The Auto-Ignition System and the MU-2

By now, all MU-2 aircraft intended to be flown into known or forecast icing conditions should have been modified by the installation of an auto-ignition system as required by AD 2000-09-15R1. The auto-ignition system is designed to automatically activate the engine's ignition system when torque output drops below a certain preset level, such as when a flameout occurs. In the MU-2, the auto-ignition pressure switch closes at a torque pressure close to the NTS torque trip pressure. Therefore, auto-ignition will activate almost simultaneously with the NTS associated with a flameout. If the flameout is caused by a transient condition (such as a piece of ice shedding through the engine) and there is no damage to the internal engine components, the auto-ignition will re-light the engine. In this article, we will examine the proper operation and benefits of the auto-ignition system.

First, let's look at the procedures for certifying an engine such as the TPE-331. One of the requirements is that the engine manufacturer must show that the engine will continue to run with large amounts of water ingested through the intake. It seems obvious that an engine would flameout if enough water were to be ingested. The "flame" in the combustion chamber would be doused when water vapor changes the fuel-air mixture sufficiently to prevent combustion. With the high airflow of the TPE-331, this would be a transient condition and the proper fuel-air mixture would be quickly restored, but in the absence of ignition, the RPM would continue to decay after the flameout. For ice and water ingestion tests, the manufacturer is allowed to have the igniters operating and a procedure is placed in the flight manual to have the pilot do the same. With the igniters operating, an immediate re-light will result if flameout occurs.

Like the engine itself, the auto-ignition system was certified by the FAA. Certification testing involved simulating a flameout with a "fuel interrupt" button. The button was momentarily depressed, then released. Immediate engine re-lights were consistently observed with no tendencies to "bog down" the engine. The tests were repeated under conditions both inside the airstart envelope and well outside the airstart envelope.

What does the Flight Manual say about the operation of the auto-ignition system? First, it tells us how to preflight the system (see the NTS starting procedure.). Before starting the engines, with the RUN-CRANK-STOP switches in the RUN position and the battery ON, the AUTO-IGNITION switches should be moved momentarily from OFF to AUTO to CONT (continuous) to OFF. The pilot should observe the IGNITION lights illuminated in the AUTO and CONT positions and extinguished in the OFF position.

When taxiing onto the runway for takeoff, the pilot should place his ignition switches to AUTO and leave them there for the entire flight (unless icing conditions are encountered.) He should turn the ignition switches back to OFF after landing, before placing the condition levers to TAXI.

If icing conditions are encountered, the igniters should be in CONT prior to turning on the engine anti-ice, and should remain in CONT until exiting the icing conditions and all

residual ice is completely shed forward of the engine inlet. Note that the Flight Manual continues to require that the igniters be "ON" in icing conditions, even with auto-ignition installed. The auto-ignition is intended as a safety backup, but positive action on the pilot's part to activate the ignition system in ice is still required. Although AD 2000-09-15R1 does not require the installation of the "extended duty" ignition boxes, the Flight Manual procedure requires selecting the igniters to CONT until all ice forward of the engine inlet is removed. This makes it necessary to have "extended duty" boxes when operating in icing conditions for periods exceeding the capabilities of the "5 minute" boxes.

All MU-2 pilots, as a requirement of AD 97-20-14, are required to view Mitsubishi's Icing Video, YET 97336A, which describes procedures for operating in normal and severe icing conditions. In the video is footage of the MU-2 operating behind the Air Force's icing tanker, where large super-cooled droplets were sprayed onto the MU-2. These droplets were larger than those required by FAA icing certification regulations and represented the most severe icing conditions. In the video is a segment showing the formation of ice on the engine inlet cowling, just aft of the propeller spinner. It is not difficult to imagine a scenario where this ice breaks free when the aircraft descends into warmer conditions. This might result in an engine flameout, or possibly a dual engine flameout. The auto-ignition system could prevent a power loss regardless of whether the pilot has properly activated his ignition system. It therefore adds an additional layer of safety to the operation of the MU-2.

Honeywell provides additional guidance on the operation of the TPE 331 engine. In particular, Pilot Advisory Letter PA331-04R1 dated December 2, 1998, and Operating Information Letter OI331-11R4 dated November 20, 1998 address the operation of the ignition system in icing conditions. Copies of these documents can be obtained from Honeywell's Pilot Advisor, Helmuth Eggeling, at helmuth.eggeling@honeywell.com, or telephone (602) 231-2697.

I recently had a conversation with an MU-2 operator who openly admitted that he did not normally use his igniters when flying in icing conditions, as called for in the Flight Manual. He stated that the engines are very resistant to water ingestion and he had never heard of a flameout, even in the heaviest moisture. Of course, much of what he said was true. The TPE-331 will run without flaming out through nearly all moisture conditions. However, like all jet engines, the TPE-331 can be flamed out if very adverse conditions are present. Fortunately, this operator had not yet encountered those rare conditions. A properly operated auto-ignition system mandated by AD 2000-09-25R1 would help protect him in case he does encounter those conditions.

This last anecdote brings to mind my version of Murphy's Law. As we all know, Murphy's Law states that "What can go wrong will go wrong." I think that Murphy's Law should state "What can go wrong usually doesn't." In my view, some people engage in improper or dangerous behaviors and frequently get away with them. The fact that no serious consequences result tends to reinforce those dangerous behaviors, which are repeated again and again until, by chance, something finally does go wrong. A driver

may get away with driving drunk many times. An MU-2 pilot may fly for years without using his igniters in icing conditions. Then, one day..... (It’s amazing how quiet it can get when both engines flameout.)

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