

# WET WING FUEL SELECTOR VALVE LEAKAGE

by Eric Lightsey, TTCF Member



It has been my privilege, for the last two years, to fly and manage an excellent 1979 Cessna 414AW based at Concord, NC (KJQF). The airplane has generally been reliable, but a few systems have been problematic due to age of the airframe. This 414A has the standard main tank fuel system. No aux or nacelle tanks are installed. The particular fuel situation described below applies to all the wet wing Twin Cessnas, such as 402C, 414A, and 421C. The tip tank airplanes have a different style of fuel selector valve, which if they leak internally, can cause fuel in the tip (main) tanks to migrate downhill to the aux tanks.

The fuel selector valves in our 414A were suspected to be leaking internally. This resulted in an un-commanded fuel cross feed, where both engines were using fuel from the left wing tank, while the fuel selectors were pointing to their respective main tanks.

Here's the operating scenario. Both electric fuel boost pumps were set in the low position before engine start. These pumps would stay on low until just prior to engine shut down. My SimCom instructor informed me that many pilots just leave the pumps on low for the entire time the engines were running. It is possible that this technique may have unintended consequences if the fuel selector valves are between selections (detents) or leaking internally. Specifically, it may contribute to the creation of an un-commanded fuel crossfeed situation in the opposite crossfeed line.

In my situation, fresh cylinders and some baffle sealing issues required

that the left engine be set slightly richer for CHT cooling. This results in more fuel being burned out of the left wing versus the right wing and resulting in the need to crossfeed.

To balance the fuel in the wings in flight, the left fuel selector handle would be moved from left main to right main. This action produced the desired result of the right wing quantity reducing, while the left wing stayed about the same. When both wing quantities were equal, the left fuel selector handle would be moved back to the left main. Both fuel boost pumps remained on for the entire time.

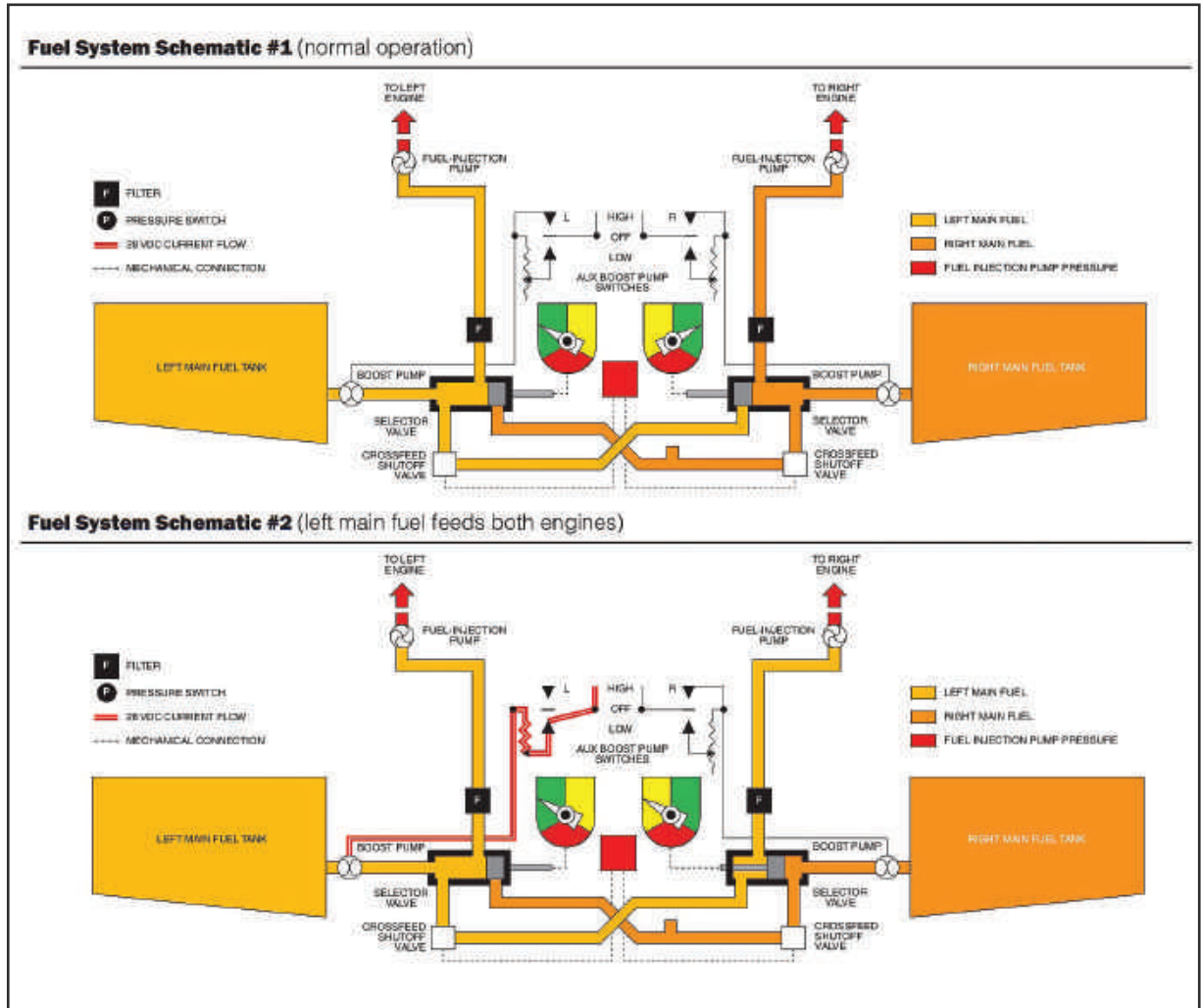
It is understood that during fuel cross feed, the boost pump for the tank supplying the fuel must be on. Fuel flow from the left boost pump (side not supplying fuel) goes through the



