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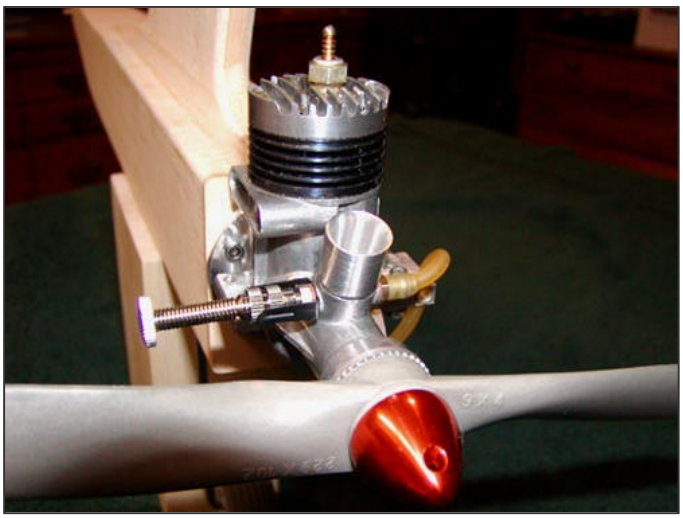
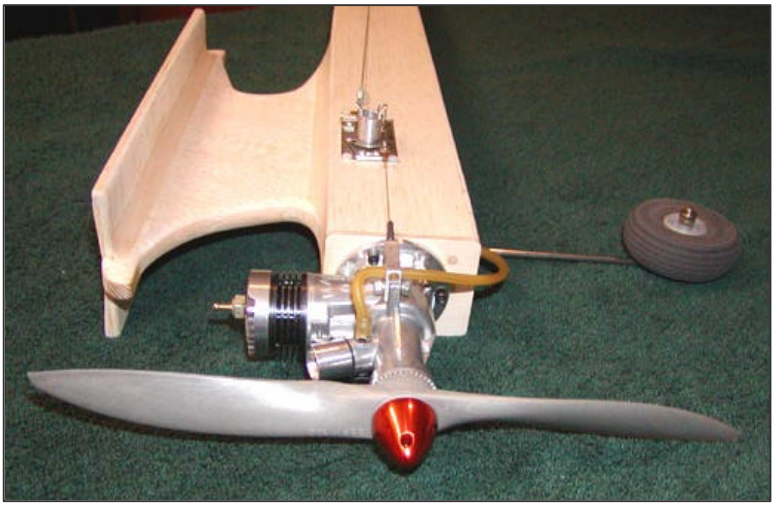
The Design Of A Bladder Fed Pressurized Fuel System For Free Flight

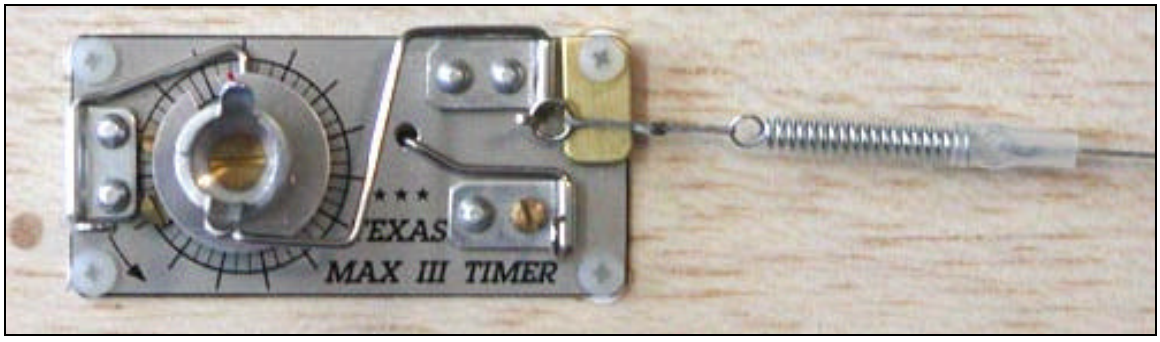


The picture on the right shows the O.S Max .19 installation on the front of the Fubar 57X fuselage. An internally mounted bladder is used for the pressurized fuel system. (Hank sez: note the custom made radial engine mount. Nice touch!)



