THE GAMGRAM

No. 48 HOW DOES WATER GET INTO AN AIRCRAFT? APR. 1998
PART 2

This is the second in a series of two GamGrams on the subject of water in aircraft fuel tanks.

7. The operator decided to steam clean the tank on a refueler truck. He used great care to remove all of the water from the tank after the cleaning operation. However, he neglected to drain the refueler pump and piping. When he put the truck back in service, the operator had a problem getting flow until he ran the engine speed up higher and increased the pump pressure. When he suddenly got flow, he congratulated himself, assuming a valve had been stuck. A later operator noticed low flow and checked the strainer. He found the remains of the burst water absorbing elements from his filter. After careful inspection, it was determined that the pump bypass valve was set at over 100 psi, but miraculously no water entered the aircraft because the filter element largely remained intact and the nozzle strainer caught all debris. This was a 22 gpm avgas truck.

   There are many lessons in this one, and all are pretty obvious. Most importantly, recirculate a truck and check sumps, pressures and filter condition carefully after steam cleaning.

8. On an ocean going research vessel, the helicopter was fueled from drums. The aircraft lost power but was fortunately not lost. It was found that rain water, pooling on top of the drums, had been the cause. Due to the need for air to enter the drums as the fuel was pumped out, the vent plug on top of the drum had been loosened and not retightened after the last refueling. As luck would have it, it rained that night. Due to temperature changes, the drum "breathed" vapor out and water in. Either lay drums over horizontally, or cover them. Use water absorbing filters in such situations for safety.

   NOTE: THIS ALSO APPLIES TO "PRIST" OR ANTI-ICING ADDITIVE DRUMS! We know of a case where the bladders in an aircraft had to be replaced for this reason. The "Prist," having just 3-5% water in it, would not dissolve into the fuel and dropped out, destroying the bladders.

   In the words of a skilled helicopter pilot who had this "water/drum" contamination happen to him in a similar case set in the mountains of a North American forest, "Helicopters glide like a streamlined brick. A safe landing is only possible if the engine failure occurs at a reasonable altitude, a suitable landing spot is available ahead and below and the pilot can perform a (very tricky) "auto-rotation" landing. The proper procedure is to first kiss the ground and then grab the refueler by the throat".

9. This one is really rare, but worth mentioning A major airport had a "Salt Dryer" in its incoming fuel system. This device is a huge bed of salt which the fuel flows through at a very slow rate. (See Gamgram 27 re: Salt Dryers). The idea is that salt bed removes not only free water, as does a filter separator, but also significant amounts of dissolved water (Similar to humidity in air). This is a primitive sounding but highly effective device. Unfortunate in this case the flow became too high and water (salt water now) was carried through to the airport fuel system. All of the water controls on this major international airport failed and all quality control checks missed it until after an aircraft had been fueled and had departed. The aircraft lost one engine on approach to its destination, and two more while taxing on the ground. The salt water damage to the fuel system was devastating.

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10. This example is not for fuel system education, but for human nature education. A lineman was about to refuel a King Air. He noticed a "shadow" in the tank and called over his supervisor. Together they drained about 15 gallons of dirty water from the sumps of the aircraft. Upon the pilots return, the proud station manager presented this hero lineman to the pilot along with the buckets of water. Not only did the pilot not appreciate the service, he got mad at the FBO for touching his aircraft. He stated that the drain valves are expensive to replace and if any developed a leak as a result of the draining, the FBO was going to get the bill. He also threatened to call management and report this incident. The station manager calmly told him "Please do that." We really do not know how the water got into the aircraft, but the two lessons here are to never underestimate the stupidity of anyone regardless of credentials, and don't touch an airplane unless the pilot says to.

COMMENTS AND DETAILS

Many of you will be thinking "The water controls should have stopped the water", or "The pilots were also at fault". You are right, but it does not matter. It is your job to deliver clean, dry fuel to the aircraft.

- Tanks and filter vessels must be sumped.
- The water controls must be checked properly Opinions vary on how to properly do this. Some say that purposely injecting water into the sump of a filter separator is the only truly reliable way, as manual testers and "squeeze bulbs" indirectly test the system, and have been known to falsely indicate that the system is in working order when it is not. The only proper way to test a water control is to have enough water in the system to cause it to work.

The best way to do this is to fill the sump with water, and then try to start fuel flow. (This usually means that you squeeze the deadman handle.) If you get fuel flow, stop immediately, your water control has failed. If you get no fuel flow, the water control worked properly.

Either way, put in a measured amount of water, and make sure you get it all out.

NOTE: Do not use city water/drinking water piping to do this, as the refueling pressure may be higher than the water pressure, causing fuel to flow into the water system, not water into the fuel system. We know of two such occurrences . In one case fuel backed up into a building where a fireman was taking a shower. The fireman was not happy with his jet fuel shower.

Others feel pouring water into the vessel sump when changing elements is the best, or removing the float and making sure it floats in water but not fuel. Others actually claim old style manual testers do the job alright (**WRONG**).

We know of flaws in all of these methods, but the big risk is relying on the manual testers on old style float controls or squirt type testers on water probe. The old testers raise the float and test the shutdown system, but do not detect excess friction in the mechanism due to old age or contamination, and certainly cannot detect a failed float. Probes can also be contaminated on the outside with a non-conductive layer of gum, varnish or other contaminant. The squirt tester tests the INSIDE of the probe, where such contamination does not reach.

Use modern counterweight floats and clean the outside of your water probes when changing elements. It is still a good idea, in our opinion, to test with real water, but be sure to remove it all. **NEVER** test with water when refueling an aircraft. **DEFINITELY** get approval from your oil company or airline before running such a test. Measure the water quantity before and after.

If you do find that you have water in an aircraft fuel tank, experience has proven that simply draining the tank sumps will not remove all water. Whether your aircraft is large or small, there is a strong possibility you will have trouble with remaining water. In one case, on a single engine propeller driven avgas aircraft, even rocking the aircraft and draining the sumps repeatedly did not prevent an emergency landing on the next flight. In the days of a large corporate / small jetliner type aircraft, repeated sumpings at two separate airports did not prevent a crash landing.