This article addresses the wet wing fuel system found in certain cabin class Twin Cessnas like the 414A I fly, pictured here.

other cross feed line and is supposed to dead end at the right fuel sector valve. The left boost pump could have been turned off, but due to the recommended standard operating procedure of leaving the pumps on low whenever the engines are running, I left it on.

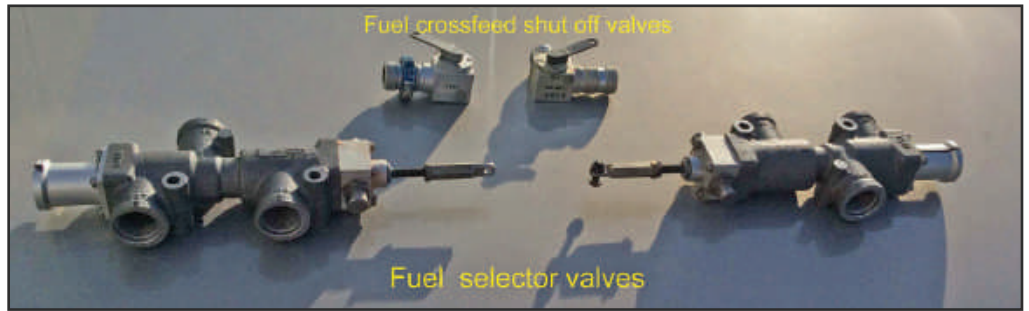
Next is where the problem rears its *(continued on page 16)*



Fuel system graphic courtesy of SIMCOM. Top panel shows system in normal operation. Bottom panel shows right engine cross feeding off the left tank.

ugly head. Upon switching the left fuel selector to point back to left main, the left main fuel quantity gauge would start to decrease rapidly. The right main fuel quantity would increase slightly because the unused fuel from the right engine is returned to the right main. I first thought that the cause of the left main quantity decreasing was a fuel leak, but no evidence of a fuel leak was ever found. Later, it was theorized that this was an indication problem, so the fuel quantity signal conditioner boxes were swapped left and right with no effect. With the indicated fuel quantity decreasing, the left fuel low warning light would eventually illuminate. The fuel low warning light is a totally separate system, so it confirmed that the fuel quantity gauges were telling the truth and the left fuel quantity really was getting low.

