

# MMM Tech Talk

Edited by Steve McLellan

## An Introduction to Using Pacifier Fuel Systems

Some of our club members who haven't tried pacifier fuel systems have been asking about how to set them up, and it seemed like a good idea to go over a basic setup and how to start and handle the engine. The advantage of a pacifier fuel system is a rock solid engine run with no sag as the model accelerates after launch. High performance engines with large venturies require one because of low suction (poor fuel draw), and the installations are naturals for flood off systems. People who haven't tried them tend to view the filling and handling operations as being complicated, but they're actually simple and straightforward, and, like anything else, once you get used to, it becomes second nature. So let's detail a basic pacifier setup, to make giving it a try easier.

### Making:

Pacifiers get their name because they use baby pacifiers ( typically Binky brand ) as inflatable fuel bladders, but, over the years, pen bladders, surgical tubing, and penny balloons have been used, too. We're going to stick with a pacifier and leave the others for a future article.

The parts of a standard pacifier assembly are: a pacifier fitting, binding wire, and the pacifier (see illustration page ).

The binding wire can be copper or steel. I use inexpensive 24 gage soft steel wire that is available in hardware stores as a roll, and Ken Phair uses 22 gage copper wire. One roll will last a long time!

You can buy pacifier fittings from several sources. Crockett makes a cast fitting and

Texas Timers sells a plastic fitting (very inexpensive). Both are sold through several free flight suppliers .. Starline makes a fairly expensive fitting set that is intended for use with surgical tubing, but the set can be used with a pacifier too. You can make your own out of brass tubing and some silicon fuel tubing that will do the job fine, and this is illustrated in the accompanying drawings.

To bind the pacifier to the fitting, a short length of wire is wrapped over the pacifier and fitting, the ends are crossed, and the wire is twisted tight several turns with pliers. Trim the wire so that a couple of turns are left and bend the sharp, cut end away from the pacifier bladder, so that it won't be cut. If the wire is too thin it will break, and, if it is too thick, it won't conform to the shape and provide uniform pressure for sealing the joint. Piece of cake.

### Mounting:

A simple "U" shaped clip is one easy way of mounting the pacifier assembly (see illustration page). The "U" is large enough to allow the main part of the pacifier to squeeze through but not the bulged lip. Make sure the clip legs go through enough wood to hold firmly. If the skin is thin, the clip may tear out when the model D1's.

There are many other mounting methods, with the only requirements being adequately restraining the pacifier while allowing it to be changed easily. Some plans show a loop soldered to the landing skid, an installation which is close to the engine and solid. You can also attach the pacifier assembly with rubber bands hooked around a few simple, short, firmly mounted hooks on either side of the fitting. Watch for deterioration of the rubber bands in use, and loop the bands around the pacifier fitting.

Simply letting the pacifier hang by the fuel line is not a good idea, though I have seen people do it. It flops around and can be pinched off where it goes around a fitting, which may restrict fuel flow and cause an irregular run. It is also more vulnerable to damage.

Keep the pacifier away from anything sharp that can puncture it or chafe a hole in it while flying. Sharp edges may chafe through the rubber even if the tank is not punctured immediately, resulting in the tank blowing out on the way up after launch. If it's necessary, mounting the pacifier a considerable distance behind the engine to avoid sharp edges works fine, because the pressure feed is very positive. One of mine IS about six inches behind the needle valve.

### **Filling:**

To fill a pacifier, you need a syringe. Cheap, fuel-resistant, plastic ones are available from model suppliers and feed stores in several sizes. The two ounce or 20cc size is best for our purposes, but the very small one can be useful for priming. Have a length of silicon tubing on its outlet with a length of tight fitting brass tubing in the end that your model fuel line also fits on tightly. To fill the syringe from a can, simply pull out the plunger. If you suck some air with it, you need to purge it by turning the syringe outlet up ( the bubble floats to the top) and forcing it out with the plunger. You fill the pacifier on the model by disconnecting the fuel line at the needle valve, and inserting the syringe into. Make sure the fuel tubing is far enough onto the brass tubing to keep it from blowing off when you apply pressure. Inflate the pacifier by depressing the plunger. If you get a bubble of air in the pacifier, you must remove it to avoid having the engine suck

air. Turn the model so that the pacifier fitting outlet is up ( bubble floats to the top again ), hold the syringe above it, and let the pacifier pressure force the bubble out. With some fittings that extend far into the pacifier, you may have to actually suck the last bit of air out of the collapsed pacifier by pulling on the plunger. With the air purged, you are ready to inflate the pacifier to size.