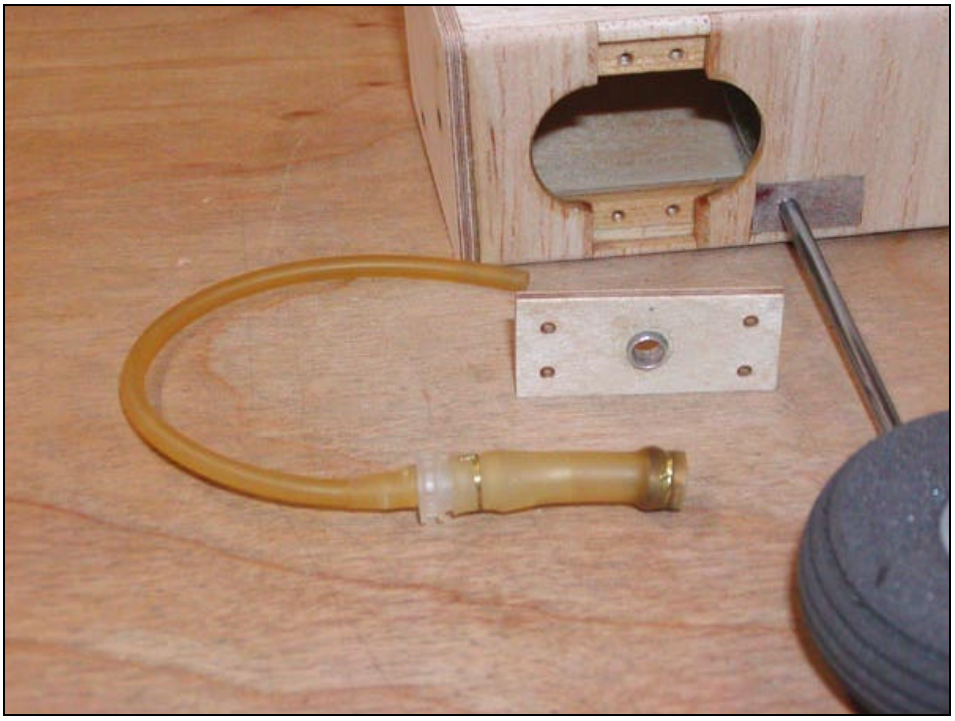
Here is a view from the left side of the fuselage showing the dual function timer (DT and fuel shut off). Notice that fuel shut off is accomplished with what is called a "Remote Pinch Off" (RPO) mounted on the forward beam mounting lug of the engine. The fuel tubing from the bladder runs through the spring loaded RPO on its way to the spray bar.

The picture below shows a close up the dual function timer I use. As can be seen on the mounting plate, it is called a TEXAS MAX III TIMER. Forward is to the left with aft being to the right. The DT line has a spring for tension and a short piece of fuel tubing to cushion the shock of hitting the DT stop when released. (Hank sez: notice how Tandy has placed a small ply shim by the DT post to prevent the split ring from slipping too low or around the bend on the wire. This sort of shim is commonly used)



The fuel shut off function is the forward trip wire on the left. This timer is sold by Hank Nystrom who owns the Texas Timer company. You can call him at (423) 282-6423 and view his web site at http://www.TEXASTIMERS.COM or contact him by e-mail at txtimer@att.net Hank stocks a complete line of timers as well as most of the other free flight items you will need.

The picture below shows the bladder/ fuel line assembly, the fuselage cavity in which the bladder is contained, and the hatch, which positions and constrains the bladder inside the cavity compartment.