During one particular flight, crossfeed selection was terminated, and the left fuel selector handle was returned to left main position when fuel quantities were

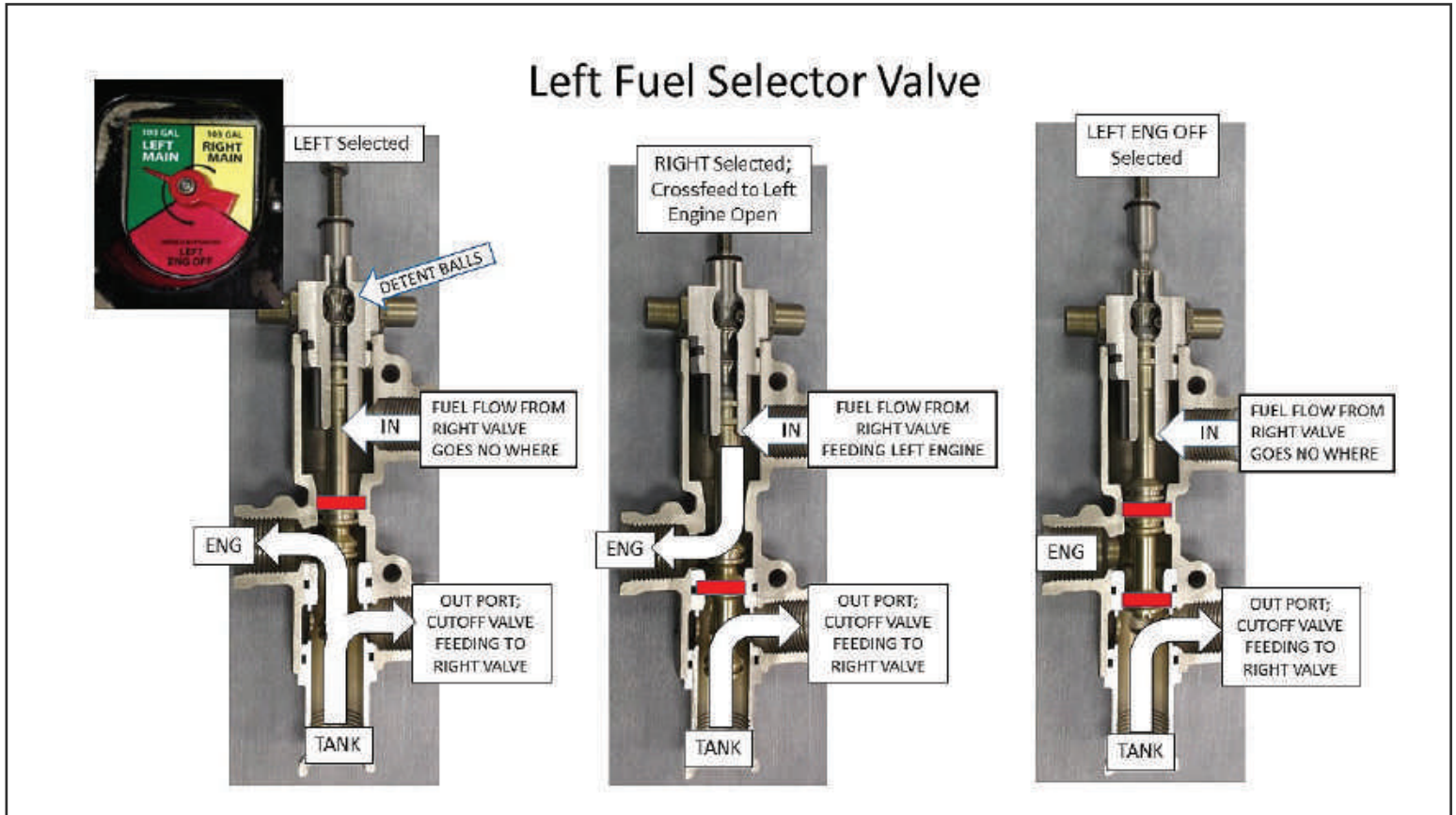


*This is what the valves look like when removed. Check your logbooks to see when yours were last overhauled. Can you feel a well-defined detent?*

matched at around 300 lbs. each. After landing, the left main quantity indicated 80 lbs. and the right main quantity indicated 400 lbs. Note that the right main quantity increased because unused fuel from the right engine fuel injection system was correctly being returned to the right main. Adding the two amounts together (80 + 400) agreed with the flight plan estimate (for this particular flight) of total fuel onboard after landing of 480 lbs. The next day, both tanks indicated 240 lbs. each. It was obvious that the fuel levels were equalizing overnight

through the cross feed lines and fuel selector valves.

