TIPS – Chapter Three
Fuel System

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FUEL CELL COVER DOOR FASTENERS

A small problem with my Comanche that has irritated me for a while was quickly solved the other day, so I thought I would pass it on to the other members.

That little wing top dzus fastener on the fuel covers will occasionally get stepped on by an un-observant passenger and get bent or broken. A Piper Parts Distributor suggested I replace them with Cherokee Six Cowling Fasteners which are round and flat, a little larger than a quarter.

Now, when they are stepped on they just pop back up unharmed. The washer holds them securely so that fuelers cannot remove them.

WIN SERVO VALVE TORN DIAPHRAGM

We have a 1969 Turbo Twin Comanche which has a factory new engine with 250 hours and new turbos with about 200 hours. On a recent flight we couldn't shut down the right hand engine, the only way in the end was to select the fuel selector to off. After one FBO supposedly cured the problem the right engine quit during an instrument approach. The problem turned out to be a torn diaphragm on the servo valve.

FUEL CELL CAP REPAIRS

The sight of fuel running off the wing while in flight is distressing at any time, but particularly so with the new high prices of fuel. I found my fuel cell caps run out of adjustment so I took them apart for repair.

What happens is that the dog ears on the cap lock wear down and the slack can not be taken up by tightening up the cap lock any further. So I inserted a brass washer under the cap lock, which made it possible to loosen the lock a little and still have the cap tight.

This does raise the position of the cap lock on the cap and you may have to file the cap down a little when locked to clear the fuel cell cover.

The adjustment on old caps may be corroded and difficult to unscrew, but the cap can be taken apart with tools if necessary. If this proves impossible, cut the rivet holding the cap lock and reassemble with a small bolt.

FUEL ODOR

A suggestion on gas fumes problem: "Check underside of wing for evidence of fuel cell leakage. Also, could be sign of leaking diaphragm in injector servo. There are important bulletins on Bendix injector units in our Comanches. Check Bendix service letters and bulletins."

FUEL FLOW SURGE

In your October 1974 issue, you published a letter from me complaining of a problem I was having with my '260C Comanche, in that in normal cruise the fuel flow indicator would slowly pulsate from 12 1/2 to 14 gallons per hour and as the fuel flow indicator rose the EGT would show a corresponding drop of 50 or so, and as the fuel flow indicator dropped to 12 1/2 gallons per hour, the EGT would rise to its normal reading. So by this cross-check I knew something

was not exactly normal.

I never did hear from any members as to the cause or cure of this condition. However, last month I noticed that my fuel sump had a tiny leak in it and after draining my fuel tanks it would really not completely shut off, so I had it changed. Since that time my fuel flow and EGT have behaved normally. I mentioned this problem to the mechanic who changed the sump and he felt that there could be an interrelation between a slightly leaking fuel sump drain, bubbles in the fuel lines causing a variation in the fuel flow. I am not a mechanic so can't say for sure, but I am a lot happier now that things look normal.

FUEL FLOW SURGE

I have a 1967 Comanche 260B with less than 200 hours on the factory re-manufactured engine, a new electric fuel pump, and all gas lines have been checked for air leaks. Shortly after installation of the new engine, I obtained erratic fuel flow indications in both the lean and rich directions which caused substantial engine missing which could be overcome by the electric fuel pump. The fuel system was checked for air leaks and thereafter the fuel flow fluctuation to the lean side stopped and I have had no more engine mist.

At the present time at altitude I occasionally will receive erratic fuel flow indications to the rich side with as much as one to two gallons of flow per hour with corresponding changes in the EGT. Sometimes the fuel flow remains constant for two or three hours, then will become erratic for a short period of time, sometimes for as long as an hour or two when the needle is in constant motion from a lean setting, rich, and back to the lean setting. There is no indication of missing in the engine performance.

One thing that can cause erratic fuel flow indication is a little dirt in an injector nozzle. This will decrease the actual amount of fuel flowing into the engine, but the fuel flow meter will show an increased flow. This is because the meter senses pressure, and the pressure in the system will be increased by the dirt in the nozzle.

Another source of such difficulty is vapor locking in the fuel pump. I remember a 1970 Comanche C on which we had to install 3 different pumps before the trouble cleared up. Neither the engine driven pump nor the electric pump will pump vapor. If there is a bubble, the pump usually just beats it around. Sometimes with both pumps on, the vapor can be pushed on through. This is why using the electric pump will sometimes help the problem.

I have also seen injection lines that were lined with some sort of scaly corrosion. A small piece of this breaking loose can cause trouble if it lodges in the flow divider, the nozzles or the gas lines. In that case, the trouble was cured by replacing the lines with new ones.

FUEL ODOR

Q. For several years, I have detected a gasoline smell in N7611P. I spent over $500 on a fruitless search for the source and was assured that nothing was leaking and it was probably normal. I usually keep the fuel tanks (90 gallons) full to the absolute top. After having used fuel out of all tanks down to about halfway, I noticed the next morning that the ever present fuel odor was missing. However, after takeoff and steep climb, it comes back again. Is it possible that fuel is leaking from around the top of the filler neck?

A. Yes, this is possible. Or, it may be that the tanks have gotten porous along the top. When a

Comanche sits in the sun, even with full tanks, there is no fuel touching the upper surface of the bladder, and in time it will develop small pinholes over that upper surface.

You might change the gaskets to the access holes to the tanks, and if that doesn't eliminate the problem you can be pretty sure that you have a porous tank.

From Director of Products and Services: General Aviation Inspection Aids lists for a PA24-250 having Fuel Cell, PIN's 20355-00 and -01 the following;
The causes for a complaint about fuel stains and fumes in both wings was traced to leaking fuel cells. Both tanks were found to have porous areas. Total time in service - 1,800 hours.

TWIN FUEL CAPS

Just a warning with winter coming on, you need to check these caps. The proper cap for the auxiliary tank is Piper Part Number 27221 -00. Caution on this as the cap has been changed but not the Part Number. The approximate length of the old-style cap with the rubber part un-compressed is 1 3/8", and the new one is 1 7/8". When getting a new cap, be sure it is the longer one. Ask for the "Long-Reach Cap."

The threaded area and hinge parts should be lubricated with a small amount of fuel lube so that adjustments can be made easily as the cap must have a snug fit in the tank filler neck to compensate for the vent line built into the inside radius. If your aircraft has the old style caps, I would strongly recommend removing the top of the tank and sponging out the water from the bottom of the tank. This cannot be drained out through the sump. With regard to the other caps, keep them properly lubricated with fuel lube and properly adjusted. Be sure that the gasket under the hinged cap which closes over the fuel cap is in good condition and fits tightly to the wing skin. This will prevent water from leaking into the filler neck-cap area.

Piper Periodic Inspection Report (page 30) states: Remove, drain and clean fuel filter bowl and screen at least every 90 days.

REMEMBER! All Comanche gas caps are non-vented. An Aztec cap, which is vented, looks like a Comanche cap and will fit a Comanche. The vented cap permits moisture and water to get into the auxiliary tanks on a PA30-39; especially if the gasket under the hinged cap, which covers the fuel cap, is missing or in poor condition.

A phone call to the man who purchased 7184Y has determined that both auxiliary tanks had Aztec caps installed.

ED: We had constant water in the auxiliary tanks of 8239Y until we installed the long- reach caps (done in 1969). At that time, we drained and sponged out all liquids. To date (8 years later), we have not recovered any water from our annual "Spongout" of the auxiliary tanks.

HISTORY OF COMANCHE FUEL CAPS

During the evolution of the Comanche series, three different types of fuel caps were used. The following is a brief explanation of them in the sequence in which they were used.

1. Fuel Tank Cap, Part Number 25983. This was known as the automotive type cap and was used on the very early PA-24 and PA-250 Comanche aircraft, serial number 24-1 to 24-580 inclusive. It should be noted that Service Letter 516, dated March 7, 1969, advises that

when you elect to install the fuel cell vent system modification, you will no longer use the automotive cap. - but rather switch to the thermos type. See the end of this article for information on the service letter.

2. Fuel Cell Cap Assembly, Part Number 21821. This cap followed the automotive type cap assembly and was in use on Comanche models, serial number 24-581 and up, and Twin Comanche aircraft. Note that the fuel caps on Comanche models and the Twin Comanche models are identical.

3. Fuel Cap Assembly, Part Number 27221. This is the current cap assembly and has for a number of years replaced fuel cap assembly 21821. Therefore, anyone ordering the 21821 - 00 cap will automatically receive the 27221 cap. The cap looks like this:

   This cap is longer than its predecessor and it has a slightly greater ridge of rubber just underneath the cap; both modifications are designed to provide better sealing. This cap is used on all Comanche models, serial number 24-581 and up, including the 400 and Twin Comanche models in both the main and auxiliary tank positions. The Britain Tip tank uses a different cap than any of the above.

A most important point to recognize is that all three caps detailed above are NON-VENTED. A Comanche uses nonvented caps.

PIPER Service Letter 516 discusses a Fuel Cell Vent System modification. It applies to all PA-24 and PA24-250 Comanches; serial numbers 24-1 to 24-3529 inclusive. Its purpose is to provide the necessary instructions to perform the installation of an improved fuel cell venting system incorporating recessed NACA type anti-icing fuel cell vents which will minimize the possibility of fuel cell vent restriction which could cause fuel cell collapse. This recessed vent is on the underside of the wing.

It also includes installation of 1/2 inch forward facing fuel main tubes to minimize difficulties that could occur as a result of loose fuel tank caps; and sealing material is provided to preclude the entrance of water into the fuel quantity gauge sender recess.

Installation of the applicable kit will preclude further compliance with FAA AD 68-13-3, and PIPER Service Bulletins No.. 216 and 231A. However, PIPER Service Letter No. 367 shall remain in effect.

Affected aircraft, with only main tanks installed will require only Kit No. 760-277; with auxiliary tanks installed, both Kit No. 760-277 (Main Tank Modification) and Kit No. 760-281 (auxiliary tank modification) will be required.

Note: Serial Numbers 24-1 to 24-580 inclusive must order, in addition to modification Kit Number 760-227, "thermos type" fuel tank caps, PIPER Part Number 27221 because it isn't included in the kit.

Compliance with this Service letter will preclude any future action with regards PIPER Service Bulletin Number 180 and 193.

Check your Comanche during the next preflight and make certain that it is "up to date."

GREMLIN IN THE FUEL TANK

The engine of a newly purchased, 1960 210 blew up in my face. The decapitated propeller cut off part of the right wing while the cowl hung up on the right wing / strut juncture, causing an almost uncontrollable descent. The oil covered windshield blocked my view forward but the forgiving ocean cradled my crash landing. I swam to shore and watched my life savings in airplanes slip below the surface.

It took nine months to find another affordable airplane that turned out to be a tired old 1959 '250 Comanche parked on the field which was pumping oil after only about 500 hours on a new overhaul. One expensive top overhaul later showed that the oil rings had lost their temper from excessive heat which the A&P thought, could only be caused by someone flying the plane with air intake plugs installed (also known as bird bungs) or from excessive ground running probably during break-in.

Now I was ready to break in a new engine in a strange airplane and, after what I had been through, I was nervous to say the least. The instructions for flying on new chrome jugs suggested takeoff light and cool so I had only the main tanks filled to the bottom of the filler flanges (50 gallons) and took off early one morning with my eyes glued on the head temp. gauge. After an hour of flying wide open for three minutes every seven minutes at full rich I landed to check things out. With only one quart of oil burned off, I took off again for another hour. I figured that even at 20 gallons per hour, I had at least two and 1/2 hours of flying. I never trust a fuel gauge, but I was puzzled as to why the right tank appeared to be going dry while the left remained half full.

After about 40 minutes of the second hour, I had just nosed down to start a descent over the airport from 10,000 feet, trying not to cool the engine too rapidly when it quit dead. Oh no - my new cylinders, I thought, now what did I do wrong? The fuel pressure was zero and pumping the throttle and turning on the electric fuel pumps made no difference. There was no use in switching tanks since I was already on both mains and the auxiliaries were empty.

The Britain type tip tank auxiliaries had dual selectors which allowed both mains to be on at once feeding to a central sump or any combinations of the four tanks and off.

After my last harrowing experience, this emergency was a piece of cake. I almost routinely told the tower of my situation with a slight note of disgust for, after all, this was getting old. It took the lightweight Comanche so long to descend from 10,000 feet that they called me several times to ask how I was doing. Finally, at 5,000 feet, I put the gear down to speed things up and hold up other airport traffic. Now the engine was running again, but when the throttle was opened, it would still stop dead. After landing, naturally, it ran fine and I taxied to my tie-down area feeling like a fool. I should have at least made the landing look a little hairy for the benefit of the firemen.

Once the plane was on the ground, the fuel pressure was normal and the engine ran fine at all power settings. The fuel flowed well from the gasolator drain. The right gauge still showed empty and left half full. A visual check of the tanks showed that, indeed, the right dry but the left appeared to be only about 1/4 full, but it was difficult to tell in the bright sun. Next I disconnected the line from the carburetor and checked the fuel flow with the electrics on. Just like a garden hose. Following the advice from my A&P mechanic, I inserted an inspection mirror down inside the filler opening after dark, being careful not to get the flashlight inside the tank and checked the finger strainers. They both appeared clear and clean, but I did notice a wrinkle in the bottom of the rubber bladder of both tanks. By this time, the fuel had equalized across the tanks and each were about 1/8 full. However, the wrinkle in the left tank was holding up the fuel sender float so that the gauge read half full. Blowing through the fuel tank vents showed no restrictions

there.

The clues to the problem were all there but no one I talked to was able to put them together. Can you? The answer was so simple.