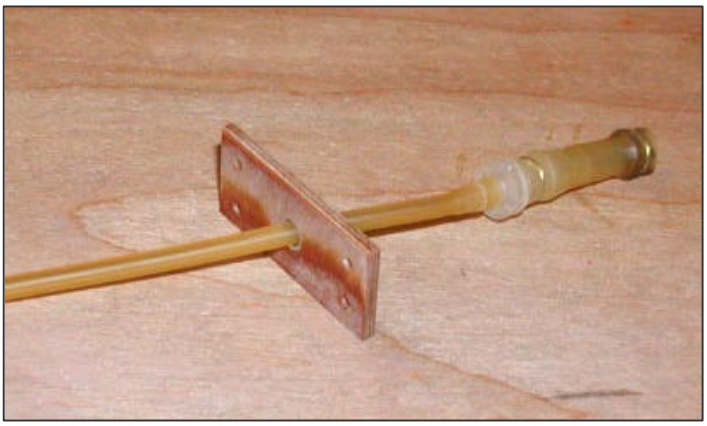
Looking at the bladder/ fuel line assembly, it is made up of four parts: (1) the fuel tubing, (2) the plastic fitting that connects the fuel tubing to the bladder; (3) the larger tubing used for the bladder itself, and (4) the bladder end plug. Now let's discuss these.

(1) The fuel tubing – Hank stocks a very special 1/8" fuel tubing for his RPO that you will want to order from him.

(2) The plastic fitting that connects the fuel tubing to the bladder – Hank stocks these fittings that you will want to order from him.

(3) The larger tubing used for the bladder itself – This is 3/16" I.D. surgical latex tubing with a 1/32" wall thickness stocked by Lee Campbell. Hanks has the same tubing with 1/8" I.D. that works similarly.. The bladder end plug – I make this end plug out of a short piece of K&S 3/16" brass tubing. I seal the opening with a cylindrical piece of flat brass soldered in the end. I solder a ring of copper wire around the opposite end as a shoulder retainer to hold the surgical tubing in place. I put a double loop of fine brass wrapping wire twisted to secure the plug as can be seen in the picture above. Notice I also use this wire to on the other end of the tubing to hold it to the plastic fitting. (Hank sez: Tandy has gone to extra work to make this end plug. Although very neat, a simple knot will work as well. And, some like to put a one way check valve at the end to make it easy to add fuel without having to remove the fuel tubing from the engine. Some prefer to use the more expensive pacifiers)

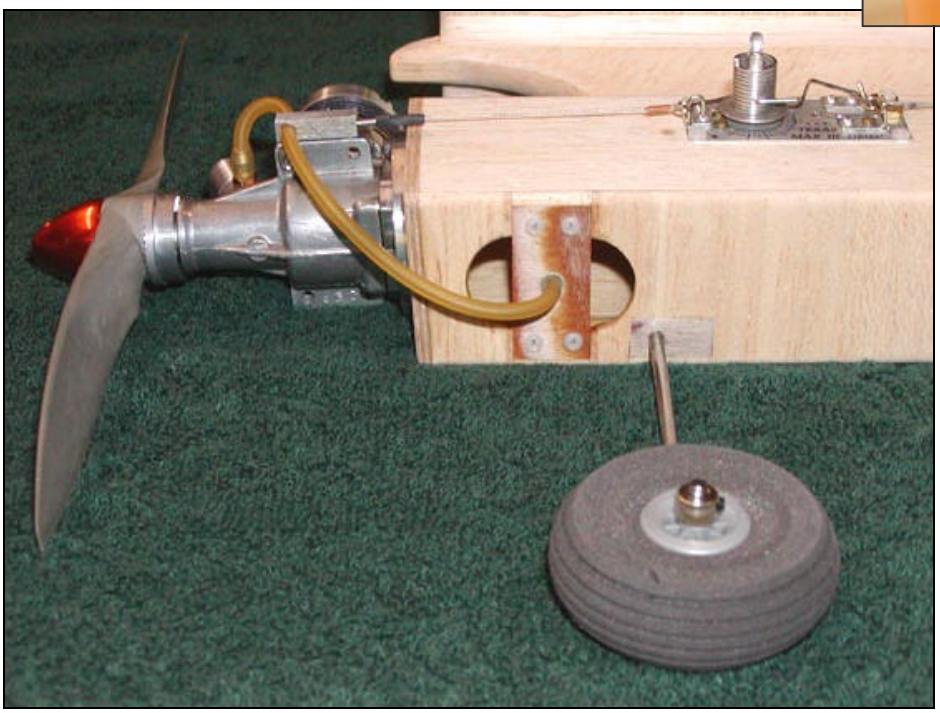
In the picture above, the cavity has been completely sealed with epoxy for fuel proofing. There are two spruce beams, each threaded with 2-56 threads for four nylon screws to hold the countersunk hatch in place. Notice that the hatch has a short piece of aluminum tubing epoxied in the center that extends up about a 1/16" on the inside.

