

Post-War Aeronca Champ Fuel Shutoff Valves

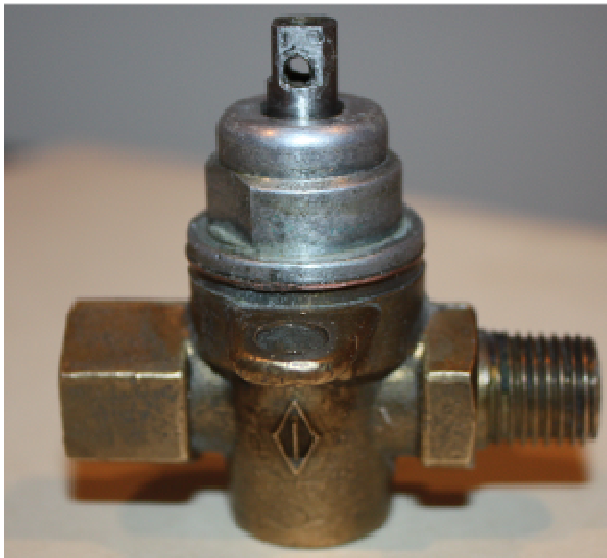
By John Propst with technical overview by Bill Pancake

Abstract: This document provides guidance for the disassembly, inspection, and repair of fuel shutoff valves typically found on 7AC Aeronca Champs.



This is a photo of an earlier model of the fuel valve used in Champs. Aeronca introduced the use of this model valve in the early 40's. This valve has an inlet screen soldered onto the valve body. The valve body has 1/4" male straight pipe threads on the inlet and 9/16"-20 straight female threads on the outlet. The outlet is designed for a special tubing nut and feral. The valve body has "ears" on each side drilled for

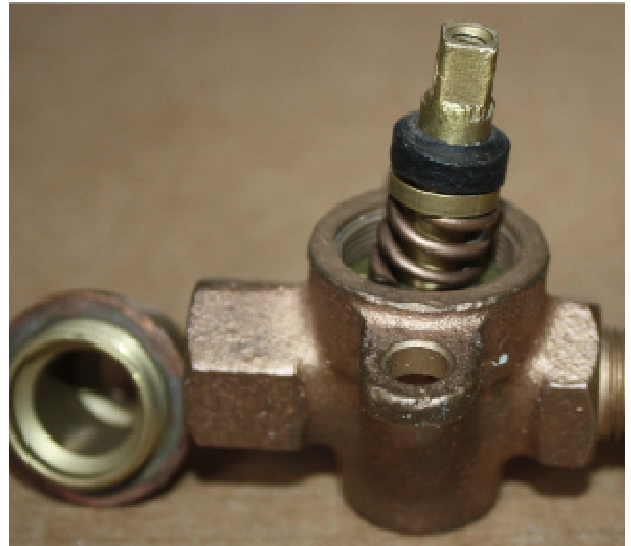
mounting the valve with 1/4" AN4 bolts. The valve bonnet is machined from brass and has two flats machined for removing the bonnet with a 3/4" open-end wrench.



This photo is a later model of the fuel valve. It was introduced by Aeronca and Champion sometime in the mid 50's. There is evidence on the valve shown that the suction screen was un-soldered and removed. Like the older model the valve has the mounting ears on the body and the valve bonnet that can be removed with a 3/4 " open-end wrench. Both valves have a tapered brass plug, a separately machined shaft, and internal keepers for limiting the shaft rotation to the open and closed positions. The primary difference between the two models relates to the method for sealing the shaft. This will be shown on the next page.



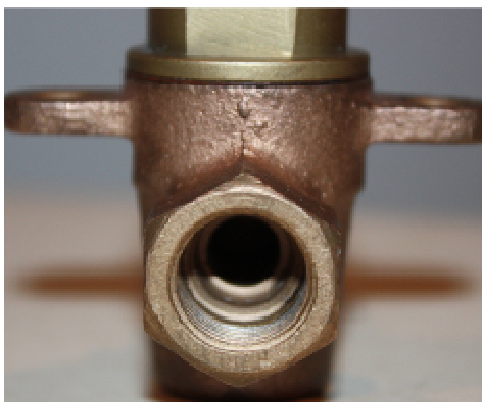
This is a photo of a fuel shutoff valve that was actually removed from a Champ. While it was a tapered plug brass valve somewhat similar to the two valves shown on the previous page, it is NOT an approved valve for use on certified planes such as the Champ or Chief. This was a standard plumbing valve typically sold in the local hardware store. The shaft on this valve was modified with a homemade universal joint to connect to the Champ fuel shutoff linkage.



