

Part #53 - Fuel Pump Maintenance

By Mike Stratman



Figure #1 – Mikuni /fuel Pumps are available in three different types. The round pump is available in two configurations with the only difference being the outlet ports as shown at left.

At the risk of stating the obvious, constant and reliable fuel delivery is absolutely essential for engine reliability. Yet often times we take the fuel pumping system for granted figuring if it works OK just leave it alone. The pulse pump while incredibly simple must be maintained properly to assure continued reliability. This month we'll look at pulse activated fuel pumps, how they work, how to set up a new system, how to inspect and rebuild the most common pumps, plus we'll look at how to set-up a reliable low cost redundant fuel delivery system.

How Does A Pulse Pump Work: Whether a single rectangular Mikuni Fuel Pump or the round dual outlet Mikuni type the system works much the same. The bottom end of the engine crankcase is continuously subject to a high/low pressure with every stroke of the piston. This pulse is transferred to the fuel pump by means of a pulse tube. The pulse line connects to the pulse chamber on the fuel pump. The high pressure/low pressure pulse of the crankcase pushes a pair of one-way valves on either side of the chamber and out the outlet port. Real uncomplicated stuff, the essence of simplicity. Yet you have to realize that the system does have limitations as far as expected fuel pressure and the distance up hill the fuel can be expected to rise. A vertical rise of no more than 39" can be accepted out of any pulse pump. Anything higher and count on deliver problems. Another thing to remember is that the pulse pump is always limited to the pressures or pumping value of the crankcase. With a pulse pump it is nearly impossible to create too much pressure for the Carb float level. Also keep in mind that the fuel pressure available will fall off as the crank seals and gaskets being to leak over time.



Figure #2 – The engine pulse port is located next to Carbs. This port accesses the engines lower end where a high/low pressure is created the piston travel.



Figure #3 – When mounting a fuel pump vibration isolation is a prime concern. Here a dual pump is mounted on two #260-657 Rotax Radiator mounts. This also puts the weep hole at the bottom point where it belongs.

Fuel Pump Mounting: Several issues must be addressed when mounting the fuel pump. First of prime concern is the distance from the crankcase pulse port. A line longer than 19" will likely dampen the pulse to a point where the pump efficiency can be greatly reduced. The rule here is to use the shortest practical line. **The pulse line must be rigid enough not to allow the pulse to be dampened by a flexing tube wall.** Fuel pumps should never be mounted directly to the engine where excess vibration may affect fuel flow. Vibration isolators are often used to give the pump a firm yet flexible mount. Mounting the pump higher than the engine pulse port is recommended. This will make it difficult for any fuel from the crankcase to reach the pump chamber. If not possible run the pulse line uphill a short length to form a "trap" for any fuel that might transfer from the crankcase. Remember the two things that are going to kill the pump the quickest is heat and vibration. If the ports on the dual pump do not match your particular set-up remember that the inlet and outlet ports can be rotated in relation to the mounted ears by removing the rack of screws and relocating the top portion of the pump.

Fuel Pump Weep Holes: By direct order from Rotax all aircraft fuel pumps must be equipped with a weep hole in the positions indicated in Figure #4. This microscopic hole is designed to keep the pump pulse chamber from filling with fuel from crankcase and failing. Of course, the hole must be at a low point of the chamber to be completely effective. When purchasing a new pump inspect the pump for this hole. Not all pumps have this modification. In order to get them for a reasonable price we actually drill the 1/64th hole ourselves using a hair size .015" drill. A tedious and time-consuming task.

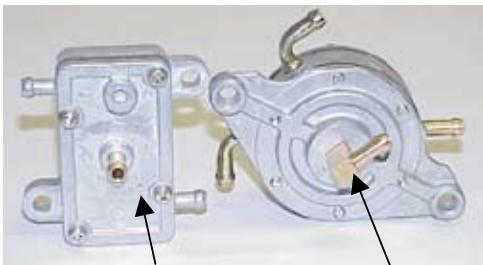


Figure #4 – Weep hole is required by Rotax to relieve any excess fluid that may travel down the pump line. Hair size hole should be located at arrows.



Figure #5 – Shows parts included in single or rectangular pump rebuild kit. Be sure to avoid inferior gasket and diaphragm kits from foreign sources by making sure the parts are genuine Mikuni.

Selecting The Right Pump: The rectangular pump while the simplest should only be used for single Carb applications. The Round or dual pump is internally more sophisticated and will push the larger volumes needed to supply two Carbs. The round pump can be used on a single Carb by routing the two outlet ports back together or plugging a port off. The ports exit a common chamber so how you do it makes little difference.

Inspection and Rebuilding of Fuel Pumps: It is recommended that pumps be inspected at the 150 hour inspection and rebuilt or replaced at the 300 hour overhaul over at least every two years. Over time the gaskets and diaphragms will deteriorate and need to be replaced. Be sure to use only Genuine Mikuni replacement parts. The quality of some foreign gaskets and diaphragms can be inferior and prone to premature failure. The cost of the rebuild kit should be about 50% of the price of a new pump

in most cases, so decide up front if you think your time is worth the difference. Remove the pump from the aircraft and prepare a large area on your workbench where you can lay the removed parts out in the order they are removed. Use a clean towel to keep the parts and hardware from rolling around.