After having all the tanks filled half full (still breaking in the engine), I took off again with the selectors still on both mains and then switched to the left main only. After about 5 minutes, the pressure gauge started fluctuating wildly and went almost to zero pressure but the engine kept running. When I switched to another tank, the pressure immediately came up to normal. A little more experimentation showed the fluctuating pressure came with only the left main selector on. Skidding and slipping the plane made no difference, but at least the engine kept running. By this time, I was fit to be tied. I landed and did not fly again for two weeks while picking the brains of everyone in sight but the only advice I got was to have a new fuel pump installed which I did. It just seemed like some sort of left fuel flow blockage to me but it flowed fine on the ground.

The answer came suddenly. I had just taken off again with all tanks full when I happened to look out at the left wing and saw fuel pouring out from under the left filler cap and streaming back off of the flap. After landing, an inspection of the fuel tank cap showed the thermos type cap's expanding cam pin had sheared on one side and bound in a way that the cap felt tight while, in fact, it was loose enough to allow fuel to be siphoned around it as well as up through the center of the cap itself.

The low pressure over the wing had first tried to collapse the flexible fuel bladder and then, after about 5 minutes, would cause the fuel pressure gauge reading to drop but enough fuel still got through to keep the engine running. With another tank switched into the sump was another story. The fuel would flow to the engine from that tank but when it went dry, air was drawn across to the left tank blocking the flow of gas from the left tank to the sump. As the plane slowed down (and the pressure on the wing lessened) it appeared enough fuel got through to idle the engine. Of course, when the plane landed and the pressure disappeared off the wing, then the fuel flowed normally. The low pressure had also caused wrinkles to appear in the bottom of the bladder and buoyed up the fuel sender float giving a false fuel quantity reading. The wrinkles disappeared when the tank was filled and, since the cap was fixed, have never reappeared.

The Comanche has given me no other troubles and I think it is a great plane. I just recently flew a trip, side by side, with a new Lance. We were both slightly loaded, but I had to throttle back to stay with him.

FUEL SELECTOR VALVE

Q. Problem: Fuel selector valve - Our PA24-250 (1960 edition - TT 2,015) has, over the past 6 years required either disassembly and lubrication of the valve (or replacement needed or not, 3 times) about every 6 months. Otherwise, it becomes so tight to move in the 'dog dish' as to resist changing valves except with a pipe wrench. All work has been done at approved shops, including Lock Haven Airmotive (her birthplace). Is there a fix? I have been told all Comanches have this problem, so live with it. It's not all that humorous over hostile terrain. Would appreciate any help from ICS that is available.

A. We assume that your 250 dues not have auxiliary tanks and therefore has the three position fuel selector valve. All Comanches do not and should not have this problem. You don't have to live with it. Your valve is cone shaped and spring loaded. PIPER says take it out every 400 hrs. or if it binds, and lubricate it. John Dean does it at every annual. It is a simple job. Remove the

fuel select or handle. The cover, or 'dog dish' is held in place with a few screws. Take it off and remove the nut from the valve stem. Remove the cone shaped valve. Wipe it clean of any old lubricant. Clean the seat, removing any old lubricant that may be in the openings. Now - coat the cone lightly with a solvent resistant grease having MIL - G-6032 lubricant specification. This is sometimes called fuel lube. It is very important to use a lubricant which is "Not soluble" in fuel for you defeat the purpose of the lubrication, it just washes away. Insert the lubricated cone in the seat and rotate it to transfer the lubricant to the seat. Remove the cone and wipe away any excess from the top and bottom and in the openings. Since it is insoluble in gas this excess can be carried down the fuel lines into the fuel pump or carburetor screens. Reassemble the valve and you should be OK. A five position selector is used with Comanches having aux. tanks. It is a totally different selector and does not require lubrication.

ED: S.B. 345B, dtd 5/19/82, solves this problem.

TWIN FUEL CAPS

Just a line to commend the nameless writer for his common sense solution (engineering evaluations indeed), to the fuel feed problem in Twin Comanche 84Y.

I purchased my 1965 PA-30, two and one-half years ago in California. It had the old, short fuel caps on the auxiliary tanks. This area of Oregon has an annual rainfall of 40". The airplane was tied down outside and after our first heavy rainstorm, I got a considerable amount of water when I drained the fuel strainers. It was obvious that it was raining into the tanks. I immediately ordered new caps for the auxiliary tanks. Meanwhile, before the new caps were picked up, while enroute IFR to Seattle, both engines quit when I switched to the Auxiliary tanks. (Both tanks were switched nearly simultaneously, a practice since corrected.) I immediately switched back to the main tanks and both engines regained full power and we continued on to Seattle without further incident. Upon draining the strainers, on the ramp at Seattle, considerable water was found in both strainers. The strainers had been thoroughly drained on the ground before the flight, in fact, several gallons were drained into a clean pan. It is obviously not possible to remove all water in a parked attitude. After replacing the caps, there has been no further water problem.

However, in view of the above experience, I agree that it would be a good practice to sponge out the tanks. I have a healthy respect for the Comanche fuel strainer system. To be fed enough water to stop the fuel flow and then continue to feed fuel when switched back, it has to be a good strainer. Has anyone tried a product similar to those used in automobiles, to pass that last little bit of water on through the system and prevent freezing?

INACCURATE FUEL GAUGES

Q. My fuel gauges (particularly the aux tanks) are not accurate from 1/4 to empty. How do you use all your fuel and not run her dry? Sometimes I can run an aux to an indicated empty and other times the engine stops with an indicated 1/8 full. Should I fly by the clock?

A. Check your tanks to determine if the liner is badly wrinkled under the liquidometer (transmitter). If they are wrinkled, this could hold the float up giving a higher reading than actually existed in the tank. Another possible cause can be a partially clogged vent line. Your tank has a neoprene bladder. If the vent line clogs, the bladder will be sucked away from the bottom and sides as you use fuel. This can cause a fuel gauge to actually start to read more fuel, even though you're burning it off. If this happened with a metal tank, you would finally pull

such a vacuum that the engine would stop. Guess that explains one of the reasons for a neoprene (flexible) fuel cell.

FUEL FLOW SURGE

Q. On my '65 PA-30, the right engine fuel flow gauge shows a surge of about 1/2 gph. I can hear the prop change pitch when this occurs. The CHT and oil temperature are hotter on this engine. Injectors have been cleaned and everything else checks OK. Any ideas what the problem can be?

A. With the fuel surge and prop changing pitch, this could indicate a fuel flow change. In most cases as long as the prop doesn't change pitch, the problem is something affecting the gauge and is not a true fuel flow problem. Since the prop changes pitch, you probably do have a fuel flow problem.

Check the following items:

1. Does turning on the electric pump correct the problem. If so, this can mean the engine driven pump needs to be replaced.

2. After cleaning the injectors, did you measure the flow? This can be done by inserting the fuel line to each injector into a small medicine bottle, and tying it in that position with wire or string. Turn on the electric fuel pump and let it run for several seconds. (Not enough to make the bottles overflow.) Now you can easily determine if all your cylinders are getting the same amount of fuel, for the level in all bottles should be the same.

3. Check the diaphragms in the fuel control for leaks.

4. The fuel control itself may be faulty. Since this is a very expensive item, try to determine if it really is the problem before replacing it. Since you have a twin, swap it with the unit on the other engine. If the problem moves to the other engine. then it is the fuel control.

With regard to the CHT and the oil temperature running hotter, this leaning of the mixture due to improper fuel distribution could be the cause. However, it is more apt to be poor engine baffles or in the case of the PA-30, the fact that the baffles are not properly positioned on the cowl.

To really solve this one, it might be necessary to have the aircraft and trace it out. If this is a turbocharged twin, make certain that the air lines from the induction system to the injectors are air tight.

PLUGGED FUEL INJECTORS

In furtherance of the question asked by a member relative to plugged injectors, I also had a similar problem with a C model Aztec and spent in excess of $2,000 finding that the flexible lines from the flow divider were flaking off inside and causing the plugging.

Lycoming finally advised me that ''they thought they had recalled all of those lines,'' and compensated me for the work previously done as well as providing me with new parts. It was a tremendously frustrating ordeal that went on for over two years and included two trips to the factory before the cause of the problem became known.

PLUGGED FUEL INJECTOR

Readers of the Flyer may remember my letter of last year concerning plugged injectors in my PA-30.

The problem has been solved by the installation of a fuel filter on each engine, placed downstream of the fuel controller, attached to the engine mount. This filter was formerly supplied by Bendix as their Part Number 450-OK and is now made by Facet Enterprises, Filter Products Div., P.O. Box 135, Madison Heights, MI 48071. It is readily available from the makers of the LAKE Amphibian in Tomball, TX, as it is a required item on the LAKE. It can also be ordered (as can replacement elements) from Bernard Industrial Components Inc, P.O. Box 2698, Ivyland, PA 18974. Since installing these filters, and after spending a kings ransom on my fuel system to no avail, I have not had an injector problem.

ELECTRIC FUEL PUMP PRESSURE AND FLOW CHECK

Like most pilots, I never worried about the fuel pump on my engine, I had an electric boost pump as back up that worked. It sounded good and supplied fuel flow for engine start up. Good pump, right?

When I decided to install a fuel computer in my 400 Comanche, I was told my electric pump must supply 60 gallons per hour at 18 lbs. pressure before the Feds would allow the installation on the 400 HP engine. I borrowed a pressure gauge to check it out.

It only took a few minutes to set up the gauges to check the pressure. What a surprise! The electric pump only put out 16 lbs. pressure at zero flow and 40 gallons per hour at zero pressure. Bendix, the injector people, told me the pump would not supply enough fuel to keep the engine running. So much for the back-up pump.

I talked to three FBO shop superintendents and they all said they never check the electric pump unless the owner asks. I would suggest all Comanche owners have their electric pump checked now, and insist they be checked at each annual.

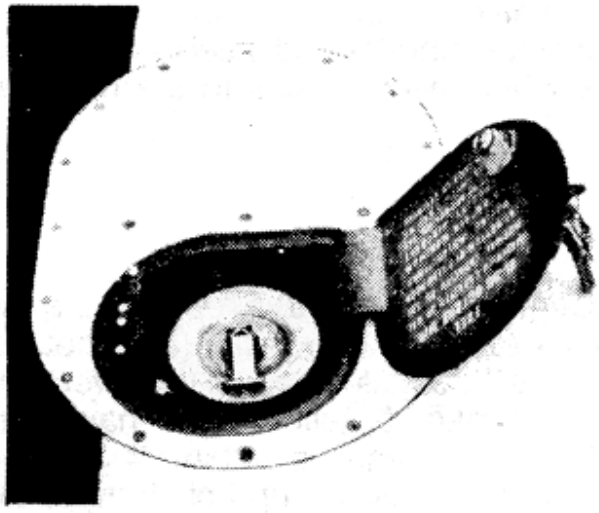
FUEL DRAIN VALVE OPEN

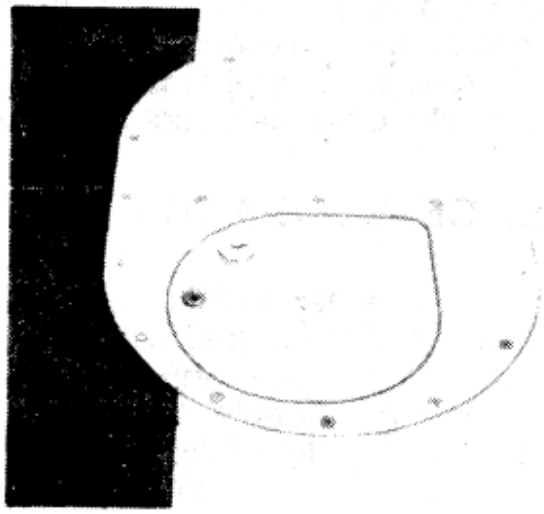
A tip on PA-30 winter flying in case some member does not know. When draining sumps always push down hard on the valve plunger to be sure it is off. These tend to stick in real cold weather (due to metal contraction) and the return spring is not strong enough to close the drain valve to the full off position.

ED: Always double check the valve after draining.

FUEL CELL DOOR LOCKS

Somebody a while back inquired about locks on fuel tanks and the enclosed pictures may be helpful. I paid $4.50 each for two locks at a Locksmith and the shop time for installation was about 3 hours. The installation was done by Alair Aviation at Aurora, OR.





TWIN ELECTRIC FUEL PUMP FAILURE

I had a failure of the right boost pump due to a leaking pump seal washing the grease out of the front electric motor bearing. At the time that I purchased a new pump, the left pump was $175 and the right pump was $335. The right pump was made by a different manufacturer and had a smaller motor than the original and included a different mounting bracket. The pump part was identical. I purchased the lower priced left pump and rotated the pump 180 degrees on the motor which makes it identical to the original equipment right pump.

BRITTAIN TIP TANKS OVERFLOW

Last year I had Brittain tip tanks installed on my 250 to increase the total fuel to 90 gallons. After a couple of months, I noticed that fuel was draining from the right tip to the already full right main; from there it was going through the overflow to the ground. This occurring with the selector in any position, including off.

Naturally, I ordered another valve to replace it. In conversation I discovered that other installations had the same problem. So, before installing the new valve, I decided to check the valve in the plane. With the tanks on the right side run dry, I disassembled the valve in the plane. After some close examination, I discovered that the pin securing the valve stem to the rotating tapered valve was too long on one side. As the tapered components wore and seated it permitted the pin to ride on the shoulder of the fixed body of the valve. By filing the pin so it does not extend out beyond the diameter of the rotating valve, it permitted the valve to properly seat. Enough pin still protrudes to permit click-stop valve positioning. The pin serves the purpose of valve positioning by working against a spring-loaded steel disc with slots in it. In reassembling it is important to note which way it faces to the main tank position. Hope this helps some others.

