haven't found it yet. Force the cap into the bladder, open end first. You will have to grab the rubber with your strong fingers and pull it over the cap. Work your way around the bladder, tugging it a bit at a time until the end cap is fully encased by the bladder material. Try to make an even bulge all the way around - if the cap is crooked, you will see an uneven bulge and the bladder may curve like crazy when inflated. This process might be easier with some kind of lubricant, but I worry about petroleum products affecting the rubber and you want a tight friction fit when you're done.

3. Bladder Outlet Cap - Copper 1/2" Tube Cap with Brass Tube. Make an outlet tube made from a 3/4"-long piece of 5/32" brass tubing. I've found that if you drill the cap with a 5/32" drill bit, the brass tubing will be a friction fit. Tap the outlet tube into the cap so that only about 1/32" of the tube extends into the cap. Clean the area well and solder the outlet tube to the cap. This cap is a little easier to install because you will have some leverage with the brass tube.

4. Fuel Line - Large Silicone Fuel Line available from many sources like Sig, DuBro, Sullivan, Great Planes, etc...

5. Heavy Thread Wrapping - I use dacron tow-line glider chord available from Sig (SIGSH449, 28-lb. test, 175 ft., \$2.40). Any heavy thread or chord should work okay. Wrap the end caps about five or six turns and secure it with thin CA. It really helps to have a second person apply the glue while you're holding the wrapping tight. Carefully cut the loose ends, obviously being careful not to nick the rubber, then fully coat the wrapping with CA. Try to be neat here to keep CA from running all over the bladder. Repeat the process for the fuel line.

Testing the Bladder Tank

Once the bladder is at this stage, it's ready for testing. Blow it up using compressed air, being mindful of the possibility that it could pop right away. Safety glasses are always a good idea. Every bladder behaves a little different during inflation. Some start in the middle and grow towards one end, then the other. Some start at one end and continue all the way to the far end. It doesn't really matter; what you are looking for is a nice, straight inflated bladder. Sometimes straight-looking bladders will curve when inflated, and sometimes curved-looking bladders will inflate surprisingly straight. You can actually bend an inflated bladder across your knee to make it straighter and it will hold its new shape. With the fuel line pinched off, I like to let them sit overnight, but an hour or two is probably enough to let the rubber relax a bit.

The Rest of the Fuel System

Bladder Container - The bladder should be installed in the model housed in a clear plastic bottle. I like the Aquafina 1.5 liter water bottle primarily because it has a larger-than normal cap. An assembled bladder won't fit through the opening in a typical soda pop bottle. Drill a 1/4" hole in the cap for the fuel line to pass through. You also need a vent hole in the container to allow air to flow in and out as the bladder changes in size. The vent will also serve as a drain should the bladder pop. You can add a small pressure fitting (Dubro, Fox, etc...) to either end of the container to serve as the vent, then attach a length of fuel line to the fitting. Route the line to the outside of the model.

Fuel Line Splice - Brass tubing, 3/16" o.d., 1-1/2" long. This is needed for refueling. The splice is somewhat oversize for the fuel line, but that makes for a tighter friction fit of the tubing. That's good, because you don't want to bother with clamps at this connection, but you also don't want it to pop apart under pressure.

Cutoff Valve - Perry Smoke Valve, available from Tower Hobbies (LXDG64, \$16.49). Also listed under the Varsane name. We have found that it's pretty important to have a good fuel cutoff on our R/C pulsejet models! This valve is light and can be operated with a standard servo. I like to use the throttle stick to control the cutoff. Set up the valve so it's open at full throttle and closed at idle. Wrap the fuel lines at the attach nipples with a couple of wraps of heavy thread or dacron line.

Cline PCFS Proportional Control Fuel System - This little unit is expensive (\$50.00), but worth every penny in a pulsejet model. It's not a regulator; Cline calls it a "demand controller". The controller does not allow fuel to pass unless the engine is running. This is perfect because if the engine flames out during flight, the controller will block the pressurized fuel from streaming into a hot engine. Set your engine up to run as it normally would under suction (unpressurized fuel tank), then use the same metering jet with the bladder and Cline controller. For methanol, we use a metering jet with a .058" orifice.

Cline Attach Tube - Large Tygon Tubing, 5/8" long. Tygon is used here because it's stiff and kind of sticky. The ideal position for the Cline controller is right in front of the Dynajet head. The attach tube holds the controller firmly, so there's really no need to mount the controller to the model; in effect it becomes part of the engine.

Fueling the Model

The only way to fuel a pressurized "vessel" (the bladder) is to apply an even greater pressure to the fuel source. We use a heavy plastic bottle made for garden spraying as our fuel supply jug. We added a Shroeder valve to the bottle so we can pressurize it with the same air tank we use for engine starting. It's almost mandatory to have the bladder (in its container) visible during the fueling process so you can watch that it inflates properly without kinking or bursting. There's lots of pressure here so watch out for lines popping off and spraying around. It's happened to us more than once. When full, pinch off the fuel line going to the bladder with a hemostat as well as the fuel line coming from the supply jug. Disconnect the fuel source, then purge any air that might be in the bladder by letting go of the hemostat for a moment (the outlet cap must be facing skyward when you "burp" the bladder). Connect the fuel lines at the splice then remove the hemostat. The Cline controller will keep fuel from running into the engine.

Starting Procedure

The starting procedure when using a bladder tank and a Cline is really no different than starting with a suction-feed fuel system. Hook up your buzz box, open the fuel cutoff, and start blasting short bursts of air into the flowjector. Once in a while, especially if it's cold outside, we will use a small blast of starting fluid or carburetor cleaner sprayed into the front of the engine. Here's one small tip: We've found that these engines start easier when the spark plug is positioned horizontally rather than pointing straight up.