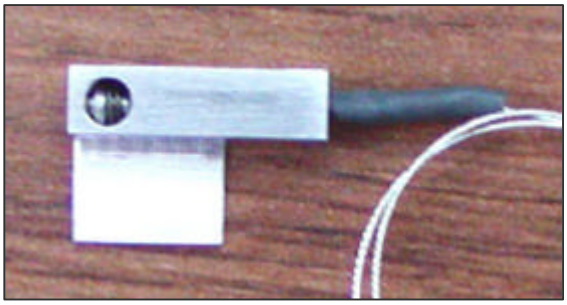


The picture on the left shows the fuel tubing threaded through this aluminum tubing, which is flush with the hatch on the outside.

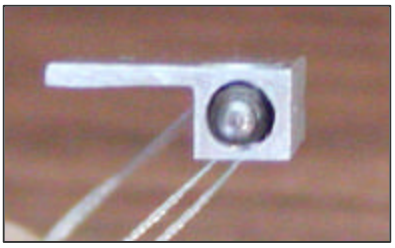
The picture on th
the bladder plastic
down snug against the raised aluminum tube. This shows the vertical p
bladder when it is inside the fuselage compartment. I selected the di
aluminum tube in the hatch such that the fuel tubing would be a snug fit th
bladder in place.

The picture below shows the flush mounted hatch installed over the b
compartment with the four 2-56 nylon screws. The compartment circula
either side of the hatch provide for fuel drainage when the bladder burst.
fuel tubing runs up through the opening in the RPO and then on to the sp
can also see the taunt RPO cable lanyard hooked to the fuel shut off functio