Mikuni Rectangular Pump: Using a Phillips head screwdriver remove the four screws holding the cover on. Pull the pump apart carefully trying not to tear the gasket material. Note the order of the gaskets and clear diaphragm. While you may think they are identical on both ends, they are differently not. Lay these gaskets out in the same direction as you removed them. At this point you need to take a good look at how this unit operates. A flapper or one-way valve on each end separates the center pulse chamber. As the chamber pulses the flapper valves allow fuel to flow in one direction only. Yes, that's right !! A piece of clear plastic the size of a pencil eraser is what keeps you in the air. If this scares you, Good !! Maybe now you can see the value of periodic maintenance. If this kind of simplicity is too much for you to trust you might try the Dual or round pump instead. The valves are a little more sophisticated. More on this in a while. Inspect the area around each valve for wear with a magnifying glass. If the aluminum body is at all deformed replace the entire pump. If this area passes inspection prepare to install the new gaskets. Lay them out next to the old gaskets paying careful attention to the direction top and bottom and end for end. Only one way works. If anything fails to line up when you place the cover back on, stop and see what's wrong. Use the new screws to seal the pump back up. Tighten screws snugly. Test the pump by blowing in the inlet and outlet. Air passes one way only.



Figure #6 – Rectangular pumps use a pair of flapper valves that are nothing more than a ¼" wide flap of clear plastic material to create a one way flow. Insanely simple !!



Figure #7 – The dual pump rebuild kit includes four gaskets, a clear diaphragm, and a pair of disc valves as shown.

Mikuni Dual Round Pump: Prepare a work area as described above. The pump has three separate aluminum sections. Mark them with a felt pen or scribe line so you can reassemble the pump with all ports pointed the same direction as when you started. Remove the rack of six screws and remove the top plate only. Remove the gaskets and lay out in order they are removed. Note that one gasket is a thick paper gasket and one is a thin rubber gasket. Note the indicator tab on both gaskets that line up with the tab on the exterior of the top cover. Remove the center body, diaphragm, and gaskets from the base of the pump body. Again lay them out in the order they were removed. Using a small diameter rod push both rubber keepers out of the valve body and remove the round clear plastic valves. Take a minute to look at these valves and how they function. They are a bit more sophisticated in design than the flapper valves found in the rectangular pumps but still made of the same clear material. Also note that the outlet ports come from a common chamber, so plugging one off or routing them back together for use on a single Carb application makes little difference.

With a magnifying glass inspect the flat area where the valves seat for wear of any kind. Discard pump at the slightest sign of wear. Use a blast of compressed air to clear all passages including the weep hole already mentioned.

Reassemble the valves with the new parts found in your rebuild kit. Make sure the rubber plugs are completely thru the Carb body and firmly seated. Reassemble the layers with all new gaskets and diaphragms. Tighten the six screws snugly and check flow by gently blowing in the inlet port. No air should pass when blowing into outlets.

Electric Fuel Pumps: A lot of operators like the ideal of an electric 12-volt DC fuel pump. Starting is easier because the Carb float bowl can be filled before grinding the starter. Facet makes a compact little solid-state unit that does an excellent job of delivering about 5 psi to the Carb. See figure #8. Unfortunately these pumps are sealed and are not rebuildable.



Figure #8 – The right size 12 volt electric pump can be a wise addition to any fuel system when properly installed.



Figure #9 – A fuel pressure regulator is essential when installing a redundant system. This particular regulator can be dialed from 1 to 5 psi.

Redundant Fuel Pumps: A number of pilots have chosen the time honored system of redundant fuel pumps. There is nothing to say you can't run both impulse and electric pumps on the same system. Way back in Part #41 we stated that a parallel system was the preferred method. Since then I have got a lot of feedback that a redundant system set up in series works every bit as well. The fact of the matter is that either parallel or series system will work fine when setting up a dual pumps. If you go parallel, tee the fuel line out before the pumps and back together immediately after the pumps. Because all pumps (and squeeze bulbs) have check valves for one-way action, a recirculation of fuel is not possible. The electric motor should be fitted with a panel switch to allow the operator to prime the Carb and to shut the pump down when not necessary. If the pressure of this dual system is too great the Carb overflow vents will signal this immediately. **What you are looking for is a fuel pressure from 3 psi to 5 psi at the carburetor.** If the system continues to deliver too much pressure, a pressure regulator is the proper solution. If you choose to go in series, mount the electric as close to the fuel source as possible followed by a fuel pressure regulator and then the pulse pump.

Fuel Pressure Regulators: The Purolator Co. makes an adjustable fuel pressure regulator (CPS # 8511) that can be adjusted from 1 psi to 5 psi. A simple turn of a dial gives you the pressure you want. With a dual system as already outlined, this pressure regulator is not only advisable but may be required.

Fuel Pressure Gauges: A growing trend is starting toward the use of fuel pressure gauges. While this is standard equipment on most GA aircraft, its use on light homebuilts is becoming more common. If a delivery problem is experienced, it will often show as a fading fuel pressure. There are two different types to choose from. Electric units run in the \$250+ range due to the rather expensive and sensitive transducer needed to sample these low pressures. Recently we have been able to find some mechanical type gauges that can be "hard plumbed" into the fuel lines. These units do not need 12 VDC to function and cost less than \$100. Before you jump on the less expensive mechanical type remember that you will have to run fuel into the back of the gauge and fuel in the cockpit can open the door for other potential problems.

Conclusion: A smart operator should keep an extra fuel pump on hand. Many a flying day has been saved by just changing out the pump. With the wider use of oxygenated fuels the chances of methanol or other caustic additives attacking the diaphragm material increase. While the simple pulse pump has been the workhorse of the Ultralight industry for years proper care and inspection will go a long ways to keeping your powerplant running strong and reliable. **END** Source: part 53