These two photos show the older model valve with the bonnet removed. The photo on the left shows the tapered plug. Above the plug is a single keeper that limits the shaft rotation to the open and closed positions. A pin is used to attach the valve stem to the tapered valve plug. Above the valve plug is a compression spring. The spring keeps the valve plug tight in the valve body seat and also forces the molded shaft packing up into the valve bonnet to seal the valve shaft. There is a concave washer located between the top of the spring and the valve packing. The right photo shows the inside of the valve bonnet. It is bored larger than the newer style valves to accommodate the packing. The top of the valve bonnet bore is beveled to force the packing against the valve shaft. There is a thin copper washer on the threaded connection between the valve bonnet and valve body.



These two photos show the assembly of the newer model valves. Whereas the older model valve had one thicker keeper for indexing shaft rotation, these newer model valves had two thinner keepers. The pin for attaching the valve shaft to the valve plug is visible on the right photo. The pin extends beyond the shoulder of the valve plug and contacts the keepers to limit shaft rotation. Above the valve plug the newer model valves have a spring for keeping the plug tight against the valve seat. The spring also applies pressure between an o-ring and the valve bonnet. There is a thin brass washer between the top of the spring and the o-ring. In the photo on the left, when the valve was disassembled, the o-ring had become brittle and broke into two pieces. On the right photo note that the valve bonnet is bored considerably smaller than the bonnet on the older model valve and there is a small rounded shoulder at the top of the bore to provide a sealing surface with the o-ring. It should be noted that the valve bonnet and internals shown on the right photo is from a different valve than the valve shown in the left photo.



This photo shows the outlet of the valve with the plug turned to the open position. Bill Pancake told me that when Imperial originally manufactured these valves the bore through the valve body and plug was smaller than shown but that Aeronca increased the valve passage to 5/16". Bill said that sometimes you will come across a valve with a bore smaller than 5/16".

Valve Disassembly.

Disassembly of either style valve is relatively straight forward. While securing the valve body, use a 3/4" open-ended wrench to remove the valve bonnet. Be careful not to damage the thin brass gasket located between the bonnet and body. Also, care should be taken not to nick or damage the tapered plug. Carefully remove either the packing or the o-ring and the rotation keepers. The internal parts can be cleaned with Varsol, alcohol, and or carb cleaner. Keep in mind that alcohol and carb cleaner may damage the packing or o-ring. If the plug is scored, there are suggestions on the NAA website that recommend using toothpaste for lapping the plug and seat. Staining and cosmetic cleanup can be done with 1500 or 2000 grit wet/dry paper and mineral spirits. (fine grit paper is usually available at professional auto paint suppliers.)

The most probable location for a reassembled valve to leak externally is either around the shaft or at the bonnet to body joint. The shaft should be inspected in the area of the packing or o-ring to assure that it is smooth without scratches, pitting, or other imperfections. It should preferably have a near mirror finish in the sealing area. Likewise the valve plug and seat should be smooth without scratches, pitting, or other imperfections. Any damage in this area could result in the valve leaking through when the valve is in the off position. Care should be taken to clean the thin copper washer that goes between the bonnet and body as well as the mating surfaces on the bonnet and body.

Here's a few additional tips that I received from Bill Pancake for reassembling the valve.

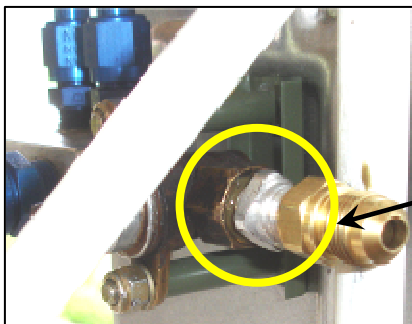
On the valves with packing, there is a concave washer below the packing. If the packing is worn, you may be able to seal the valve stem by installing a 5/16 " ID o-ring between the top of the packing and the bonnet. The o-ring serves two purposes – first it helps fill the gap and extends more pressure on the packing, and second it provides an additional shaft seal at the top of the packing. A liberal amount of fuel lube should be applied to the o-ring and packing.