Suppliers

Bruce Tharpe Engineering - 8622 E Evans Creek Road, Rogue River, OR 97537 Phone: 541-582-1708. tharpe@cdsnet.net
Assembled Bladders, Pulsejet Model Plans. www.btemodels.com (under construction)

McMaster Carr - Chicago, IL 630-833-0300. Natural Rubber Latex Tubing. www.mcmaster.com

Sig Manufacturing - Montezuma, IA 800-247-5008. Fuel Tubing, Brass Tubing, Dacron Line. www.sigmf.com

DuBro Products - Waukonda, IL 800-848-9411. Fuel Line, Tygon Tubing, Exhaust Fittings. www.dubro.com

Cline & Associates - Alpha, OH 937-426-4167. Proportional Control Fuel System. www.billsroom.com/pcfs

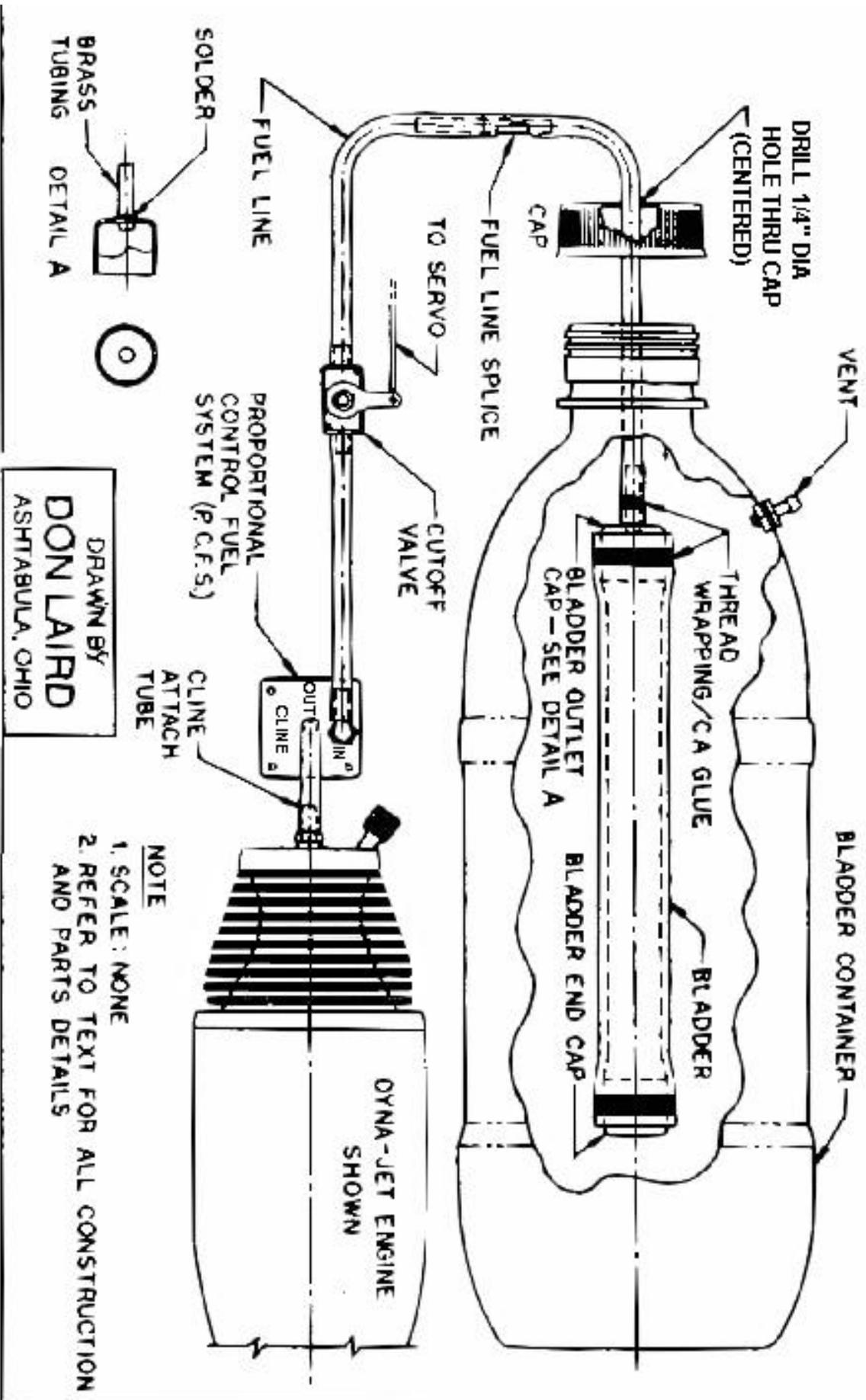
Tower Hobbies - Champaign, IL 800-637-6050. Perry Smoke Valve, Hobby Supplies. www.towerhobbies.com/index.html

Bailey Machine Service - Houston, TX 713-694-7017. Reed Valves, Metering Jets, Flowjectors. (no website)

Klotz Special Formula Products, Inc. - Ft. Wayne, IN 800-242-0489. Nitromethane. www.klotzlu.be

BLADDER FUEL TANK FOR R/C PULSEJET MODELS

BY BRUCE THARPE



NOTE
 1. SCALE: NONE
 2. REFER TO TEXT FOR ALL CONSTRUCTION AND PARTS DETAILS

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