FUEL CELL CAPACITY

I have owned a 180, a 250 and a Twin Comanche "B". I have repaired the main tanks on all of these and calibrated the tanks to make dip sticks (I do not trust gauges). Without exception, the inboard tanks held 30 gallons when they were filled above the top vent hole. Any tank that does

not take 30 gallons must have some snaps loose. My dip sticks have proved out to be accurate to within 1/4 gallon on mine and several of my friend's Comanches. Before gassing up I stick my mains, subtract it from 30 gallon and see how close the truck comes to that number. This also would show you a collapsed or partially collapsed tank.

All Comanche drivers should have a dipstick to check their fuel. They are easy to make. Drain a tank, then go to the pump when they are not busy and put one gallon in, measure from the top of the neck to the fluid surface, record this dimension, add another gallon, measure and so on until the tank is filled to the top of the neck. Make these marks on a piece of aluminum about 1 1/2" wide, stamp the numbers, spray with flat black lacquer and you have a dipstick.

By the way, my 250 Comanche (1962) held exactly 15 gallons to the top of the neck in the auxiliary tank and the twin holds 16 1/2 gallons.

UNSNAPPED FUEL CELLS

I thought some of the members might like to know about a rare problem with extra fuel burn that I had with my Comanche lately. I noticed that I was burning about 22 gal. per hr. out of the right main tank and normal burn out of all the other tanks. (I have 90 gal. in-wing fuel, two mains and two aux's.) I asked around at several FBO's and got every explanation from loose tank caps to fuel by-passing the selector I attacked these problems one by one, first replacing the tank caps then checking for leaks, then etc. etc. Still could not find out why the excess burn out the right main tank. I noticed that the tank would stay full if you didn't use it at all and it was full for takeoff. This really puzzled me. I determined that the tank couldn't possibly be leaking if it stayed full on the ground and if it were not selected during flight.

Finally, after moving my airplane to St. Louis, where I now live, I ran across an explanation from John at American Jet at Spirit of St. Louis Airport. He told me that the right main tank had come UNSNAPPED on the inside and whenever I selected the tank and it started to burn down, the collapsed tank would force fuel out the tank vents. The fix is simple. You just take the tank access cover off (be sure you have a new seal available), drain the tank and snap the tank back in place. I now have normal fuel burn and it really makes a difference when you pay the fuel bills.

FUEL DRAIN VALVE OPEN

A member noticed in the May 1982 "Pilot News" an article concerning a PA-30 that crashed in August 14, 1980. There was no post crash fire. The first person to reach the scene reported that there was no gasoline on the ground nor was there any odor of gasoline.

During functional tests of the fuel selector valves, contamination caused the left fuel selector drain valve to remain in an open or drain position when the drain handle was released - a condition that results in continuous fuel leakage from the drain located beneath the fuselage. Since the spring force acting on the drain plunger valve is relatively light, the drain valve would not return to the spring-loaded, normally closed position until physical pressure was applied to the drain handle. A stiffer spring probably would have resulted in positive closure under the same conditions.

The drain spring retaining washer in the right drain valve assembly was corroded extensively. Although the right fuel drain system was functional, loss of this retaining washer was imminent.

Under the circumstances, there would have been no spring force available to hold the drain

valve in the closed position and excessive fuel leakage would have occurred.

ED: The ICS Technical Advisor acquired copies of Service Bulletin No. 314A "Selector Valve, Fuel Modification"; Service Letter No. 589 "Stainless Steel Fuel Selector Valve Housing" and Service Letter No. 851 "Fuel System Draining Procedure, Water Contamination, Parts A and B" and sent them to ICS headquarters. If you don't have these we can make a copy and send to you. He advises that due to the inside drain, one should always get back out to make sure that the drain valve has shut off.

FUEL ODOR

Responding to the question concerning the "fuel fume smell on final".

This problem plagued my pocketbook for sometime. Finally, after determining there were no leaks in the fuel system, my mechanic suggested we take the covers off the fuel cells to see if there could be a problem topside. Nothing visible, but all the bolts were loser than specified. After torquing these bolts, no more fumes. The problem seemed to be the new fuel cells which were installed a couple years ago. The gaskets compress and need torquing once or twice to retain a good seal.

ENGINE FUEL PUMP LOW PRESSURE

A couple of things - A friend of mine has a 250 and once when flying back from Mexico from Caba San Lucas where he had topped his tanks he ran out of fuel after 3 1/2 hours. He landed safely on the highway, contacted Mexicali airport by radio prior to touch down and parked off the road. Soon a pick-up from Mexicali arrived with 10 gallons and with help from them by their tending to the traffic, he took off for Mexicali. Examination showed his tank's hangers had come loose and allowed part of the tank to collapse which prevented a full load of fuel when refueling. He had this attended to and now periodically checks the hangers.

The second item of interest occurred on my Comanche at about 5,000 ft. altitude enroute to San Diego from Torrance, CA. I had leveled at 5,000 feet, shut off my boost pumps and reduced power to cruise when the engine quit, as if from fuel starvation. I was near Santa Ana so I started a slow turn toward the airport, switched tanks, turned on the boost pumps and continued the glide for probably 15 seconds. Meanwhile the prop was still rotating, but the cabin was quiet as a tomb. Fuel pressure was up and then the engine picked up, but ran rough as if a plug or two were fouled.

I took it back to Torrance, pulled the plugs and found two (platinum) plugs to have the ground wires bent so that they made contact with the center electrode. After setting them properly, the engine ran fine as it had before flight.

However, the problem was caused in flight by a vapor lock in the fuel line from the engine driven fuel pump to the boost pump T". The engine pump's output was less pressure than the two boost pumps and during the climb heat had allowed a bubble to form. As soon as the boost pumps overcame the bubble, fuel was again delivered to the carburetor and the engine came to life. Apparently, the plug electrodes bent due to rapid cool down of the chambers. Of this I am not sure, but I suppose it could happen. After replacing the engine driven fuel pump, I have not had any more problems with engine failure. Luckily, I was high and had plenty of time. Also the airport (S.D.) was about 3 miles away.

FUEL CELL REPAIRS

A helpful tip for Comanche owners: Uniroyal makes a repair kit for their fuel cells that are used in PA-24's. The kit contains everything that is needed to repair leaking rubber fuel cells and instructions.

My cells were dried out and leaking around the top, due to the airplane being left outside in the sun. A coat of the Uniroyal 3230 cement supplied in the kit, made them look like new and stopped all leaks.

The kit of cement can be ordered through a local Uniroyal Industrial Rubber Supplier.

FUEL CELL WRINKLED BOTTOMS HOLD WATER

A member explained that the engine of his 1959 Comanche failed on takeoff resulting in serious injuries and total loss of the airplane. Wrinkles were found in the bottom of the fuel tank bladders, damming up the condensation water which apparently filled the carburetor on takeoff.

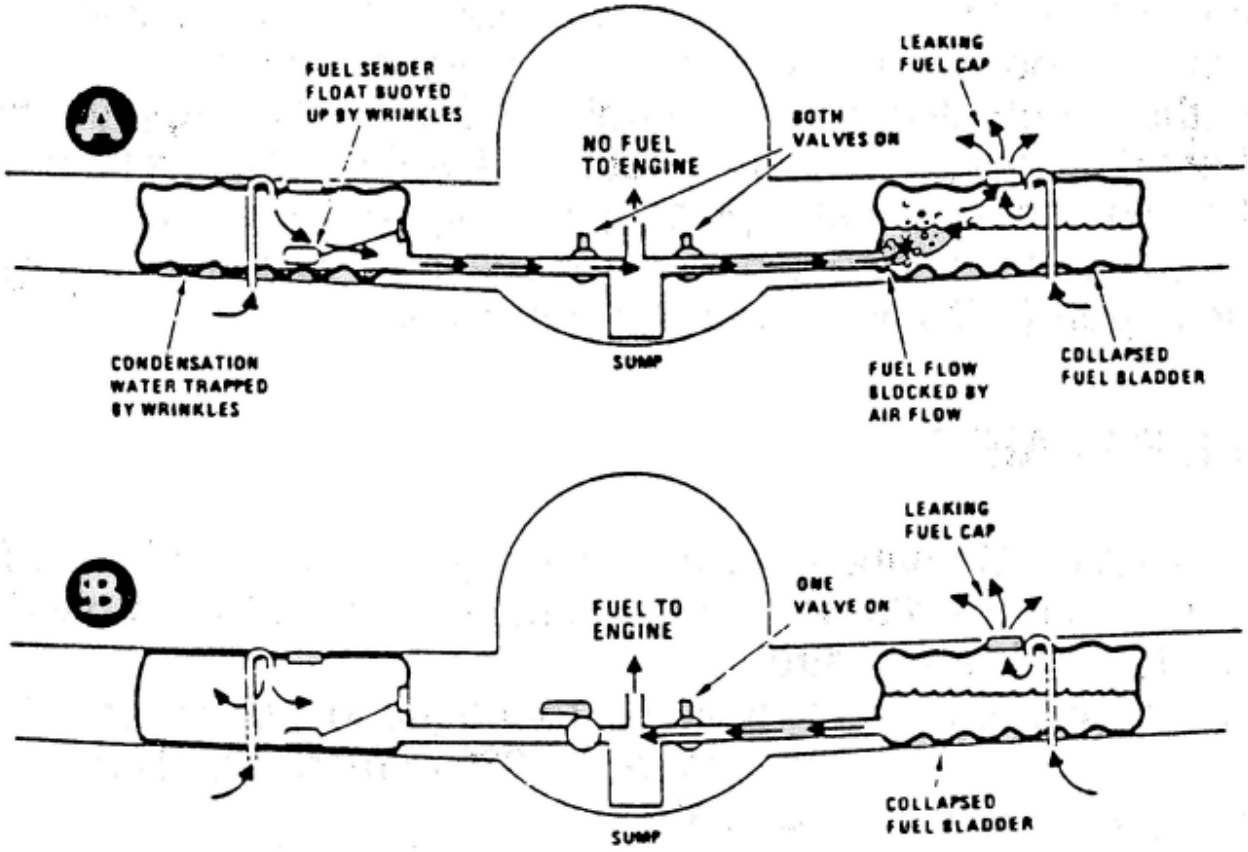
I became familiar with wrinkles in the bottom of my fuel cells in my 1959 Comanche after experiencing an engine failure while breaking in a newly overhauled engine over my airport. The wrinkles were caused by the failure of one of the fuel caps thermos type cam which allowed the low pressure on the top of the wing to collapse the fuel bladder. It also drew the fuel across from the other tank until it went dry. Then, the air moving up the line into the collapsed tank blocked the flow of fuel so the sump and the engine quit until after I landed and the pressure was eliminated. I was also receiving a false reading of fuel in the tanks when the fuel sender float was lifted by the wrinkles.

This situation is illustrated below.

I suspect leaking fuel caps is the only way the wrinkles could have formed in the fuel cells. After fixing the leaking caps, the wrinkles completely disappeared. It should be noted that improperly installed caps by an inexperienced line boy could also create this problem. I now make it a policy to fly on only one tank at a time - ESPECIALLY DURING TAKEOFFS AND LANDING. Even if you were using a tank with a leaking cap and collapsed cell, the fuel would still flow into the sump - just as long as it were not blocked by air coming from another tank.

My airplane is equipped with tip tanks. I have heard that there is a placard against takeoffs and landings on the tip tanks only, although I have never seen one on my airplane. One could hypothesize that if there were a large difference in pressurization between the tip and the main, a similar situation could develop. If the high pressure tank were empty, then air could flow through its intake port and across, through the sump, to the other tank and out intake port thereby blocking the flow of fuel.

I have never had this happen in all my combinations and I suspect the tanks are pretty much equally pressurized. This is possibly what the AD on the main tanks on Comanches (to install larger intake ports) was all about but more than likely it was brought on by the leaking cap problem.



FUEL CELL FILLER NECKS ON BACKWARDS

This is a story that is hard to believe. Eighteen months ago I purchased a Twin Comanche. During most of this time, I have been plagued with water in the fuel system. There was rust, corrosion, crud in all fuel valves, corroded stainless steel fuel line between the flow dividers and corrosion in the fuel dividers. Every time it rained the auxiliary fuel tank filler necks were full of water. This resulted in plugged fuel nozzles and sticking fuel flow dividers and other thrilling things. I tried three different gaskets of different materials for the tank covers. Nothing worked. Still water in the fuel. Finally, after inspecting several other twins that landed here, I discovered that mine was different. The fuel filler necks were installed backwards. (The left neck was in the right wing and the right neck was in the left wing.) This resulted in the water drains being on the outboard side or uphill. After conferring with Piper, their answer was "couldn't have happened here". There is no record of any maintenance being done to this area so it must have been assembled at the factory this way.

I am interested to hear if any other owners have had this experience and if so I suggest you inspect filler necks to ascertain drain direction. I am in the process of having the necks switched and will let you know if this solved the problem.

TIP TANKS TIPS

To drain the sumps on the tip tanks, turn on the master switch and put the switches on the fuel selector to "tip", then drain the fuel as you would the aux's and the mains. If the aircraft has been standing for sometime, it is best to catch the fuel in a bottle and examine, it. If you are alone, this requires quite a few trips from the cockpit to the ground; but believe me, it is worth it!

Secondly, if either one or both of the tips are drained dry in flight unless the procedure that is outlined in the installation manual of the tip tanks (it is not in the flight manual) the next time the tip tanks are used with the switch on the fuel selector valve pointed to the tips, you will not be using the fuel from the tips, but from the aux. tanks, and this can spoil your whole day as it did the pilot in Furfari's article.

FUEL CELL PRESERVATION

Is there a compound available to treat fuel cells to prevent or at least delay deterioration? Could such a compound be applied while the cell is installed after removing the access cover?

ED: I know of no compound presently available to treat fuel cells. The two things will help the most are to keep the tank full of fuel and out of the hot sun as much as possible. They all seem to fail on top where it is not kept wet with the fuel and the most heat is at this point

AD 68-13-3, FUEL CELL COLLAPSE

Fuel cell systems in PA-24 and PA24-250 with Serial No. 24-1 to 24-3529 inclusive.