On the o-ring valves you should install a high quality 5/16" ID o-ring. When reassembling the valve, every part and joint should be lubricated with EZ lube valve lube. Valve lube is impervious to fuel. However, alcohol will dissolve it so be careful to keep alcohol or alcohol based fuels out of the system. Do not use Tight Seal, Permatex, or other types of sealant on the bonnet to body threads. Coat these threads only with valve lube. Bill recommends using Colgate toothpaste with "whitener" to lap a valve if necessary. Bill cautions that any significant lapping may result in the valve plug bottoming out in the valve body and will also result in a misalignment of the bore between the body and the plug. When reassembling or installing a valve, be especially aware that the female outlet hub on the valve is not a standard pipe or tubing thread. The valve inlet has 1/4" standard straight pipe threads. This American Standard Thread form has 18 threads per inch and a major diameter of .5343". At first glance you might think that the outlet is also 1/4" standard pipe threads, but it isn't. The outlet is 9/16" – 20 threads per inch straight threads with a major diameter of .5625". On a new installation you may need to have a custom transition fitting fabricated.



Bill Pancake took the three photos shown above. These photos are of a new valve and outlet nut and feral. The nut has non-standard 9/16 – 20 threads. According to Bill, at one time this nut and feral could be purchased at the local hardware store, but they are now difficult if not impossible to find.

As previously mentioned, a 1/4" pipe fitting will screw into the valve outlet but it will be extremely loose and the 18 thread per inch (TPI) pipe fitting will not match the 20 TPI valve body. Some people have attempted to solve the looseness by filling the gap with multiple layers of Teflon tape. This will only result in a leaking valve and ultimately with the Teflon tape migrating down to the gasolator.



The photos above shows a transition fitting fabricated to convert to a flared copper fitting.

If you are repairing a valve in place, be sure to stuff rags in all the holes and cracks in the floor so that you are not searching for dropped parts under the floorboards.

Repairing a valve in place can be a challenge, especially if your bi-focal glasses don't allow you to look up or your body no longer allows you to fit up under the dash. One added benefit of the fuel lube on the assembly of a valve is that it is really sticky and can help hold the parts in place. When working on a valve in place I found the most difficult task was to install the rotation keepers in the o-ring style valves. The ear on the keeper must be inserted into a small hole in the side of the valve body. I found that a liberal amount of "sticky" fuel lube plus a long small straight bladed screwdriver helped with the task. When assembling the bonnet on the valve, the bonnet may have to be tightened fairly tight to eliminate leaks. After reassembling a valve you should perform a leak test with gasoline. Testing a valve before it is installed in a plane is much easier than solving a leak problem after the valve has been installed.

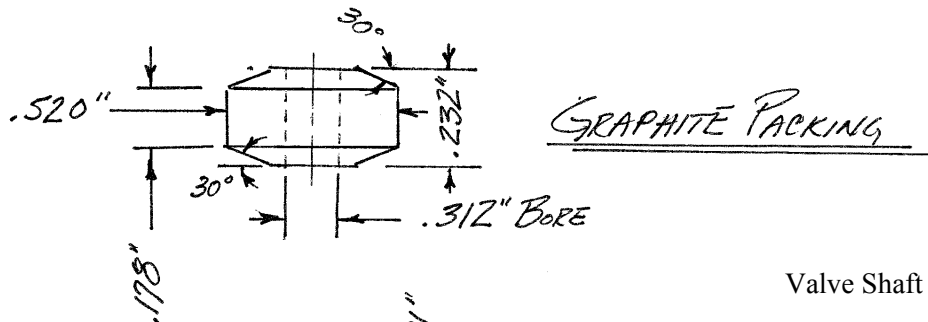
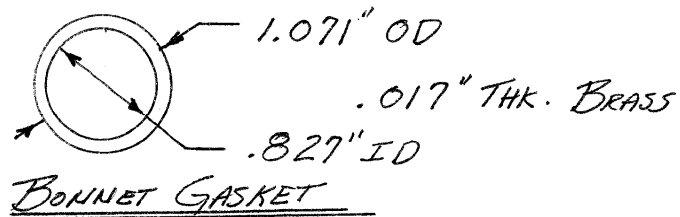
For reference Aeronca Drawing 1-2403 is a drawing of a fuel valve and screen assembly. Aeronca Drawing 1-3417 is a drawing of the fuel valve tank outlet screen. Note that the screen shown on this drawing is fabricated from copper tubing whereas the screen shown in the photos is fabricated from copper mesh screen. Bill Pancake told me that in his entire career working with Aeronca aircraft he has only seen one outlet screen fabricated from tubing as shown on 1-3417. Bill said that the old timers at the Aeronca factory told him that Aeronca received the valves from Imperial, and then reamed the through hole larger and fabricated and installed the screens at the Aeronca factory.