Hold the model away from you as you fill the pacifier, so that you will not get fuel all over you if the tank ruptures. You need to pump in enough fuel to keep the pacifier adequately filled while you are getting set to launch, but you don't want too much. Overfilling adds weight, can change the model balance, and can result in a very long overrun if your timer fails, especially with small engines. Learn by trial and error, noting how much fuel you have when you're ready to launch. If you didn't put in enough, the run will go lean as the tank collapses and loses pressure. There are ounces or cc's marked on the side of the syringe that may help you to determine how much fuel you have pumped into a pacifier at a given size of inflation, but they tend to wear off quickly. A proper fill will hold a steady needle valve setting without adjustments after you set it.

For a pinch off system it is best to do a practice run to check out your fuel shutoff timer to make sure that it really can cut off the fuel flow with the added pressure.

### **Pinch It Off:**

You need a method of pinching off the fuel line to hold the fuel in after filling the tank. With a pinch-off fuel system, such as a KSB or Texas Timers type, just use the pinch off to shut the fuel line off until you are ready to start. With a flood off system, some sort of auxiliary pinch off is required. Texas Timers has just started marketing a very small,

easily operated and lightweight plastic unit that pinches the fuel line. If you are using a Seefig timer with a plunger type shutoff, such as the Texas Timer unit, you can open or close the plunger with the fuel shutoff arm and permanently set it after the engine is running. Just lay your thumb over the lever. If you are good with gadgets, you should be able to come up with a home fabricated unit that will do the job for other installations.

Of the other possible approaches the simplest types are a clothespin (no kidding) or a hemostat neither of which is mounted on the model and which simply hang hooked to the fuel line. These can be used to control fuel flow when starting the engine, but they keep one of your hands busy so that you can only hold the model with one hand. The other holds the clothespin or hemostat. Hemostats are also awkward to operate left handed due to their design, and either may be hard to get back on the fuel line quickly if the engine quits. KSB type pinch off timers can also be released when starting, but they are hard to reset quickly to the closed position.

A temporary pinch off allows you to release any clamps prior to starting. Your thumb can be used for a temporary shutoff, but you must have a hard surface to press upon and the fuel line should be held in place with guides that keep it from squirming around. It gets awkward after any significant length of time. The most effective temporary pinch off is a finger operated plunger or lever. This gives you very accurate control of fuel flow when you are starting the engine, and allows you to set pinch off units before starting

### **Starting and Adjusting:**

The first time you try to start an engine can be the toughest, because you are not sure of the needle valve setting. The needle valve

will be closed more than it would be for suction systems, since the pressure forces fuel through faster. Rule of thumb: With the needle valve closed, turn the model over and open the needle valve enough for a slow drip from the venturi, which will give you an initial setting. The approach works well, as described, for medium sized engines. For a smaller engine the dripping should be slower. If you have started it before and set the needle valve for maximum engine speed, it is not necessary to reset the needle valve to start the engine. It will jump right up to full speed.

When you are ready to go, try starting the engine without priming. If you have just used the "slow drip" setting procedure, the intake will be wet with fuel after you pinched it shut to hook up the glow driver for starting. If you have used a flood off on the last run the engine will still be wet (of course, you still have had to drain all of the excess fuel out of the crankcase if you did not use a properly sized fuel dump - we'll discuss that another time), but if you used a pinch off it will probably be very dry and need a prime.

Prime only if necessary to avoid flooding the engine. A little priming bottle or small syringe works well any time you are priming. If you have very accurate control of the fuel pinch off, such as you have with a plunger or lever, or if you are very good with a hemostat or clothespin, you can crack the fuel line open briefly to prime the engine, but this is easily overdone and may flood the engine.

When the engine catches on the prime, don't open the fuel line too quickly. Sometimes it will tend to flood and quit if too much fuel enters before it gets up to full speed, and you need to pinch things off slightly to lean it out and let it pick up the necessary revs to hold. You'll develop a sense for this after doing it for a while, and not all engines have this trait.

If you are using a pinch-off timer, you can start the engine on a prime and then pull the timer open to open the line, but it is difficult to reset, as we mentioned before. Have the timer switch set to "off" so that it will stay open. If you are hand starting a small model, like a 1/2 A, you can use the third or fourth finger of the hand holding the model to pull the timer arm open. ( Don't forget to accurately set it after adjusting the engine) You can also use a finger to pinch off the line if the engine dies or tends to flood

### **Clearing a Bad Flood:**

It is very easy to flood the engine and fill the crankcase up like a bathtub if the fuel line is open any length of time without the engine running. To clear a bad flood, pinch off the fuel, disconnect the glow plug clip, and turn the model however necessary to let fuel drain out of the exhaust and intake. To get fuel trapped in the crankcase out, slowly rotate the engine backwards, turning the model upright briefly to let fuel drain out of the ports and then over to drain it out of the intake. If you don't get the excess fuel out and you ram the engine into a starter, you may hydro lock the piston and break the engine.

