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Technical Counselor Note #4
by Will Fox

Fuel Injection Systems - Nozzles

Well, its April and after a few weeks of warm weather, Mother Nature has decided that a little more winter weather will be good for us, so it is snowing outside. I want to work on the Pegazair today, but I think I'll wait until it warms up a bit. In the mean time how about if I tell you what I've learned about aircraft fuel injection systems recently.

I recently had a buddy who noticed that the Exhaust Gas Temperature (EGT) had gone up 50-100 degrees in one of the cylinders on his Long Range High Speed Cruiser (LRHSC). He was trying to figure out the problem. I asked him if he had checked his fuel injector nozzles to make sure that one of them wasn't plugged. He said he had cleaned them and they all appeared to be fine. I asked if he had also checked the air bleed hole in the nozzle. He said what air bleed hole? Turns out that the injector nozzles used in the Bendix Fuel Injection system common to Lycoming engines, have an air bleed hole in them surrounded by a fine screen. My buddy had only removed the fuel flow restrictor located inside the injector nozzle for cleaning. He actually needed to remove the entire nozzle and clean it as well. Below is a picture showing the nozzle and fuel flow restrictor. The screen over the air bleed hole can be seen below the steel shroud and above the hex head nut.

Bendix Fuel Injector Nozzles

The fuel flow restrictors on older nozzle designs are not removable, but in newer nozzles they can be taken out for cleaning or replacement. The stripes indicate the size of the nozzle. They are sometimes flow matched with a particular nozzle and a particular cylinder so be sure not to mix them up when cleaning them.

Bendix Fuel Flow Restrictors

Remove the nozzles with a 6-point deep well socket. Make sure the socket clears the steel shroud on the nozzle. Using the wrong socket can loosen the shroud or damage the nozzle. The nozzles should be cleaned in MEK, Acetone, or Hoppes #9 gun cleaning solvent. After cleaning, they should be rinsed with Stoddard solvent, dried with compressed air, and then inspected for any blockage. When reinstalling the nozzles torque them to 40-60 inch-pounds. Some nozzles are marked with an "A" on one of the flats of the hex head. This denotes the location of the air bleed hole, which is opposite the "A". In horizontal installations it is important to install the nozzle (within torque limits) with the "A" down to prevent fuel from leaking out of the nozzle. Do not over torque the nozzle, as you can damage it. Make sure that the correct nozzle and flow restrictor go back into the same cylinder they were removed from. In some applications the nozzles and flow restrictors are matched to each other and may also be matched to a particular cylinder. The GAMI nozzles are a good example of this. You will notice that in a GAMI installation, a tag is placed on each cylinder noting which nozzle goes with which cylinder. When attaching the nozzle injector lines, make sure to tighten the cap to a maximum torque of 40 in-pounds. In the absence of a torque wrench, you may do this by turning the hex nut ½-1 flat beyond hand tight.

A nozzle flow test may be conducted to determine how evenly the nozzles are flowing. This is sometimes referred to as a "Baby Jar" test, because baby jars are often used because of their convenient size and volume markings. In this test the nozzles are removed from the cylinder head and the injector lines are reattached. A baby jar is placed under each nozzle and the electric fuel pump is turned on with the throttle in the full open position and the mixture in the full rich position for 30 – 60 seconds. During the test, the nozzles are observed to make sure the flow stream is uniform and unperturbed. After the test, the nozzles are removed and the baby jars are set on a level table and the fluid level is compared to determine that equal amounts of fuel are in each jar. The nozzles are flow matched to within 2% of each other, so there should be very little difference in the amount of fluid in each jar. If there is, then you may have a nozzle that has the wrong restrictor in it or has a partial blockage, or possibly a plugged air bleed hole. Try

cleaning the nozzle and make sure that you are using the correct flow restrictor for that nozzle and do the test again. If you still have a problem, then try a different nozzle on the same injector line. If you still observe the problem, you could have a kinked injector line or you could have a dirty flow divider that needs to be cleaned or rebuilt. A discussion of how aircraft fuel injection systems work and the cleaning and rebuilding of the flow divider will be the topic of another Tech Note in the future.

I hope this helps you understand a little more about your fuel injection system. I have attached a few web sites for additional information.

http://www.sacskyranch.com/eng53.htm
http://www.sacskyranch.com/eng54.htm
http://www.sacskyranch.com/rsafuelt.htm
www.kellyaerospace.com/articles/FuelInjection.pdf
http://www.precisionairmotive.com/
http://www.airflowperformance.com/