It is apparent that this is not being properly taken care of as we keep getting reports of collapsed fuel cells. Paperwork for this subject is Piper S/B No. 180, 193, 216, and 231 A as well as S/L No. 367 and 516. AD No. 68-13-3 also pertains to this.

If you want to eliminate the repetitive cleaning of the vent lines as is covered in the above paperwork, there are 3 kits available. Kit No. 760-277 for the main tanks, Kit No. 760-281 for the aux, tanks, and S/B No. 216 requires Kit No. 756-756. Labor would be in addition to kit prices.

For your information, if you are flying when there is a plugged vent, the tank might be reading half full and a bit later, it will show more, not less. This indicates that the tank is collapsing, and pulling the float up. If nothing is done about this, the next time you fuel, that tank will not hold the number of gallons that it should and you will have less fuel on board than you think you do.

FUEL DRAIN VALVE CONTAINER

Since the Comanche fuel drain is on the bottom of the plane, and in order to drain fuel, you have to pull the drain valve inside the plane, we made a catch bottle to save the drained fuel sample for inspection. We took the black bottom off of a clear plastic two-liter pop container and (after washing it out thoroughly) we punched a hole in the aluminum cap with a center punch. We then forced a three-eighths inch inside diameter plastic hose approximately four inches into the bottle and left approximately four inches sticking out. By slipping this plastic tube over the outlet tube of the fuel drain, the bottom of the bottle stands on the ground and a fuel sample can be drained from the tanks for visual inspection. We very seldom have any water in our tanks, but it is good to know that a proper inspection can be made this way. We take a large fuel sample and if any

water is present, we carefully decant most of the fuel back into the tank and then pour the rest of the sample out, including the water and any other impurities that are found.

FUEL GAUGES FOR EACH TANK

We put in four fuel gauges and bypassed the single gauge system previously installed in the aircraft. I discovered that the selector on the floor had worn to the point where the flat in the circular hole which locked the rotary switch to the fuel selector shaft had worn completely out and the hole was circular and one never knew which fuel sender was connected to the single fuel gauge.

Because of my concern for safety and having read several places that fuel exhaustion played a part in several Comanche accidents, we decided to by-pass the rinky dink system that this aircraft was originally equipped with and install new Stewart Warner Gauges (Part Number 82303) and new Stewart Warner Senders (Part Number D385B).

The original gauges were Stewart Warner. Of the four original senders which came on the aircraft as purchased, one had rusted into and was lying in the bottom of the fuel cell, one was in such a condition that the float would pivot but it was otherwise non-operational. The third float was locked in position and would indicate approximately threeeighths full, regardless of how full or empty the tank was. The fourth sender worked intermittently. I'm happy to say that we are very satisfied with the new system, however, I would pass on the following advice: if one chooses to use the old gauge and the original rotary switch, one should be very careful to inspect the rotary switch often.

We found that Beechcraft fuel senders available from Wag-Aero (Beech Part Number 96-380043-5, Wag-Aero, Catalog Number A-1 56000) worked perfectly with the original equipment fuel gauge.

The new Stewart Warner fuel gauges, however, require their own sender. We discovered on searching for senders to interchange, that there must be some industry-wide convention in regard to the bolt pattern on these senders because we found all of them to be similar. This is a lucky break for us and we pass on this information with the hope that safety will be enhanced. You can easily imagine what might happen if you were in IFR and ran a tank dry when the fuel gauge reads half full. Now we have a gauge for each tank and having calibrated them personally, we know what the sender means when it says there's a fourth of a tank full, etc.

FUEL SUMPS DRAIN AFTER FLIGHT

My service is being done by Hill Aviation at Lancaster, PA, and I strongly recommend that Northeast Tribe members get to know Dudley Hill. He is careful and sensible about maintenance and annual inspections, and goes all out to make the annual as convenient as possible with minimum out of service time. They have tooled up to fix the Airborne Instrument Fuel Valves, which can be a headache.

Operating tip suggested at Hill: Drain your aux. and main lines through the filters after each flight, so that accumulated water does not remain in the valves to rust and/or freeze.

FUEL ODOR

Read the letter on fuel smell in the cabin. In my experience, keeping the tanks filled to the very top is the best insurance against cell rotting. I find that almost 3 gallons can be squeezed into the tank, after filling to the bottom of the filler neck. Our bird is kept inside, where temperatures are moderated by the shade. Leaving the Comanche out in the hot sun is ruinous. Found that out, parked at Yolo County for three weeks. The top of one cell was totally destroyed by that caper!

But something else comes to mind on 'the fuel smell, and that is the quick drain in the belly. Despite what some may say, crawling under there is the only sure way to preflight the tanks. I have occasionally found tiny bits of debris can keep the spring loaded drain from closing completely. Pulling down on the drain stem with the fingers will ensure complete closing, preventing a slow drip from developing. I have confirmed this, in flight, to be the source of fuel smell in our bird. Once we started making checks on the drain valve, no more smell in the air.

FUEL CELL WRINKLED BOTTOMS HOLD WATER

The fuel bladders in our Comanches can get wrinkles in them which trap water. This trapped water may not drain out during the pre-flight fuel draining process.

Good refuelling practice, i.e using clean good quality fuel and not leaving tanks partially full over night along with well maintained fuel caps and seals in the the fuel cap doors will go a long way to stopping water getting into your tanks.

If you find more water than normal during the pre-flight, it is worth draining again after giving the plane a good rocking (by moving it it from the wingtips) in an attempt to dislodge any water that may be trapped in the wrinkles.

It is also a good practice to do a fuel drain at the completion of a flight. Any small amounts of water that may have been present (and trapped by the wrinkles) at the start of the flight will most likely be now in the bowl of the fuel drain. If left there between flights could start corrosion in the fuel bowl. Let’s face it there can be several days or weeks between flights for our birds.

WATER IN FUEL CELLS

For many years we operated a PA-24. We based the aircraft outside, in St. Louis, MO, in the United States. During the many years in which we operated this Comanche we never experienced any significant amounts of water in the fuel. In retrospect there are a number of factors to consider. One was that the aircraft was used at least 6 hours or more each week, and the other was that the tanks were always completely filled immediately upon landing. If, on occasion, we had a little rough engine operation, then along with carburetor heat we would normally open the door in the floor and pull the filter drains while in flight. We did, however, consistently have the auxiliary tank fuel cells collapse which gave an incorrect quantity reading.

When we purchased our PA-30, however, we found to our surprise that there was a much more pronounced water problem associated with the fuel. After a number of questionable experiences we felt that we managed to understand these problems and solve them. For one thing, our mode of operation was different. We flew the PA-30 much less frequently, and, due to the difference between "duty free" and "duty paid" fuel prices we no longer tanked up fully upon landing. This meant that the aircraft usually was parked outside for extended periods of time with partially filled tanks. With the typical temperature changes here in Switzerland between day and night our

tanks work as a "condensing machine", breathing in water vapor laden air during the day, and condensing it out on the tank walls at night, so that a slow but sure accumulation of water in the fuel takes place. In addition to this, we noted that the auxiliary tanks in the PA-30 appear to be accumulating more water. If you look carefully at the fuel port, with the rubber "Thermos bottle" cap removed, then you will notice that the opening is not perfectly round, but in fact has a discontinuity where a vent line is welded into the opening. I am no longer certain if the PA-24 opening looks the same, but my memory is that it does not have this. The correct rubber "Thermos bottle" caps are (a) quite long, so that they deform and bulge out at the bottom, (b) do not have a vent hole (only the Aztec, I believe uses caps which look the same but which have a vent hole), and (c) should be soft enough to seal properly. How soft is soft enough? I don't know, but we replace the rubber caps now at least every two years and have just about eliminated the water problem. Another potential leak is the seal around the tank bladder installation plate itself.

During pre-flight the tanks should be drained and the drained fluid should be caught in a container for inspection. With a little cleverness you can do this even if you are alone. At annual inspection, or 100 hours, replace the clear plastic tubes that go from the sump out the bottom of the fuselage, so that you can see what is flowing if you pull the drains while sitting inside. The water will be clear and will look like bubbles in the fuel.

The tank bladders in the Comanche should not collapse or deform, but if they are empty it is possible for wrinkles to exist in the bottom of the tank. It is also possible for pools of water to form in locations that will not drain into the sump. When you do your pre-flight drain on the ground, be sure to drain all tanks every time. Once you have been flying for a few hours at subzero temperatures aloft, even a small drop of water which freezes can form a piece of ice which has the potential of stopping your fuel flow.

After having done a thorough drain on the ground, we do another drain in the air after we have bumped around a bit or made a few slightly uncoordinated turns. This gets the water which was trapped by a wrinkle in the tank into the sump. Once you are in cruise configuration, and not too busy, just go around to all tanks and do another drain procedure in the air. Take care to push the drain knobs solidly down afterwards. It is possible for the knobs to stick open and allow your fuel to drain out.

TWIN CHANGING FUEL TANKS

A visual check during the preflight of the fuel on board by using a dipstick is recommended.

You should always preserve the fuel in the main tanks for the stages of flight where you are manoeuvring the aircraft, i.e take off, climb, descent, approach and landing, missed approach or go around. If you are planning on using the fuel in the Aux and Tip tanks this fuel should be selected as soon as you are in the cruise. If fitted the Tip tanks should be used first then the Aux tanks. This to prevent a failure of the electrical system or the solenoid system that selects the Tip tanks.

In the PA 30 don’t be in a hurry to change both tank selectors unless of course you are draining the tanks to empty prior to changing. Before changing the second selector allow time for the newly selected tank to prove that it is flowing properly.

ELECTRIC FUEL PUMP LINE DETERIORATION

A member has a PA24-250 and when he used full power, the engine had a bad surge. After having the governor checked, as well as a number of other items, he, somewhat by chance in inspecting the engine compartment, noticed a drop of fuel coming from the flexible line on the fuel tank side of the two electric pumps. This flexible line was removed and tested under water as you would test an inner-tube. This revealed the presence of minute pinholes shown up by the air bubbles. With this condition with maximum fuel required for full power, air was pulled through these holes and starved the engine for fuel. A new line corrected the problem.

We have to remember that many of these aircraft are thirty or more years old and flexible lines need to be changed during this span of time. With the fuel injection models, the small flexible line between the fuel injector and flow divider is very important. Small particles come off the inside and there is no fuel screen between there and the nozzles.

ED: Flexible fuel and oil lines should be changed not later than 5 year intervals.

ICE IN FUEL CELLS

I would like to mention another problem I found when taxing the tops out of the fuel cells to install the collars.

The plane had been sitting outside in weather that for a few weeks had been raining in the daytime and freezing at night. Apparently the gasket between the wing skin and the tank top was leaking, because, on removal I found a block of ice 2" thick and almost as large as the tank pushing the top of the cell down. I hate to think how many minutes early one of these tanks would run out with 2" less fuel in it. It has been said before but I will say it again "Be sure your tanks are full and that it is all gas".

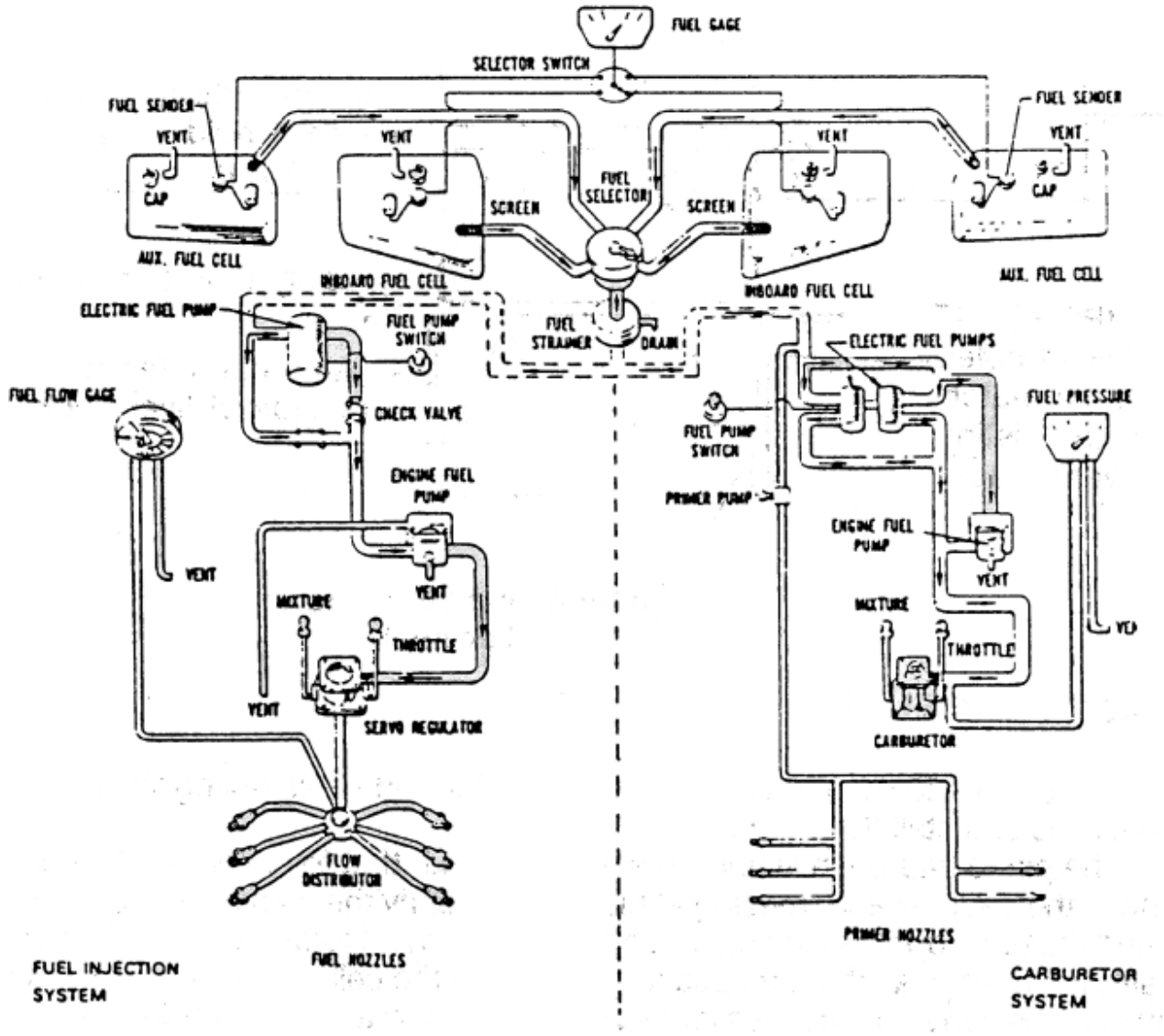
ELECTRIC FUEL PUMP

Note from the drawing that the fuel from the electric pump bypasses the engine driven pump. This is not true of the fuel injection models. Be sure that your aircraft - other than a 180 - has the cooling baffle with blast tube for cooling the fuel pump. A 180 does not have this cooling baffle.