### **Setting the Needle Valve:**

Fliers who are used to suction systems or poorly functioning pressure tanks tend to set the mixture quite rich to avoid the engine leaning out during launch. This is not necessary with pacifiers. Lean out the engine to full RPM and then *very slightly* richen the mixture to avoid a lean run and to let the engine unload in flight. Hold the model in its climbing attitude while setting the mixture. If you launch reasonably quickly, a good fill and needle valve setting will hold throughout the preparations, launch, and climb, if the pacifier is

adequately filled. If you are taking a lot of time lighting a fuse you may have to do some final tweaking just before launching. The engine will not respond to needle valve changes in the same way as an engine running on suction. In general, what sounds lean on suction will sound rich on pressure. You can get a surging "wah wah wall" sound from a high performance engine that is too lean.

### **Some Final Words:**

Pacifiers don't last forever, and the more nitro methane you use, the shorter the life will be. High nitro fuel may reduce the life to one contest, and if a funny thin skinned bulge forms on one then replace it. Exposure to sunlight, as is common with most external mounts, also greatly shortens life, possibly to a single day.

Drain them between contests. Make up several at a time, and-keep spares in your support box. One should easily last a contest if it doesn't puncture when you DT. Once you have the basic gear, the pacifiers are only about 50 cents apiece, and the wire is inexpensive, so it doesn't make sense to be cheap about it and risk a rupture. The fuel you use probably costs more, and the reliability and consistency you achieve will make you more competitive.

Lots of words about a pretty simple subject. Hopefully, most of your potential questions have been answered, but if they weren't, talk to me or someone at the field who uses pacifiers. This should have been enough to get you started, and sometime in the future we'll cover other topics such as fine thread needle valves, surgical tubing bladders, pacifier compartments, fuel dumps, flood off restrictors, and bladders for very small engines.

*A special thanks to Ken Phair and Chuck Etfierington for reviewing the draft and providing suggestions.*



MAX-OUT

R. Pangell, editor 6994 So. Prescott St., Littleton, Co. 80120

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### Assembling a Pacifier Fuel Bladder



Fitting  
Binding Wire  
Pacifier

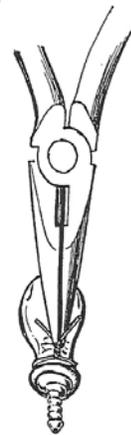
See sources at bottom and on next page



Slip the pacifier over the fitting



Wrap the binding wire around near the lip and cross the ends



Grab the wires where they cross and twist until snug. (too loose and it leaks, too tight and the wire breaks)



Clip off all but 2-3 turns and bend away from pacifier to prevent puncture.  
**Your Done!**

#### Parts Suppliers:

Binding wire: Hardware Stores  
(Buy 24 gage soft steel or 22 gage copper wire)

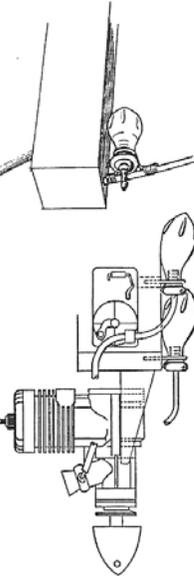
Pacifiers and Fittings:  
Campbell's Custom Kits  
P.O.Box 3104  
Muncie, IN 47307

Aerodyne (Al Heinrich)  
1924 E. Edinger  
Santa Ana, CA 92705

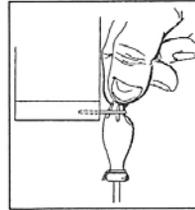
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A "U" of 1/16" wire will make a simple pacifier mount. loop should be a snug fit on the pacifier assembly just behind the pacifier lip. Just make sure it's epoxied in enough wood to prevent pulling out. (The plywood fin is an excellent place to mount it)  
You can also bind and solder it to the skid.



Sample Pacifier Installations  
(Use the forward position for remote pinchoifs or floodoffs )



To install the pacifier, just pull it through the loop.

Special thanks to  
**Sweeney Hayashi**  
for the excellent  
illustrations!

More Parts:

Pacifiers and Surgical  
Tubing:

Jack's Models (Jack Moorland)  
7711 Canyon Pt. Ln.  
San Diego, CA 92126-2049

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