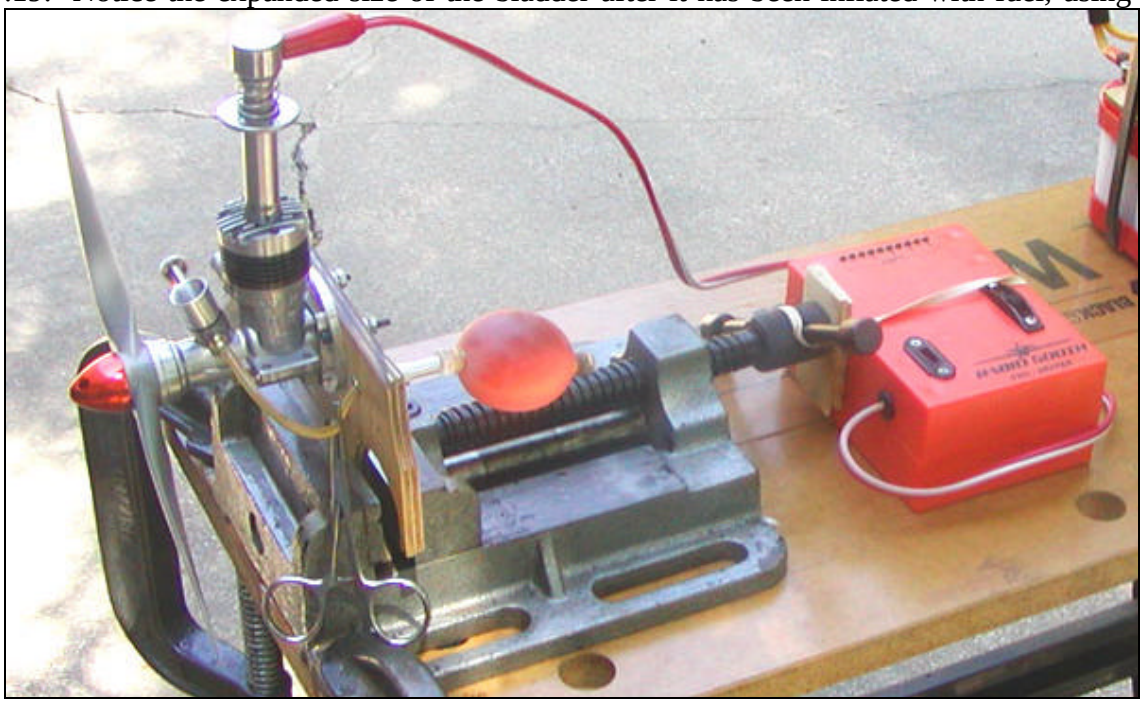




The Remote Pinch Off (RPO), also sold by Texas Timers, is pictured on the right. The aluminum case of the RPO measures 0.71" in length and contains a spring loaded plunger, which can be seen in the forward hole where the fuel tubing goes through. There is a 0.015" braided steel cable attached to the aft end of the spring loaded plunger, which goes to the fuel shut off trip wire on the Max III timer. The picture on the left shows the end view of the RPO. The head of the spring loaded plunger is visible inside the case from this forward end. The machined mounting flange extends off to the left in this view. A hole for mounting has to be drilled in this flange to match the engine lug hole or what ever type of mounting bracket is used.



The picture below shows my bench mounting set up for breaking in the NIB O.S. Max .19. Notice the expanded size of the bladder after it has been inflated with fuel, using a



syringe, and clamped off with a pair of hemostats. There is more fuel in the bladder than required for the engine run in order to maintain pressure. I used this picture to stress the requirement for sizing the fuselage cavity compartment to fit the bladder. First, decide the maximum amount of fuel you will need based on the size of your engine and the required run time, plus a suitable margin for starting and launching. In addition to this, you will need excess fuel remaining in the bladder to maintain fuel pressure through your engine run because if the bladder starts to get too exhausted, the fuel pressure will drop off dramatically. Cut off a trial piece of the surgical tubing and make up a short bladder. Fill the bladder with different amounts of fuel and bench run your engine using the

bladder to be sure it maintains RPM throughout the required run time. You will have to vary the amount of fuel and shorten or lengthen the bladder tubing until you find the right combination for your application. (Hank sez: it really is not necessary to be so precise in the size (length) of the tubing bladder. The bladder expands starting at the fitting and grows as you add more fuel. Any extra amount of tubing used will remain in the original shape. And, you must plan on carrying some extra fuel as you sure to do want to run out on the way up. That is a real bummer!)

Next, make up a fresh bladder of the right length. Make yourself a mock up of the fuselage cavity that will contain the bladder. Using the fuselage width, block off an area with bulkheads. Now insert the bladder inside the mock up and using a syringe, fill it with a volume of air equal to the number of cc's of fuel you determined above. You probably will have to adjust the mock up size to get the right cavity dimensions. Now, plank the open cavity, leaving a hole that just let you insert the bladder into the mock up. Fill your syringe with water this time, and inflate the bladder inside the mock up and prove that you can get all of the water into the bladder inside the mock upped cavity. Once you have done this, you now know the size to build the cavity in the actual fuselage itself. The cavity must be smooth inside with no protruding screws and completely sealed with epoxy to make it fuel proof.

A BIG THANKS TO TANDY FOR PUTTING THIS TOGETHER. IT ANSWERS MANY OF THE QUESTIONS THAT ALL FIRST TIMER BLADDER USERS WILL HAVE. AND, HIS MODELING TECHNIQUES CAN BE AN INSPIRATION FOR US ALL. HANK