I suggest the following procedure, especially when the ambient temperature is high. Before starting the engine, turn on the electric pump and check the pressure. This will prove that the pump is working, and then turn it off. Start engine, taxi to runway and do your run up. Just prior to takeoff as you go through your check list, turn the electric pump on. As soon as you are at a safe altitude above the field, turn the electric pump off. This method will keep cool fuel going through the engine driven pump, keeping it cool and avoiding vapor lock. The fuel pressure range is 5 to 5 PSI and the engine runs just as good at one as it does the other. It takes fuel from the carburetor bowl and .5 pressure will keep that full.

In my opinion, this method will prevent the very large drop or the temporary loss of fuel pressure when the electric pump is turned off after being on a long time on the ground plus a long time to altitude. However, there will be some drop in full pressure when the electric pump is turned off but no interruption of fuel flow should occur.

A typical Comanche fuel line schematic. Carb. models could suffer excessive fuel heat and vapor build-up in engine-driven pump and its lines when electric pumps are operated for long periods.



ELECTRIC FUEL PUMP

In the past, we discussed the rotary electric pumps on the fuel injected singles. Now for the electric (or auxiliary) pumps on the 180's and 250's. The Piper part number for these pumps is 481- 666 and the Facet number is 478-360. The 180 uses one pump and the 250, two.

Before starting engine with master switch on and electric pump on, the 180 with one pump or the 250 with two, your fuel pressure gauge should read a minimum of 4 PSI. You should make this check before every flight. Then shut fuel pump off before starting engine. This will let you check the operation of the engine-driven pump.

For proper procedure with the electric pump on the carburetor models, check the January 87 Flyer.

AD 77-25-05, FUEL INJECTOR ICE

An interesting point raised in the Flyer was the notice of Piper Service Bulletin 861. For the benefit of those who fly Comanches, or any other aircraft equipped with a Bendix RSA fuel injector, you should read Airworthiness Directive AD 77-25- 05, under Enstrom helicopters. You should excerpt it and put it into your Pilot Operating Manual and your pre-flight checklist. There are two ways in which these fuel injectors leak internally. The one mainly addressed by AD 77-25-05 concerns idle mixture valve leaking and causing a rich idle mixture. This problem can be fixed in the field by lapping the valve and plate. Alas, the other form of internal leakage occurs on rare occasions and quite randomly. Small quantities of fuel leak past the center body seal and out of the impact tubes, or venturi bullet and can result in icing, just like with a carburetor (see also Lycoming Service Instruction 1166A). Such leakage might show up as a rough running engine at idle on taxi, but in the air, it is hardly noticeable. But, when descending at low power in humid conditions, not the icing conditions that the Flyer reported for bulletin 861, the throttle can ice up. The pilot will probably be unaware of any problem until he opens his throttle and finds his engine dead.

The insidious thing about this is that a fuel injected engine is not supposed to suffer from ''carburetor'' ice. This, it seems to me, is why the alternate air has to be heated, just like it is with a carburetor. This form of internal leaking cannot be fixed in the field, and the fuel injector servo must be sent away for overhaul.

The pre-flight check list should simply include the following check: With the engine warmed up and idling, switch the boost pump on and off. Any change in rpm indicates internal leakage. Do not fly until corrected, or as AD 77-25-05 puts it, replace with an air-worthy unit.

ED: Piper considers SB 861 compliance absolutely necessary for Comanche 260 models. To encourage owner action, Piper and Av-Pac have reduced the cost of the kits to the manufacturer's cost.

FUEL CELL REPAIRS

Fuel Cells, Main: The A/C service manual calls for a sealant/glue by 3M that is still made, but rarely available. My calls to 3M to locate some source revealed that most dealers instead stock 3M's EC-776 Sealant / Adhesive and this is used by A/C mfg's and the military for AvGas tanks. If you have a ''minor'' seepage point to repair, this will save you the down time involved in shipping your tank off for overhaul. (Not to mention the cost for an over-haul when needing only a small repair.) My tank had a spot about 1/4'' diam. on the upper outboard side, where it was apparently working against the cavity liner. Examination revealed the fore-aft upper corner apparently buckles with less than full fuel, pushing the spot against the aluminum. I sealed the entire tank, inside and out, tho it otherwise looked like new. Just as a precaution I then soaked a patch in the sealant, let it dry, putting additional coat of sealant on the bared tank fabric. My ''patch'' I made large enough to go around the corner, reinforcing it, to try and prevent future buckling. Put it together, as per the tech-reps instructions and the info sheet. Clamped and let cure 24 hrs. A note of caution: The interior of the tank doesn't dry / cure well due to lack of ventilation for the solvent. I used a muffin fan in the opening to blow air in and the fumes out. Then when the tank has stopped being tacky for several hours, coat the inside and outside adhesive areas as per the ASM, with light oil to prevent it sticking together when handling.

On my tank, one deteriorated place that almost convinced me overhaul, with its long wait was

going to be necessary, was the fuel outlet nipple. The exterior surface of the nipple was cracked, or spilt, and in generally bad shape from long term exposure to the air. Finding a replacement seemed impossible, not to mention how tricky removing the old nipple and gluing in a replacement would be. Close examination with a 10x glass, while crushing and rolling the hose part of the nipple, failed to show any interior cracks. But I was sure it was, or soon would, leak. The finger- screen on the fuel line made putting any sealant on the nipple interior look inadvisable. A talk with a 3M tech-rep brought the suggestion that it might be worth a try to coat the cracks with the sealant by opening them, then wrap the exterior with a thin fabric patch to reinforce it. The nipple goes through the inboard bulkhead, so a thick exterior patch would not work, I used the suggestion and when that cured, pressure tested the whole tank.

The wing access opening must be taped before removal, and left taped until the cell is back in, for sure. Before re-installing, get the wing compartment spotless. Vacuum, and I used tape lint remover to pat up every particle of grit. Check the flannel over rivets, seams, etc. Re-glue and/or replace with more flannel, making sure every possible rough point in the cavity is covered. Lube the nipple interior to slide the finger screen through easily. Use fuel soluble lube, such as heavy oil, or light grease, so you don't plug the screen. Last, but not least, if you can afford the time, or live west of the Mississippi, I would seriously consider sending the cell to Continental Fuel Cell for overhaul. I made "necessary repairs," which I hope will give me a few years of trouble-free ops. An overhaul ought to give a full "cell life" period of freedom from trouble, so it's worth the money.

ENGINE FUEL PUMP FIRE

About a year ago, while making a practice instrument approach and taxi back, I lost the left engine. I continued to taxi and attempted a re-start. During this procedure, I saw fire and smoke coming from rear of engine. Thinking it a backfire, I continued cranking, thinking it would be sucked back into intake. Not successful. Luckily, I was just passing a line vehicle, the boys converged on me with a fire extinguisher and quickly put it out without major damage. As you may be aware, this type fuel pump has an overflow or vent line from pump to drain manifold on bottom cowl. This line had come loose and was laying on the hot exhaust. The engine or boost pump will continue to feed this line (if pump leaks), even though the fuel mixture is in the OFF position. I found out later that neither of my fuel control valves would shut completely off. Had I been in the air when this happened, I would never have survived. These were overhauled immediately by Bob Weber, Newton, KS, for $45 each. New ones from AV-PAC were $1200, and as far as I know Bob is the only one who performs this service on these valves.

Safety check to make frequently to catch this problem:

1. Remove side cowl LEFT from both engines.

2. Mixture IDLE CUT-OFF.

3. Master switch ON.

4. Boost pump ON. Observe pump and drain while boost is operating. If there is an internal leak, it will show.

FIREWALL FUEL LINE LEAK

I had flown my 180 Comanche, to pick up some aircraft parts about 12 miles away, prior to giving the plane its 100 hr. inspection. Upon entering the cockpit for the return trip, I caught a slight whiff of fuel odor, but didn't get alarmed or suspect a serious problem. The following day, I

opened the cowl and immediately spotted a blue stain down the left firewall, running directly down to the exhaust tail pipe. Needless to say, I was gratified that somehow I was spared an in-flight fire. The fuel pressure 3/16" line had chaffed through at the firewall and fuel was flowing down both sides of the firewall. Had a fire started, I would have lost her, and possibly my letter of caution would have been presented in a different manner by an accident report.

I repaired the chaffed line by cutting a 1 1/4" section from the forward side, installed a "B" nut and sleeve and flared the tube. I repeated the same on the cockpit side. I drilled a hole through the firewall the diameter of the firewall fitting and installed from the cabin side with the nut on firewall side. Securing the "B" nuts completed the repair.

My aircraft had flown 3,500 hrs. prior to the incident, but the contact with the prop gov. cable and cabin heat cable had been concealed by the compound sealing the grommet and had not been discovered.

FIREWALL FUEL LINE LEAK

I recently had a fuel leak problem. We started noticing an intermittent minor fuel odor in the airplane, but could not isolate the source. It seemed to become more noticeable during the landing pattern phase of the flight. Fuel tank caps appeared to be seeping and were replaced with the improved Weber type.

Then one day just after takeoff, a large fuel odor dictated an immediate return to the airport. Investigation revealed fuel leaking from the 3/16" fuel pressure line right at the firewall grommet with fuel running down the firewall and back on the belly of the airplane.

Removal of the bulkhead sealer revealed corrosion and pitting around the fuel line under the sealer. A slight pull on the line during removal caused separation of the line at the corroded area.

At that point, the complete line to the fuel gauge fitting was replaced and the old line also had chaff points from being rubbed by the control cables. It was noted that the sealer around the line appeared to have cork chips as part of the sealant material and it looked as though it absorbed moisture, causing the line corrosion problem. This sealer has been replaced with silicone firewall sealant material.

UNSNAPPED FUEL CELLS

All Comanches have bladder-type fuel cells; big, floppy, rubber like bags in the wings to hold gasoline - and occasionally a bit of water. While these bladders are probably less prone to the annoying little fuel leaks found in wet-wing airplanes, in which fuel is stored in a metal box formed by the wing skin and structure, they can cause some serious problems An accident involving a PA24-250, which was recently reported in NTSB Reporter magazine, illustrates the point.

The airplane was on a planned IFR, daytime flight from Pittsburgh, PA, to Oshkosh, WI. Before takeoff, the fuel quantity gauges and a visual check indicated that both fuel tanks were full. Conservatively estimating a consumption rate of a bit over 13 gallons an hour, the airplane should have had a cruising range of almost 4.4 hours. However, nearing Oshkosh after only 3.41 hours of flight, the engine failed due to fuel exhaustion; both tanks were completely empty. The pilot made a forced landing during which he and his passenger were both injured and the

airplane was ''substantially'' damaged. After the accident, investigators determined that several of the fuel bladder retaining clips were loose. These clips normally hold the fuel bladders in position and give them their shape. With the clips loose, the fuel bladders had partially collapsed, significantly reducing the capacity of the tanks. While they would have looked and indicated full before the flight, the tanks were not actually holding anywhere near as much fuel as they should have been.

The problem is not new. It was recognized over 20 years ago when Airworthiness Directive (AD) 68-13-03 was issued on 29 May, 1968. This AD applied to all PA-24 and PA24-250s from serial number one through 3529. It required a visual inspection of the fuel bladders, initially within 25 hours. The inspection is to be repeated every 100 hours thereafter (the AD is still valid) unless a fuel cell vent and drain tube modification kit has been installed. These kits, No. 760-277 for the main tanks and 760-281 for auxiliary tanks, provide for the installation of recessed, NACA type air inlets on the bottom of the wings to vent the fuel cells. The idea is that these air inlets are less likely to be restricted than the original vent tubes. That should minimize the possibility of the fuel cell collapsing as fuel is pumped out of it by ensuring adequate vent air to the tank.

I assume that airplanes after serial number 3529 were built with the improved vent system since the AD does not apply to them. However, I have not gone out and looked at one to be sure I do know there are a number of early airplanes that have not been modified. Mine is one of them. I think the accident airplane was probably another, since the report said the AD had been complied with, probably by inspection, 41 flight hours before the mishap.

This accident almost sounded like Catch 22. There was a problem with fuel cells collapsing, an AD to prevent the problem, the AD was complied with, and still the pilot was left holding the short straw. Is there anything you can do to avoid the same trap? I think so. But it will take a little planning and forethought.