The sketch shown on the next page shows the measured dimensions of various parts of the older style valve shown on page 1 with the shaft packing. This is a "new old stock" valve that has not been in service. Be aware that the design and tolerances of the valve may result in dimensional differences between this valve and your valve.

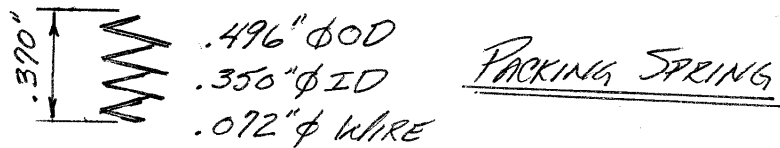
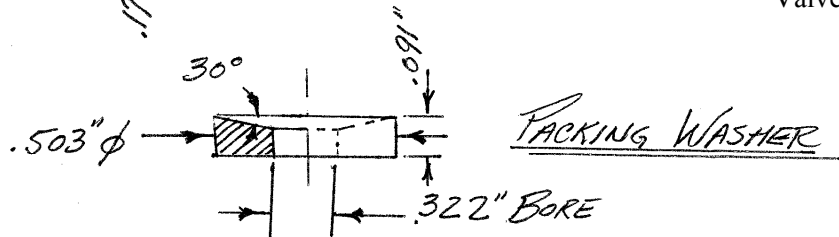
Bill described the following method for creating replacement packing for the older style Aeronca fuel valves.

1. Position the valve bonnet with the threaded end facing up.
2. Place an actual valve shaft or a piece of smooth rod 0.3105" Dia. in the valve.
3. Apply a generous coating of Fuel Lube to the inside of the valve bonnet and shaft.
4. Wrap 1/16" graphite impregnated string packing around the shaft in the bore of the valve bonnet.
5. Place the beveled packing washer on top of the packing with the concaved side down toward the packing. Apply Fuel Lube to the washer.
6. Make a fixture or place an appropriately sized socket wrench socket on top of the packing washer such that the fixture or socket extends beyond the top of the bonnet.
7. Place the assembly in either a manual or hydraulic press and squeeze the string packing between the packing washer and the bonnet until it is compressed into a shape that resembles the graphite packing shown in the photos and on the sketch on the next page. Bill indicated that it takes about 1000 psig on his hydraulic press to achieve good results.

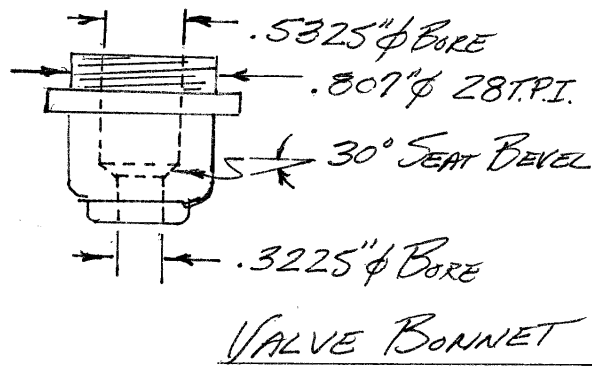
It is important to remember that all inspection, maintenance, alterations, and documentation should be done in accordance with Part 43 of the Federal Aviation Regulations (FAR).



Valve Shaft = 0.3105" Dia.



Spring pitch = 8 turns/inch
 Spring material non-magnetic



Measurements from old style valve with shaft packing as shown on page 2