I learned this problem was not unique to our airplane. There was a related incident (NTSB Identification: ERA09IA140) in 2009, when a Cape Air 402C experienced fuel starvation on both engines then successfully performed a night dead stick landing at Naples, Florida with both props feathered! This appears to have been caused by a similar un-commanded crossfeed situation that can be created



*These pictures illustrate how fuel flows through the left fuel selector valve in various tank selection scenarios. The potential problem with the left valve pictured would be that if the piston did not move all of the way toward left main, fuel from the right valve that was supposed to “go nowhere” can cross the red line pictured and unintentionally feed the left engine. If the external mechanism is not lubricated, the detent balls may not be felt and the pilot will not be able to position the piston correctly. Even if the piston is positioned correctly, that won't stop the wrong flow if the internal seals leak.*

when returning to a tank to engine configuration if a fuel selector valve does not completely move, or it is leaking internally.

In reading the NTSB account, inadequate lubrication of the actuating mechanism at the fuel selector valve end resulted in the left fuel selector valve internal piston being mis-positioned somewhere between left main and right main, even though the handle pointed at left main. In this condition, with the left fuel selector handle pointed at left main, and with the left engine set at cruise power, the left engine could be made to quit if the fuel cross feed shut off valves were moved to shut off, proving that the left engine was being fed from the right main. Cape Air subsequently replaced the left fuel selector valve and actuating cable on this particular 402C.

A search of the FAA Service Difficulty reports for the valve part number 9910201-1 (you must leave out the dash) produced 3 results:

7/25/2016; C-402C; N660CA (Cape Air); "PILOT REPORTED ENGINE FAILURE WHEN LEANING

MIXTURE. RESTARTED WITH RIGHT FUEL PUMP ON. MAINTENANCE TROUBLESHOT THE RIGHT FUEL SELECTOR VALVE. REPLACED FUEL SELECTOR VALVE"

1/29/2009; C-402C; N2615G; (Cape Air); "LEFT AND RIGHT ENGINES LOST POWER, LANDED WITHOUT INCIDENT. AIRCRAFT WAS INSPECTED AND IT WAS FOUND THE LEFT FUEL SELECTOR VALVE WAS STICKING. SELECTOR WAS LUBED AND EXERCISED OPERATIONAL CHECK GOOD. AIRCRAFT WAS RELEASED." (This was the same event as described in the NTSB report).

3/26/2000; C-414A; N4686N; "FUEL SELECTION WAS MOVED FROM LEFT ENGINE TO CROSS-FEED. AFTER FLIGHT, THE FUEL SELECTOR WAS MOVED FROM CROSS-FEED BACK TO LEFT ENGINE. FUEL SELECTION WOULD NOT MOVE. IT WAS DISCOVERED THE FUEL SHUT-OFF VALVE HAD FAILED INTERNALLY AND WAS STUCK IN THIS POSITION. VALVE REPLACED."

Back to my 414A. Prior to overhaul of the fuel selector valves, the left fuel selector handle was spongy when moved to left main. A definite detent could not be felt. The external actuating mechanism for both fuel selector valves was lubricated which resulted in some improvement of the subjective detent feel.

No logbook entry for the left fuel selector valve was found, so it likely had the same time in service as the airframe, approximately 7,000 hours. The right fuel selector valve had been overhauled in 2004.