Here's how:

The accident airplane took off with about 13 gallons less fuel aboard than the pilot thought it had, even though the tanks looked and indicated full. The only way to detect a shortage in this situation would have been to cross-check the amount of fuel added during the last refueling with the flying time, since the refueling before that. For example, assume your 250 normally burns 13 gallons an hour. You fill it up, fly it 2 hours and find it only takes 14 gallons to fill it back up again. Don't start congratulating yourself on your exceptional leaning techniques. Suspect a fuel cell problem.

Actually, I'd recommend cross-checking fuel and flying time this way on any airplane, all the time. Not only could it alert you to a collapsed fuel cell, it should also give you pretty accurate fuel burn figures to use for flight planning and let you know if fuel consumption is changing. That could be the result of other fuel system problems, including even a leak that you haven't suspected.

Finally, even if you have an airplane after serial number 3529 or your early model has been modified, I'd still watch out for the possibility of fuel cell collapse. The improved vent system should "minimize the possibility" of the problem, but I don't think anything will absolutely guarantee that it can't happen.

ELECTRICAL FUEL PUMP MODIFICATION

I am the owner of a 1959 Comanche PA24-250. I have always been unhappy with the way in which the electrical circuit to the dual electric auxiliary fuel pumps was originally designed because:

1. When checking the aux. pumps for proper operation prior to engine start-up, it is impossible to determine whether both pumps (as opposed to only one of them) are operating.

2. In case of switch failure or wire breakage, or in case of short circuit in one aux. pump or anywhere else between and including the switch and pumps, the use of both auxiliary pumps is lost, thus losing a very desirable degree of redundancy.

I therefore modified the auxiliary fuel pump circuit as shown on the accompanying drawing. A split type Cessna master switch fits nicely into the space previously occupied by the single aux. pump toggle switch. Since the circuit breaker is upstream of the switches, I could see only limited benefit in doubling up that part of the circuit, so left it as is.

I have a one-time approval from Transport Canada's Airworthiness Branch for this modification.

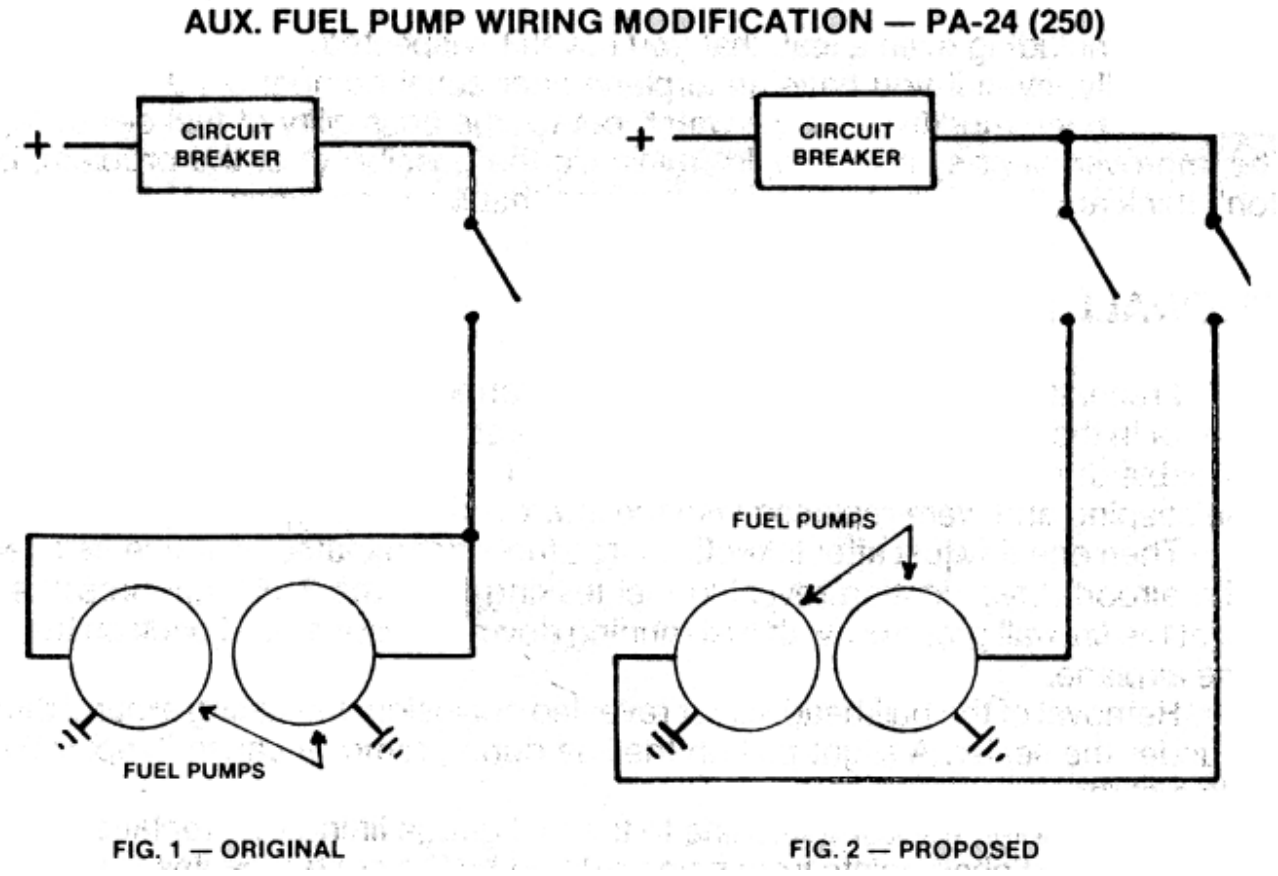


FIG. 1 — ORIGINAL

FIG. 2 — PROPOSED

FUEL CAP REPAIRS

I'd like to pass on a "fix" I observed a seasoned mechanic perform. The rubber portion of my fuel cap had shrunk and become hardened. He rummaged around in his back room and came out

with a can of MEK (Methyl - Ethyl - Ketone). He loosened the clamp / thread so the MEK could surround all the rubber parts. He immersed the cap for a couple of hours, checking it about every 30 minutes. I was amazed to see the rubber swell to its normal size, and become soft enough to seal the tank opening again. It worked! I've since used MEK myself on other caps that didn't seal, with good results.

I bought a one-gallon can of MEK at a local 'Standard Brands' paint store for approximately $12. That gallon has lasted 5 years and still has some MEK remaining. Some cautions need to be observed. MEK is a powerful stripper. Vapor can be harmful, use plenty of ventilation. When using, check it every 30 minutes or the rubber may swell too much. Make sure all the MEK is emptied out of the gas cap before you try it in your gas tank. You don't want this stuff in your gas tank. Try it on a "spare" or a cap that you discarded because it wouldn't seal. It works!

ELECTRIC FUEL PUMPS

It has been brought to my attention by a member to again remind the members of the importance of checking the performance of the electric fuel pumps. If you have been at one of my seminars, you are aware that we cover this in some detail, but let's go over it again.

First, the fuel injected models - singles & twins: Remember that if the engine driven pump should fail, you cannot keep the engine running without a properly functioning electric boost pump. From a pilot's or operator's point of view, if you can start the engine with the electric pump, this does not guarantee that it is working properly. With the small amount of fuel needed for starting and the help of the engine driven pump, even at cranking speed will furnish enough fuel with the help of a very weak electric pump to start the engine.

If your 250 or 260 has a Dukes pump, it should flow 50 GPH at 14 PSI and have a no flow pressure of 25 PSI max. If you have a 400 with the Airborne #2B5-26, I do not have exact data on this pump, but feel that the pressures and flow would be very close to the Bendix pump for the 400.

For the PA-30/39, the shut off pressure from each electric pump should be 26 PSI max. I have no flow information. Since all of the above rotary pumps are positive displacement pumps, just a shut off pressure test will tell you a great deal.

Now, the models with carburators - 180 / 250 / 260: These aircraft use a Bendix plunger type pump. The 180 has only one and there are two on the 250 and 260. Each pump should have 4 to 4.75 PSI shut off pressure and flow 32 GPH at 0 pressure - 3.2 gallons in 6 minutes. It is very important that if you have the two pumps, you test them separately to make sure both of them are operating. On all of these pumps, there should be no fuel stains or leaks of any kind.

Be sure to use the necessary caution when working with the fuel.

FUEL SELECTOR VALVE

My Comanche sat unused for a long period of time before I purchased her. Since I purchased it, the fuel selector has been difficult to turn. At first it took two hands to operate, but finally loosened enough to only require one strong hand. During the first annual, I squawked it and the selector handle was removed and lubricated with a fuel valve lubricant that I ordered from the ICS. It was easier to operate afterwards, but was always tight. I assumed that was the best that could be done.

A few months ago, I had some other work done and the shop noticed that the valve was tight. Evidently, someone that they knew was killed when the fuel valve broke off in his hand and he couldn't switch tanks, so they insisted that they perform the AD on the valve again. This time they disassembled the valve completely and cleaned and lubed it per the AD. Turning the valve now is a two finger operation. If yours is tight, have your A&P perform a complete disassembly and lubrication.

ED: Per SB 354B.

ELECTRIC FUEL PUMP GASKETS

The gaskets for the Bendix electric fuel pumps are indeed available through auto supply stores. They are AC (Delco) Part Number FG-1. However, they may be difficult to locate because many auto parts are now supplied as "after market" components, that may not be equivalent. Do Not accept substitutes, especially cork! These same gaskets also fit the gascolator bowl. They are inexpensive, should be inspected every 100 hours, and changed periodically.

The little snap-on dust caps over the zerks fittings on the landing gear system and prop can also be obtained through auto supply stores. One brand is know as "Lubricap" with Part Number 715-1091. Large supply houses should carry them.

SYSTEM MAINTENANCE

Further to previous discussions on the fuel system, there are other elements of the fuel system to be aware of, namely fuel boost pumps, filters, injectors, etc. These must be maintained in perfect operating condition.

On the 180 there is only one boost pump and it is simple to check for condition. Simply turn on, listen for the regular clicking and note fuel pressure on gauge. This pump should pump min. 4 PSI. On all Comanches it is essential to have correct fuel boost pump pressures. If they are low and you have a main fuel pump failure, your boost pump may not deliver enough fuel to keep your engine going.

The 250 Comanche has two Bendix boost pumps and are checked in the same way as the 180 except that they are wired to the same switch and operate together. One must be disconnected to check that each one operates. Note the injected 250 is essentially the same as the 260 system where the boost pump is a vane type capable of supplying higher pressures, which vary according to the type of pump used. There are also external check valves plumbed into the system and should be checked also, as a leaking valve can effect pressure readings.

The Twin Comanche uses two Weldon fuel pumps mounted in the underfloor area and have external adjustment provision in the rear of each pump. The pressure relief valves on these pumps are set at 26 PSI.

Fuel filters that show signs of leaking when stationary are a source of concern as during flight, air is sucked into the system depending upon the degree of defect and will show up in a fluctuating fuel flow indication as the system struggles to rid itself of the air bubbles. If your fuel sump valve does not close off properly after a water check, air can be induced through this valve. The Bendix injection system does not have an air bleed return, consequently any air in the system must pass through the system into the engine.

A blocked injector will show up as rough running and lean misfire, accompanied with a rise in fuel flow. Because the fuel flow-pressure line is tapped in at the flow divider on top of the engine, any blockage downstream of here causes less fuel to get away from the divider and thus increases the fuel flow reading, even though less fuel is passing through the divider.

Your injector nozzles should be removed and cleaned at regular intervals (Piper says each 100 hrs.). Indications of injectors blocking up can be seen by excess fuel stains around the injector area. This stain occurs because the injector nozzle blocks and fuel is still coming down the line, no air is coming in the gauze screen, so fuel is forced out here. Regular cleaning of the gauze filter is necessary to promote good atomization of the fuel, as these injectors draw unfiltered air from the engine bay. Do not poke or probe a blocked injector, as the hole is a precise size and finely metered. Sonic clean or use high pressure air. Do not mix injectors, as each cylinder sometimes uses a different code as determined by the engine manufacturer.

Another service point often overlooked is the finger filter inside the injector body. Access to this filter is gained by removing the fuel inlet hose and unscrewing the fitting from the injector body. On removing the screen it may at first appear to be clean, but this filter works in reverse to a normal screen, in as much as the fuel flows from the inside to the outside, therefore any contamination will be contained on the inside. Take care that the "0" ring is still in place where the filter fits into the fuel line fitting. The absence of this "0" ring allows fuel to bypass the filter screen. (Do not remove the filter from the plug situated in the opposite end to the fuel inlet fitting, as this can allow any contaminate contained in the filter to fall into the injector body.) Remember to use clean fuel and keep it clean.

GAUGE SENDERS

I recently inspected the main and auxiliary fuel tanks quantity sending units on C-FAKY, a 1969 PA 24-260C, Serial No. 24- 4832, for the possibility of a fuel leak in that area. What I found was not a pleasant sight. The 2 main tanks sending units were rusted away to the point that you could look through the body of the units into the fuel cells. The right auxiliary tank sender was severely rusted, but the left auxiliary tank showed no sign of rust. All units were still functioning accurately.

Calling a Piper Dealer in Canada, I was told that the sending unit replacements were no longer available and that the replacement units now used required the fuel receiver gauge to also be replaced, at a cost of $250 for the gauge and $190 each for the sending units.

A search for used parts was made at a local salvage company that was parting out a PA24-250 that had landed several hundred feet short of the runway due to fuel exhaustion. The 2 fuel quantity sending units were removed, but were badly rusted and inoperative.

A further search at the salvage company turned up 2 fuel senders that were tagged for a 108 Stinson. These were identical units made by A.C. with a resistance of 0 to 32 OHMS. They were installed and work fine.

I purchased the aircraft in August 1990 at Burlington, Ontario, Canada, and brought it out to South Vancouver Island, B.C., where as we all know, there is no ice or snow (very often). The problem may have been caused by snow on the wings melting and freezing, plugging the drain lines from the fuel filler section, thus allowing water to leak over the top of the bulkhead between the filler section and the sending unit section. This would fill the sending unit section with water that would remain trapped. Rust deposits in this section indicated that they had been full of water

for a long time, probably until the senders rusted through, allowing the water to drain into the fuel cells.

There was also corrosion of the aluminum well in which the senders are mounted. Anyone with an aircraft parked outside in similar weather conditions might be advised to take a look at this area.

FUEL PUMP REPLACEMENT

For PA24-180 owners - when, or it, it is necessary to change your engine driven AC fuel pump #40295 to a new AC pump, you will find the replacement pump #41271 is larger. This fact requires modifying the engine mount to avoid the pump striking it. You can now have your old pump #40295, rebuilt by Aero Accessories Inc. of Gibsonville, NC. Their telephone number is (800) 822-3200 or (919) 449-5054 and talk with Charles Wood. In addition to not having to modify your engine mount, this will cost less.

FUEL CONTAMINATION

In earlier Flyers I discussed the importance of correctly sealing filler caps to prevent water entry to the fuel cell in regard to rain water entry. A correctly designed cap is essential to prevent water entry from other sources also. If you are still using the old style cap and you park your aircraft outside or even if it does not rain, given the right conditions, moisture will condense in the fuel filler compartment and collect in the top of the fuel cap and enter the tank in this way.

Fitting the new style cap will not entirely eliminate water contamination, as we still have to contend with normal condensation problems. If you do not refill your tanks after use, moisture will collect on the exposed inner wall and fall to the bottom when either the droplets become heavy enough, or when you fill at a later stage and it is washed down during the refilling process. This process occurs because the Comanche tanks are pressure vented to the atmosphere through the lower portion of the wing. The vent line is open to the atmosphere at all times.

Correctly sealing fuel caps play several other important roles in the safe operation of the fuel system. In the first instance, if your fuel cap does not seal tightly and the seal around your fuel cover flap is not fitting correctly, fuel can be drawn from a full tank in flight. This occurs because air from the high pressure lower side of the wing flows up through the fuel drain pipe into the filler bay and out through the cover flap to the top low pressure side, causing the fuel to escape to the atmosphere.

In instance No. 2, a correctly sealing fuel cap is essential in maintaining the proper venting pressure in the fuel tank, in particular, the fuel injected engines. Low pressure venting can cause erratic fuel flow indication, and in twin engine operation, different fuel flow indications between left and right engines.

Vent systems should be checked at regular intervals to ensure against blockages, as they are susceptible to closure by the hornet or mud daubing insect. If further venting problems continue to occur, check the flexible rubber hose which connects the fuel bay filler housing to the vent pipe for security and condition. I have found those to be kinked and blocked off and the clamps insecure.

As you can see, the fuel system is a fairly complex unit, and the lowly fuel cap is not there merely to allow you to fill the tank.

LEAKS

1. All propeller governor oil lines with the blue anodized aluminum nuts should have been replaced by now. This applies to all Twins and 180's

2. Any sign of leakage from the small drain tube near the center of the Twin cowling or the drain line in the nose wheel well of the 250 / 260 / 400 fuel injected singles should be investigated. More than likely, your engine driven fuel pump has a ruptured diaphragm.

   To check it, do the following:

   Operate your electric fuel pump's while the mixture and throttle are at idle cutoff and idle position and check for fuel leakage from the drain tube. There should be no fuel leakage from the drain. Of course, the drain also carries excess fuel overboard if you over prime the engine for starting.

3. Recently I noticed a blue stain on the bottom of my right cowling near one of the drilled drain holes. Further investigation utilizing the above procedure found a pin hole leak in the fuel line between the firewall fitting and the fuel servo unit. Needless to say, the line was replaced immediately. Don't overlook any slight evidence during your preflight.

BOOSTER PUMP MIX-UP

I began to have problems with left boost pump (sporadic operation) on the left engine of my Twin Comanche a month ago. I located a used boost pump (Weldon), and had my local mechanic, Steve Johnson, put it in. This was an all-day job, as Piper really buried those boost pumps.

After the pump was installed, I had scheduled an instrument flight lesson in the plane with my instructor Rob Hunter. We usually do instrument flight lessons at night, as that is the only time I consistently have available. After takeoff, I turned off each boost pump in turn. It's a good thing I waited the recommended interval - after about 10 seconds the left engine fuel flow started dropping. I turned the left boost pump on and it came back up. I turned it off again and waited until the engine started stumbling (not the gauge), before starting the boost pump again. We returned to the airport and landed.

I called my mechanic again and told him the problem. The left engine is 100 hours out of major, but the motor driven mechanical fuel pump did not appear to have been replaced. He ordered a new mechanical pump and put it on the aircraft the next afternoon when it arrived. I started the airplane and thoroughly checked both engines via runup (without the boost pumps on). Nothing abnormal appeared. I taxied to the runway, did another set of runups (also normal) and set up for takeoff by turning on the boost pumps. I heard the normal whine (hard to tell if both are running).

As the airplane picked up speed, I watched the fuel flow meter closely. Everything was normal. I adjusted the mixtures to lower fuel flow, as it was 90 degrees at 5,270 ft. field elevation. I rotated at 90 and pulled the gear up (Coronado apt is a small field). At about 50 feet the left engine fuel flow started dropping (boost pumps still on). I tried changing left fuel tank from main to aux. (both full), but it didn't help. I cycled the left boost pump switch several times but it didn't help either. The engine was stumbling badly, barely running, and causing a lot of drag I couldn't afford (Coronado airport has trees at the end of 17). I feathered / shut down the left engine and went

around the pattern for a single engine landing. The good news is a Twin Comanche will climb under these conditions (slowly) with only one person and lots of fuel on board.

This time around I took the time off work and Steve and I tore the entire left engine fuel system, selector valves, boost pump, etc., apart. We made electrical checks of all wiring, the switches, circuit breaker and all other components remotely associated with the fuel system.

The first thing we found is that the left boost pump that was installed three days earlier would run, but at a very slow speed. There was hardly any noticeable pressure increase at the left engine cowling where the fuel line enters the mechanical pump. The motor would get hot, and after a couple of minutes, it would stop altogether.

We reassembled the selector valves/piping and removed the boost pump panel containing both boost pumps. I noticed that the tag numbers were different on the Weldon pumps (different between left and right side). The right side was a Weldon Model "J" 8100 - AA, but the left side, the used pump that I got was a Weldon Model "J" A8001-A. It doesn't take a person with dyslexia to glance at the two pump tags and see the same number. You have to look closely at very small stamped print to see the differences.

These differences are however critical. The 8000 series pump is not from a Comanche; it is out of an Aztec. The electric motor connected to this pump is out of a Comanche (same bolt pattern, 3/8" shorter electric motor to fit in that ridiculous Comanche bulkhead space). The point being this is an Aztec pump mated to a Comanche motor.

This is a potentially deadly combination. The 8100 series pumps required for Twin Comanches contain an internal bypass to allow unrestricted fuel flow if the boost pump is either not running or disabled. The mechanically driven pump takes its suction from the tanks / selector valves through the body of the boost pump on a Twin Comanche.

On an Aztec there is external piping to provide this by pass function. The 8000 series pump has no internal bypass and it is difficult to even blow air through the pump with your mouth. The mechanical fuel pump on an Aztec takes its suction through a separate line to assure unrestricted fuel flow when the boost pump is off.

Steve Johnson got all this great information from the Weldon Tech Rep. at (216) 721-5454. He also got another great piece of information - this is NOT the first time this has happened. Evidently someone out there is mixing / matching boost pump parts out of different Piper aircraft and the particular combination described above is dangerous. It appears identical to the other boost pump. You cannot tell the difference with a brief glance, casual physical inspection, port locations, etc. You have to do a number by number tag comparison.

In retrospect, it would have been prudent to stop and go back to the boost pump problem rather than put a new mechanical pump in the aircraft, but the failure I experienced with my flight instructor sure looked like a mechanical pump failure. This, coupled with the fact the mechanical pump was not replaced during the major overhaul, made the failure seem plausible.

There are several insidious aspects of this problem. First, Twin Comanche engines are small; they will run for awhile with diminishing fuel pressure (long enough to get airborne and gear up). This is also why the manual recommends waiting 20 seconds prior to accepting the fact that boost pumps aren't needed after turning them off. The Aztec pump assembly will allow minimal flow past the impeller region, causing fuel pressure to bleed down slowly. This is NOT great news it you are taking off.

The second aspect of this problem that bothers me is the fact that the two pumps are visually identical. If they were even a different color, it would help, but they aren't. I'm sure its the same casting, port location, bolt pattern, etc. This visual similarity, coupled with the similarity in model number (displaced A's and 1's) makes inadvertent installation of this pump / motor combination highly likely.

The final and worst aspect is the apparent existence of more of these combinations of Aztec pump bodies bolted to Comanche electric drive motors. I recognize that multiple failures are needed to repeat the problem I had shortly after takeoff. However, given the fact that these are used pumps, a boost pump failure is more than a remote possibility. Once this boost pump fails, as mine did during takeoff, you will shortly be single-engine whether you like it or not.

It is this final point that concerns me the most. I hope this information proves useful to you and ICS.
If you require further information you can reach Steve Johnson (my mechanic) at (505) 865-7389 or me at (505) 299-9275.

FUEL PUMPS

If you are in need of an engine driven fuel pump, you can get in touch with Aero Accessories, Inc. They are an approved overhaul agency for most or all of the fuel pumps used on our aircraft. Their address is:

Aero Accessories, Inc.
1240 Springwood Church Road
Gibsonville, North Carolina 27249
Telephone: (919) 449-5054
(800) 822-3200

This is especially important for the 180 owner, as the new AC pump is larger than your old one. The AC pump will bolt on the engine, but unless the engine mount has been modified as indicated in the Tech Tips video, it will strike the engine mount when the engine is started. Getting your pump overhauled will save the big job of modifying the engine mount.

FUEL SYSTEM MAINTENANCE

Whenever problems arise the first move is to check the fuel inlet screen for blockage. This 74 micron screen should be removed from the same side of the injector to which the fuel line is attached. This stops any dirt from falling into the injector body. On early type injector bodies the screen is attached to the fuel inlet fitting and can only be removed from that side.

Later types have spring loaded screens to provide a fuel bypass in case of blockage. (Refer Bendix Bulletin RS-48 Revision 2). To clear the screen, tap the filter open side down on a clean piece of paper and inspect the contaminants for signs of fuel system deterioration. Wash the screen in MEK, and blow out with compressed air.

The next step is to check for the correct linkage geometry and adjustment. When shutting down the engine observe that you can get a 25 to 50 rev. rise as the engine tops. A lean mixture will cause the engine to falter or "flat spot" as the throttle is moved open from idle. To adjust the idle mixture place the aircraft crosswind to eliminate propeller loads. Have the engine at operating

temperature. Turn the scalloped wheel either towards R or L as indicated until the desired rise in RPM is reached. Each time the mixture is changed run the engine up to 2,000 RPM to clear it before making the rev rise check.

If your engine refuses to quit when the mixture control is fully retarded suspect a fault with the mixture control jet on rotating plate or a faulty jet "O" ring. To check for these faults remove the fuel outlet line at the injector body, place the throttle and mixture controls in the fully retarded position and turn the boost pump on. Observe the open fitting. There should not be any fuel coming from this outlet at this time.

If no problem exists here and the engine continues to run on, then the delivery nozzles are blocked. Remove the nozzles and clean in MEK or sonic cleaner and blow out with compressed air. Check the top threads on early type nozzles for damage from over torquing the fittings. Later type nozzles have a removable center distribution tube. Check that the top flange is missing the center tube falls into the center of the nozzle and causes the nozzle to inject a solid flow of fuel. The engine will not fire and that particular cylinder until 1,800 - 2,000 rpm is reached. At these revs the port air velocity is sufficient to atomize the fuel. This nozzle when viewed from the top will look like an early type, so check them carefully.

Fuel stains around the filter screen of the nozzles indicate a plugged nozzle. Standard R.S.A. nozzles will flow 32 pounds per hour at 12 PSI.

On the turbo charged engines the nozzles are shrouded and vented to the compressor discharge. "Deck Pressure". Check for leaks and dirt obstructions in these lines and fittings.

When installing RSA nozzles make sure that the letter "A" stamped on the hexagonal base is pointing down + or - 30 degrees. This places the air bleed hole up. If this is not done the fuel which flows down the line after engine shut down, flows out the hole and through the screen and gives a visual indication of a fouled nozzle. When replacing a nozzle, torque valves change the flow characteristics.

The next check is for an internal leak in the center body. If there is an internal leak all the delivered fuel will not flow through the injector lines, some will enter the engine via the throttle body. This fuel will not show up on the cockpit fuel flow gauge and cause the engine to run overly rich. If this conditions exists you may find that you have to retard the mixture control on landing or that the idle mixture will require constant adjustment.

To check for an internal leak, remove the induction hose at the RSA body, then plug off the fuel delivery line to the flow divider. Place the throttle and mixture controls full forward, and operate the boost pump. No fuel should flow from the air impact tubes. If it does, the center body seal is leaking and requires that it must be removed for overhaul.

HEATER FUEL VALVE

Ivan Warrington, ICS #08405

The Heater Fuel Valve needs to be checked immediately for the safety wire, (item 1 in attached Diagram). The manual states that the assembly must be replaced if the nut is not bored for the safety wire and the safety wire is missing. We have just experienced a large fuel spillage due to the nut (6) backing off the shaft (2) allowing leakage past the shaft.

Check with the bonnet off and observing for fuel when the electric fuel pump on the right engine

is operating and the valve is open 3/4 to 1 turn open.

If any fuel is observed valve must be repaired or replaced.