Both fuel selector valves (9910201-1) were sent for overhaul by Aircraft Accessories International in Peachtree City, GA. Richard Hewitt overhauled them and advised that the internal pistons were extremely difficult to move from one position to another upon arrival. Over 22 pounds of force was required to break detent when they came in, but after overhaul, they would break detent at less than 15 pounds. Cost to overhaul was \$375 each. All of

*(continued on page 18)*

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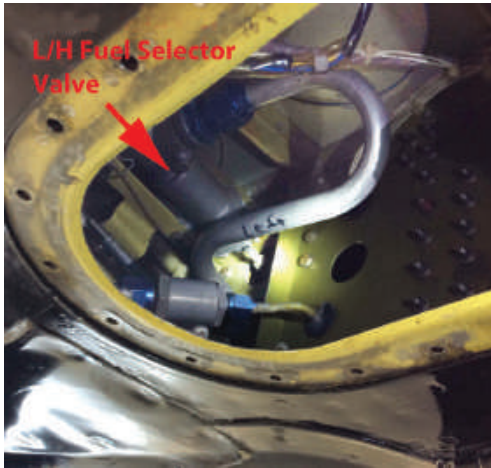
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Location of left hand fuel selector valve.

the o-rings required to re-install the valves were included. This is a fantastic price and they were turned around in one day! The fuel selector diagram is courtesy of Richard Hewitt at Aircraft Accessories International.

After re-installation, both fuel selector valves now had a definite detent that could be felt when repositioning the handle.

Both fuel crossfeed shutoff valves (9910201-3 LH, and 9910201-2 RH) were also overhauled. After reinstalling the fuel cross feed shut off valves, the local shop found an issue with the cable rigging to the RH fuel cross feed shut off valve. When the red lever was pulled up from the floor, both cables were simultaneously pushed, and the RH cable wanted to kink. It was thought that the RH actuating cable might require replacement. Doing that would be a huge labor bill to take the plane apart and the cable would not be cheap either. It was suggested to straighten and lubricate the cable. Changing to a new cable would only be a last resort.

Further investigation led to the discovery that the RH cable housing was not secured from being pushed with the internal cable. The green cable housing was incorrectly moving with the red lever because the lower phenolic bracket 5156019-1 was cracked. A serviceable bracket was purchased from Preferred Airparts in Kidron, OH. Everything tests fine now.

In the process, the fuel selector decals got damaged. The original part numbers: (5115259-9 LH

and 5115259-8 RH) were no longer available. New reproduction fuel selector decals (priced at \$50) were ordered from:

Bill Burger  
325 Menlo Park, CA 94025  
[bill\\_burger@yahoo.com](mailto:bill_burger@yahoo.com)  
(see his ad in the Classified Section)

The button in the top of the fuel selector handles has a tiny retaining clip that was hard to find. Grainger had them as Retaining ring, Ext, Dia. 3/16 In. item 5DV43; Mfr. model #SH-18ST PA.

In conclusion: The fuel selector valves should have a positive detent that can be clearly felt, and require periodic lubrication of the actuating cable mechanism is also a must. Fuel selector valves which are worn internally may allow fuel to be directed where fuel is not supposed to go. A worn fuel selector valve assembly can stop its travel somewhere between main tank and cross feed. This can cause an un-commanded fuel cross feed situation which eventually will run one main tank dry. If a pilot cross feeds to equalize the fuel load in flight, the pilot should continue to closely monitor the fuel levels after returning the fuel selector handle to main tank.

Editor's Note: I always run technical articles by Tony for editing and comment. He often has extensive edits to

member submitted articles but this time his comments were few - a tribute to the thoroughness of Eric's research.

*Eric, great article. We see this problem in the wet wing Twin Cessnas from time to time but it is not particularly common. I would note that:*

- *This is in the wet wing aircraft and the fuel selector valves and cross feed shut offs are much different those in aircraft with tip tanks.*
- *The cost for your repair and overhaul is on the extreme lower end, based on our experience. To have that kind of cost would require absolutely no corrosion or damage being found on any of the part (only o-ring replacement and a clean up.)*
- *The operation of the auxiliary pump on low 100% of the time is still an important SOP even though in this case it did exacerbate a problem. Use of the aux pump should not be abandoned because its use alleviates the much more prevalent problem of fuel interruptions.*



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