Item "C" of the service manual states to inspect the stem, seat body and threads for possible damage. On our valve we found that the shaft was dirty from years of service and when opened allowed the shaft to enlarge the sea[(4). The stem was cleaned with MEK and Scotchbrite, lubed and returned to service. The valve is now operating correctly and not leaking.

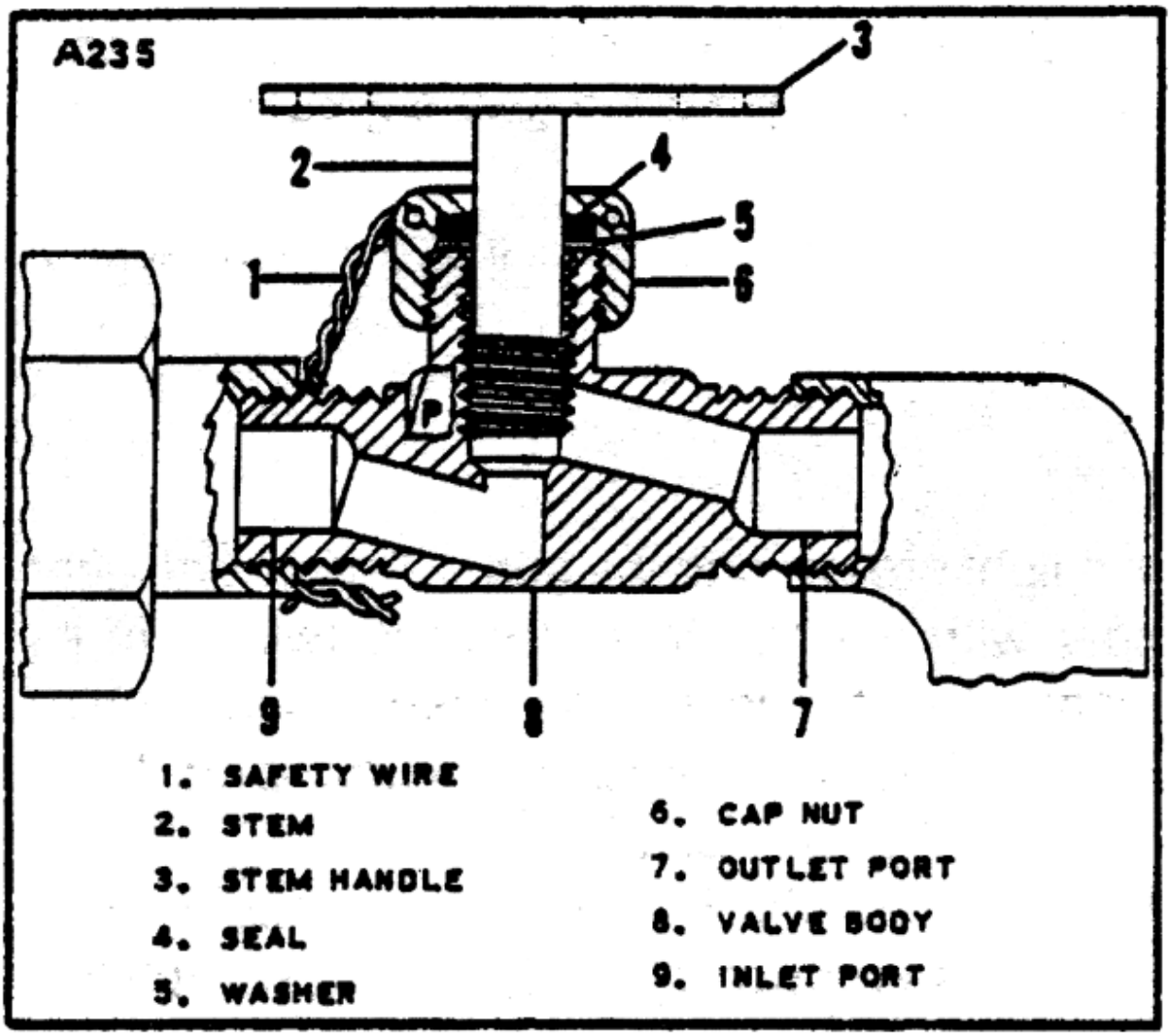


Diagram A235[above], is taken from Twin Comanche Service Manual, Heating and Ventilation Section

LEAKING FUEL SENDER UNITS

John A Pabst, ICS #02722

After years of frustration I finally located a persistent fuel leak in my Comanche '250. The symptoms were a leak from the left main, right main, and right auxiliary fuel tank; the leak only appeared to occur when the tanks had been "topped off"; and only a small amount of fuel would leak from the tanks, but enough to leave a stain on the wings during flight. No stains appeared anywhere else on the plane.

During every annual inspection, we removed the inspection plate over the fuel tanks. We could see no fuel stains either over the fuel gauge sending unit or around the actual cap primarily due to the zinc chromate paint.

The tanks would leak for the first three or four minutes of flight.

Prior to the annual, the Al advised me to fly a substantial amount of fuel out of the tanks. This would minimize the amount of fuel to be unloaded to comply with the fuel tank AD.

I replaced the fuel caps, in frustration I removed the inspection plate over the fuel cap after refueling the aircraft completely. The seals surrounding the fuel gauge sending units had deteriorated, causing fuel to seep out of the tanks and form in the indentation over and above the fuel gauge sending unit. At the annual the tanks were always approximately 3/4 empty. The fuel never reached the level of the fuel gauge sending units. The pool of fuel was not noticed because of the barrier between the fuel sending unit and the fuel cap. After a resealing of all fuel sender units, this matter has corrected itself.

This ended an extremely frustrating detective game. I was thoroughly convinced that the fuel caps were leaking, when in fact, it was the seals around the fuel gauge sender units.

Again our thanks go to Maurice Taylor for pointing us in the right direction.

FUEL SELECTOR

Al Bieck, ICS #02171

One of Murphy's laws says: "if it is possible to install a part backwards, someone will do so!"

Recently, when I removed the sediment bowl from the strainer assembly, (part No. 22312-00), in our "250", I discovered internal leakage through the fuel selector valve (hoof) which I later rectified by installing a new "O - rings". What concerned me was that the fuel dribbled out of the outlet port above the screen. To make sure it wasn't fuel draining from the line to the boost pumps, I selected a full tank and, sure enough, fuel streamed out of the wrong port! I then removed the strainer assembly from the aircraft. Confirming what I already knew, the arrows on the casting showed that the outlet port was connected to the fuel selector and the inlet port 180 degrees opposite had the 45 degree fitting which connects the line to the fuel pumps and the engine. Turning the unit 180 degrees and changing the fittings over to where they belong (the right angle fitting receives the line from the fuel selector) corrected the situation.

For 18 1/2 years we flew our Comanche with fuel flowing through the strainer the wrong way and I feel embarrassed to admit this. But then, we never had leakage through the selector valve resulting in a dribble in the "OFF" position. Neither did I have a reason to take the strainer

assembly out. You can't see the arrows on the casting while the unit is installed, except by using a mirror but I never had reason to be suspicious. We never had a problem but think we were very lucky. If we had ever gotten a load of dirty fuel, all the crud would have been trapped on top of the screen, possibly blocking it! No wonder we never found anything bad in the samples we have been taking all these years! I never found anything that caught my attention on top of the screen either during annual inspections or I would have caught on.

Before we brought our "250" in 1975, it was operated and maintained by a Piper dealer. We never had occasion to remove the strainer from the aircraft and the dealer probably didn't either. Did the aircraft come like that from the factory, or did the mistake occur during a subsequent repair or modification? We will never know. Most of the early records were lost in a hangar fire long before we bought the aircraft and the surviving records do not give any clues.

FUEL PUMPS

Maurice Taylor

At annual time are your fuel pumps getting checked for flow and pressure? It's required by item #34 on inspection sheets both single and twins. You check the electric pump (pumps) when it is turned on before you start the engine. The thing that you can't check on the 250 or 260 with a carburetor (they have two pumps) controlled by one switch, are they both working? Many of these aircraft have one pump that's inoperative. Be sure that your IA checks them for both flow and pressure.

ENGINE DRIVEN FUEL PUMP PROBLEMS

Stanley Gitlow, ICS #03324

Just read V. 24 #7 of the Comanche Flyer, where on pages 2021, Bruce Williams asks about the trouble with his left engine driven pump on his 1964 PA-30. I am certain that many people gave him help on that one, but just in case the issue remains open, I would advise that he change the pump. In 1963, 1 owned 7056Y and went to the Piper Service Hangar for minor assistance one day. I returned that evening, and took off (to the SW as I recall). Shortly after turning off my electrical pumps, I lost one engine (the left, I believe). Starting the boost pump brought the engine back to full function immediately. I landed and one of the service personnel took a look at the plane the next day.

During my visit, they had done no work on the engine at all. We ran the engine to full throttle WITHOUT ANY DIFFICULTY on the ground. Flight, however, produced the same problem. They changed the engine fuel pump, and everything corrected itself at once. They could NOT see what they believed was a minute pin hole in the diaphragm but said that they had experienced such events before. They felt that the climb and the temp change had something to do with why they could NOT trust a full throttle ground run up.

A year later, flying a loaner 1964 PA30, while climbing out of Salt Lake City (after having had no trouble whatsoever flying from NYC to SLC in the same A/ C a few days before), the same thing happened to me. I landed and asked the local mechanic to change the mechanical fuel pump, over his protestations since the full throttle run up on the ground revealed NOTHING wrong! He changed it, everything was perfect on my next climb out, and the trip to NYC was without incident.

On my next PA-30, I installed turbines; that kit gave me "real" mechanical fuel pumps rather that the ones dating back to the early automobile days using a rubber diaphragm and a lever action (in which, needless to say, I have less than adequate trust). In somewhat over 11,000 hours in PA-30's since those days, I have never lost an engine driven fuel pump again.

FUEL SYSTEM MANAGEMENT - CARBURETED MODELS

Maurice Taylor

I had an ICS member visit me not long ago, and we got to talking about fuel pump operation. I'm aware that it's not summer with its hot weather, but this reminded me that we could review the proper operation of fuel pumps on the carbureted models.

The last few Flyers have had a series of articles pertaining to this problem. This only occurs when the temperature is above normal, and last summer was one of the worst that I can remember. However, if you operate the system correctly, even these extreme temperatures should not cause you any trouble.

The problem is that the temperature of the engine driven fuel pump gets so hot that the fuel vaporizes. There is nothing wrong with these pumps. GM built millions of them for their cars, and they have a very long life. If on a very hot day the engine pump fails because you left the electric pumps) on while on the ground or forgot to turn pumps) off after takeoff, you have not damaged either pump in any way. You now have to get rid of the vapor in the engine pump which is quite easy when you understand how.

A checklist of how I operate to eliminate or minimize this vapor lock problem follows:

1. Before starting engine turn on electric pumps) and check to be sure you have a minimum of 4 PSI. Turn off pump(s).

2. Start engine. Check fuel pressure again for a minimum of 4 PSI on the engine pump.

3. Leave the electric pumps) off for all taxi operations.

4. Turn electric pumps) on just before takeoff.

5. At approximately 1,000' AGL or a safe altitude for the terrain, turn off the electric pump(s). Monitor fuel pressure just after turning off the electric pump(s).

The engine driven fuel pump operates off a cam on the back of the camshaft. The only time that it operates with a full stroke is when the pressure is at or near zero as the pressure builds up to its normal operating pressure of 4 to 6 PSI.

The stroke is reduced to near nothing, so when the electric pumps) are on, they maintain the pressure of 4 to 6 PSI. This compresses the spring in the engine pump, holding the lever away from the cam lobe which causes it to have no stroke or pumping action at all.

This is why there is no fuel flow through the engine pump when the electric pumps) are on. As soon as the electric pumps) are turned off, and if the pressure drops below 4 PSI, the spring in the engine pump will move the diaphragm to a point where the stroke begins to produce the pump action, and it will start to move fuel through it.

Although this system has worked for over 30 years, and I see no reason why it shouldn't continue to work for that again, we just have to live with its limitations, knowing what they are. It is helpful, but not mandatory, to know how the system works, but it is absolutely mandatory that you know how to operate it. Do not operate on the ground with the electric pumps) on other than the takeoff run. If you have forgotten to turn off the electric pump(s), then you need to know how to get rid of the vapor lock.

This can be done by turning off the electric pumps) and monitoring the fuel pressure. If it drops down to or nearly to zero, turn the electric pumps) back on only long enough to bring the pressure back up to the normal 4 to 6 PSI, then immediately turn the electric pumps) off. In an extreme case, this may need to be done two or three times, requiring only a few seconds each cycle. If you turn the electric pumps) back on just as the pressure reaches zero, the engine will not falter. Remember that you have to give the engine pump time to push the vapor out of the pump through the line to the carburetor and into the carburetor bowl and out the bowl vent.

The real fix for this problem would be to have all the fuel go through the engine pump as it does in the fuel injected models. The valves in these pumps are of adequate size to permit this. However, this would require changing the fuel lines and getting approval from the FAA -the latter being the more difficult part of it.

You must be sure that your pumps) are working properly. The engine pump pressure must read between 4 and 6 PSI. If it is below 4 PSI, have it repaired. Pressure for the electric pumps) must be between 4 and 6 PSI on each pump and the flow 32 GPH (3.2 gallons in six minutes).

These electric pumps are not being checked properly. Request from you IA that they be checked and have a note in the log book of the results on each pump. This should be done at each annual.

Note on these engine driven fuel pumps that GM no longer makes them but Lycoming does. If you have a 180, and you get an overhauled engine from Lycoming, you will get a new fuel pump, AC #41271. That is the new style, but it is larger, and although it will bolt on the engine, it will strike the engine mount when you start the engine. Piper made a drawing on how to modify the engine mount to give it room. MY advice on this is to call Aero Accessories in NC at (800) 822-3200 and get an overhauled AC #40295 at less cost. This fits the 180, and either one will work on the 250 or 260.